grass roots

Newsletter of the Grassland Society of Southern Africa

Incorporating Vol. 16-2 of the Bulletin of the Grassland Society of Southern Africa
ISSN: 10166122 ● Vol. 6 ● No. 2 ● May 2006

11th Agrisson Congress

Conserving ecosystems for species

Fire and seedling recruitment

After all these years...

Do we *really* know how to manage veld?

Editorial

Dear Members

By the time you read this, the 41st Annual Congress of the GSSA will be almost upon us. This year's Congress promises to be exciting and stimulating. Two special interest symposia have already been planned: the first is a day's joint session with the SA Weed Science Society on managing invasive plants, and the second is on long-term ecological monitoring and long-term trials, with SANParks and the South African Ecological Observatory Network. This will continue our tradition of collaborating closely with other organisations; you may remember last year's workshop on grasslands conservation that was held with the National Grasslands Conservation Initiative.

Abstracts need to be in as soon as possible, so please don't leave it to the last moment—anyone who's ever tried to arrange a Congress programme will know how difficult it can be trying to squeeze in last-minute submissions. Speaking of which, I'd better get on with that myself.

See you at Congress!

Alan

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

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

Printed by Wilprint
10 Willowton Road, Willowton
Pietermaritzburg
wilprint@iafrica.com

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News

Funding opportunities

"Top-Up" Call for Proposals of the European Union's Sixth Framework Programme (FP6)

This call offers many valuable opportunities to South African researchers to (i) secure participation in the FP6 through simplified modalities and (ii) lay a solid foundation for future Seventh Framework Programme (FP7) participation.

The "top-up" call seeks to address the poor participation of "third countries" in the FP6. Third countries include those from Africa, the Caribbean, the Pacific, Asia, Latin America, the Mediterranean, the Russian Federation and the New Independent States, as well as the Western Balkans. The call provides an opportunity for researchers from these countries to join existing FP6 projects (i.e. projects which had already been approved for funding by the European Commission, and have more than 18 months of implementation remaining.)

The deadline for submissions is 16 May 2006.

For more information, visit www.gssa.co.za or www.esastap.org.za

International Foundation for Science Research Grants

DEADLINE for submissions: 30 June 2006.
The new granting session is now open at IFS. As usual, we are inviting young scientists in developing countries to apply for IFS research grants. Scientific topics acceptable must fall under the broad concept of sustainable management of biological or water resources.
For more information, visit www.ifs.se/

ANSTI (African Network of Scientific and Technological Institutions Postgraduate Fellowships for Africa

The African Network of Scientific and Technological Institutions (ANSTI) is offering a limited number of fellowships for postgraduate studies in the 2006/2007 academic session tenable in ANSTI member institutions. The fellowships cover fees, subsistence and international travel, and are awarded to sub-Saharan African nationals for studies outside the applicants' home countries.

The deadline for submissions is 31 May 2006. For more details visit our website or www.ansti.org/fellowships

News

The African Fellows Programme

DEADLINE for submissions: 3 July 2006

The Rothamsted International African Fellows Programme aims to provide problem-focused training in Europe for mid-career African scientists. The Programme started in 2004.

The purpose of the programme is to assist in capacity building, institutional strengthening and knowledge transfer in order to find relevant solutions to the problems of achieving sustainable agricultural production, as well as improving rural development and conservation of biodiversity.

The development of effective partnerships is fundamental to ensuring the success of the programme in order to build long-term strategic alliances.

Fellowships will be awarded on a competitive basis through an assessment panel and will normally be for periods of 6 months although they can vary from 4 to 12 months depending on the nature of the project.

The aim of the African Fellows Programme is to support sustainable agriculture in sub-Saharan Africa by catalysing innovative solutions needed to achieve food security. Projects should aim to develop lasting partnerships and strategic alliances that will help in developing local scientific capacity relevant to sustainable agricultural production. African scientists will carry out research projects in a partner European research institute or university for periods of four to 12 months. Fellowships are awarded on a competitive basis in a two stage assessment process.

Projects on food processing will NOT be supported, nor can the programme support field work in Africa.

MSc and PhD studies are outside the remit of the programme

Eligibility

Research projects need to:

- be focused on solving an agricultural problem or constraint;
- demonstrate a clear path from research to application; and
- be of benefit to small-holder African farmers and the rural economy.

For further information, contact Dr Paresh Shah via email: paresh.shah@bbsrc.ac.uk, or visit the Rothamsted International website: www.rothamsted-international.org/

Upcoming events

From www.gssa.co.za

Re-Organisation and Management of Complex Social-Ecological Systems: Global and Southern African Perspectives
Deadline for Registration: 25 April 2006
Date: 28 April 2006
Venue: SANBI Education Centre, Botanical Gardens, Pretoria
Contact: Magriet van Wyk
MvWyk@csir.co.za
(012) 841 2238.

Fourth Natural Forests and Savanna Woodlands Symposium
Date: 15 - 18 May 2006
Venue: Summerstrand Inn, Port Elizabeth
Contact: Merle Falken Inclusive
Tel: 021-448 7948
info@merlefalkeninc.co.za

First International Association of Agricultural Information Specialists (IAARD) African Chapter Conference
Early Registration Deadline: 21 April 2006
Date: 21 - 26 May 2006
Venue: Hotel Intercontinental Nairobi, Kenya
Contact*:* Dr. Joseph Kiplang
jkngetich@yahoo.co.uk

26th Annual Conference of the International Association for Impact Assessment
Deadline for Registration: 10 May 2006
Date: 23 - 26 May 2006
Venue: Stavanger, Norway
Contact: info@iaia.org

ISF World Seed Congress
Date: 29 - 31 May 2006
Venue: Copenhagen, Denmark
Website: www.worldseed2006.com

International Scientific Conference on Desertification and Drylands Research
Date: 19 - 21 June 2006
Venue: Tunis, Tunisia
Contact: Mr Thomas Schaaf
sc.drylands@unesco.org

World Congress of Soil Science
Early Bird Registration: 1 May 2006
Date: 9 - 15 July 2006
Venue: Philadelphia, USA
Contact: Keith Schlesinger
kschlesinger@soils.org

South African Weed Science Society Congress
Date: 15-18 July 2006
Venue: ATKV Klein Kariba, Bela Bela
Contact:
Suzette Bezuidenhout
Suzette.Bezuidenhout@dae.kztl.gov.za

Grassland Society 41st Annual Congress
Date: 17-21 July 2006
Venue: ATKV Klein Kariba, Bela Bela
Deadline for early bird registration: 31 May 2006
Contact: Freyni du Toit
admin@gssa.co.za
Website: www.gssa.co.za/congress2006

Council News

The Council met on 3-4 April for the quarterly meeting, as well as to review the progress on the strategic plans outlined a year ago (see February 2005 *Grassroots* for more details).

Several new council members are required. Please consider names for these posts to take to the AGM: Vice President, Treasurer, Secretary, Public Relations Officer and two Additional Members.

Standard guidelines for the Peter Edwards award (which is presented to the best conservation farmer in the region hosting the Congress) have been drawn up and will be circulated for comment.

The Society is investigating a new award for emerging commercial farmers. This will take time to develop and requires inputs and discussions from a diverse group of people.

We would like to encourage publication of journal articles with practical implications in *Grassroots* in a popular format. We also encourage publication of small parts of PhD or MSc theses (side studies) that have some practical relevance.

The Public Relations Officers, Nicky Findlay and Luthando Dziba, would like to extend GSSA floating trophies to other agricultural colleges. Presently, there is one at Cedara and one at Potchefstroom Agricultural College.

The winner of the Science Expo GSSA award, Emily Swart, will be asked to attend one day at Congress 41. Schools will be made more aware of the GSSA Science Expo award through the information packs distributed by the organizers to schools.

A new GSSA poster is being developed. GSSA would also like to have a roller banner with the name and logo on it as this would be useful to give the GSSA a more professional image at exhibits or farmers' days. This will be put on hold until the financial situation has improved.

The Council discussed changing the position of website coordinator to website editor. At present the situation is still rather dynamic and this will be dealt with in future and made into a permanent position on council as the function and importance of the website increases.

The *Grassroots* editor is now officially appointed as Publications Editor, a previously ambiguous constitutional post.

The objectives were reviewed and updated where necessary. The idea is for the objectives to be dynamic and serve as a framework for activities within the GSSA. These have to be adjusted from time to time to remain relevant within a changing environment.

The vision was discussed and it was decided that it could be reviewed and proposals will be considered. It was also decided that there is opportunity to develop a byline which alludes to the function of the GSSA. This will be a competition open to all members.

The previous strategic plan has been successful because the aim of the previous planning meeting was to set realistic targets rather than a wish list. Hence there has been a measure of success for all the objectives.

Ecosystem conservation – A combined approach

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The importance of natural grasslands and wetlands, not only to humans but also to the numerous rare and threatened species that inhabit such areas, has been well documented. The loss of such ecosystems has for a number of years been highlighted by numerous conservation organisations, scientists and so-called "greenies" – so much so that certain conservation organisations have invested large sums of money into various programmes in order to raise the awareness of the importance of such systems amongst those communities that are having the biggest impact thereon. The KwaZulu-Natal Crane Foundation (KZNCF) and the South African Crane Working Group (SACWG), a working group of The Endangered Wildlife Trust (EWT) are two such committed non-governmental organisations dedicated to the conservation of South Africa's three crane species and associated habitats. The SACWG co-ordinates crane conservation on a national level whereas the KZNCF is an autonomous body co-ordinating crane conservation within the boundaries of KwaZulu-Natal. The KZNCF operates under the guidance of the SACWG and in turn has played an active role in the compilation of national strategies and policies.

The KwaZulu-Natal Crane Foundation (KZNCF) has over the past ten years been actively involved in promoting the importance of both grassland and wetland conservation across the province. It has interacted with landowners, predominantly from the agricultural sector, on a daily basis, highlighting the importance of grassland and wetland areas not only for cranes but mankind as well. The KZNCF is

Above: Crane conservationists conducting wetland assessments in order to determine the habitat requirements of the Wattled Crane

presently involved in a number of conservation programmes which include the following:

Education and Awareness

Ninety percent of all cranes occur on privately owned land and as such the core activities to date of the KZNCF has been focused on education and awareness. Target groups of the respective organisations have included landowners, their staff, rural communities and both rural and urban schools.

Crane Population Management programme

The focus of this programme is to reduce the current levels of mortality of the various crane populations. This includes:

- The reduction of poisoning incidents by working closely with agrochemical management on farms,
- The reduction of powerline collisions and electrocutions by participating in the Eskom/EWT Powerline Interaction project, working closely with Eskom to identify hazardous powerlines and mitigate these problems.

Above: A young wattled crane released after successfully being colour ringed

- Working closely with the landowners and staff in specific management activities on the farm which may disturb or affect the cranes.

Specific research, monitoring and information collection programme

A central database has been established by the South African Crane Working Group in order to secure all crane data. (Sightings, mortalities, banding records, etc). A need for detailed relevant research has been identified to better understand crane conservation management and the SACWG and KZNCF have initiated the following projects:

- Aerial counts in KwaZulu-Natal and other regions across the country
- Monitoring of breeding productivity
- Crane home range and habitat analysis
- Crane movement studies, using both satellite telemetry and colour ringing

- Genetic analysis of South Africa's crane populations
- A study on the habitat requirements of wattled cranes in South Africa

Habitat protection and conservation programme

Crane habitat has been severely impacted over the last two decades. We are experiencing huge losses in wetland and grassland area and for this reason, the KZNCF and SACWG are working closely with the following programmes and organizations:

- National and Regional Departments of Environmental Affairs and Tourism
- Regional Departments of Agriculture
- The Department of Water Affairs and Forestry
- Various NGOs such as the Mondi Wetland Project, Wildlife and Environment Society of Southern Africa (WESSA), Birdlife South Africa, National Conservancies Association and other working groups of the EWT.
- We work closely with the Important Bird Areas project (administered by Birdlife SA) in the management of habitats for specific avifaunal species, in this case cranes.

We contribute to the development of current legislation, including the new National Water Act, the Convention on Biological Diversity, CITES legislation, the Environmental Conservation Act, Conservation of Agricultural Resources Act, and the Biodiversity Act and Protected Areas Act of the National Environmental Management Act.

The conservation of grassland and wetland areas is the responsibility of everyone for the benefit of all.

The conservation of important habitat systems outside of protected areas requires the cooperation of a number of stakeholders, including the landowners, provincial conservation authorities, NGO conservation bodies and government departments such as the Department of Agriculture and Environmental Affairs (here in KZN). It is imperative that all stakeholders are willing to see each others' points of view and realise that the conservation of grassland and wetland areas is the responsibility of everyone for the benefit of all.

The current state of knowledge on veld and natural resource management in South Africa

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Introduction

A two-day workshop was held in Pietermaritzburg in November 2005 to examine the current state of knowledge underlying the guidelines and recommendations on appropriate veld (rangeland) and natural resource management. The workshop provided a forum for the 76 participants from national and provincial government, non-government, academic and private agricultural and conservation research and extension organisations to share their knowledge, experience and problems in developing appropriate guidelines and models for the management of veld and natural resources in various farming systems (communal, commercial, resettled farmers, wildlife and conservation).

The main findings of the workshop are summarised here along with recommendations for improving the generation, dissemination and application of veld and natural resource management (NRM) guidelines for various type of land users.

The objectives of the workshop were to:

- Share experiences and learn from each other about veld and NRM practices that work well (or not) in different environmental and socio-economic settings.
- Assess the state of knowledge on various aspects of veld management and identify critical knowledge gaps.
- Identify useful ways of generating and sharing management recommendations with various types of land users.
- Explore ways of improving interactions among researchers, advisors and land users to encourage joint learning and innovation.

Information for different types of land users

Management guidelines for specific land-user groups (LUGs) were considered, including commer-

cial livestock farmers, new/emerging commercial farmers on redistributed (resettled) land, communal livestock farmers and owners, and wildlife/ game and biodiversity managers.

The production goals as well as the information landscape of such groups range from nationally and internationally competitive, information-rich commercial farmers to communal and resettled farmers who might have adequate local knowledge on sustaining livelihoods but insufficient information (and general support) on how to become economically competitive commercial farmers.

Some group sessions at the workshop specifically focussed on these LUGs whereas other mixed groups considered aspects of veld management of general concern to all land users.

How is veld management information provided to different land users (Table 1)?

Group participants ranked the perceived usefulness of various channels/media for providing veld management information and advice, on a scale of 0 (not used) to 10 (very useful) (Table 1), and discussed factors affecting the provision (sharing) of such information to different LUGs.

Personal contact with advisors and fellow farmers, either in group settings or one-to-one, were perceived most useful for all LUGs for disseminating and sharing veld information, especially if such interactions involved demonstrations and talks in a relevant context (e.g. on-farm).

Least useful are electronic channels, except for radio, because of limited infrastructure, high costs and limited useful content. Advisors but not farmers use computer-based decision-support systems.

Similarly, the use of print materials by commercial and com-

How much do we really know about veld management?

Table 1: Group scores (0-10) of perceived usefulness of various channels for disseminating veld management information (high & low scores in bold; Cons = biodiversity conservation)

Communication type	Source/channel	Land User Group		
		Commercial	Communal	Game/Cons
Broadcast	Radio	6	5	3
	Television	3	**2**	3
Internet	E-mail	**1**	**1**	3
	Web	**1**	**1**	**8**
Print	Textbooks & books	4	**0**	**8**
	Training manuals	4	**1**	**8**
	Lecture & course notes	4	**1**	**8**
	Information brochures	5	4	**8**
	Fact sheets	5	**2**	**8**
	Posters & slides	5	7	**8**
	Popular magazines	5	**2**	**8**
	Scientific articles	*	**0**	**8**
Group contacts	Training courses	**9**	5	**9**
	Workshops	**9**	**1**	4
	Farmer days	**9**	**10**	**9**
	Fields visits & demonstrations	**9**	**10**	**10**
	Community meetings	**9**	7	4
	Conferences	**9**	**0**	**2**
Personal contacts	Farm visits	**10**	4	**10**
	Telephone/e-mail contact	**10**	**1**	5
Computer decision-support aids	Resource assessment programs	**9**	**0**	3
	Grazing capacity calculations	*	**0**	**0**
	Stock & fodder-flow programs	*	**2**	**2**
Other	Video	*		
	Cell phones	*	*	*
	Newspapers		3	
	Drama		*	

**use noted but usefulness not scored*

Table 2: Mean scores (1-10) for different land users on the state of knowledge on "Assessing the productivity, quality and capacity of forage and natural resources"

Management aspect	Land User Group		
	Commercial	Communal	Game/Cons
Assessing land suitability	8.7	8.3	7.7
Assessing carrying capacity	6.2	5.0	4.7
Assessing vegetation condition	5.5	5.5	5.5
Assessing productivity	7.3	5.0	6.0
Assessing seasonal supply of forage	5.2	3.0	4.8
Assessing forage quality	4.0	4.0	5.0
Assessing value of key resources	6.0	3.3	3.8
Assessing overall forage flow	8.0	5.5	7.0
Mean	**6.4**	**4.9**	**5.6**

munal livestock farmers is limited but texts are useful for reference and can support oral communication, especially if they make extensive (and careful) use of pictures and provide practical advice written in a style and language accessible to the reader. Popular magazines, such as Farmer's Weekly, do fill this gap to some extent but the quality of the information is variable.

Participants also noted that advice provided by some consultants is questionable and that this sector needs greater regulation.

How good is in the information provided to land users?

A large proportion of the workshop was devoted to an assessment of the state of knowledge on various aspects of veld and NRM to identify those aspects of management where the knowledge provided is regarded as sufficient and applicable to particular LUGs, and to note critical knowledge gaps.

Four groups, comprising a mix of experts working with different LUGs, independently scored the state of knowledge on a scale of 1-10, with 1 = very little applicable knowledge to 10 = adequate knowledge that can be applied by the particular LUG to achieve their objectives. Scores in the following tables (means calculated from at least three group scores) therefore reflect the collective confidence in the management advice provided by various organisations and individuals on the assessment of forage and

natural resources, animal (grazing) management and vegetation and soil management and rehabilitation.

Scores for resettled farmers were similar to those for communal farmers and are therefore not presented.

How good is our knowledge on resource assessment (Table 2)?

It appears we know what sorts of domestic or wildlife enterprises are best suited to particular landscapes but less confident when assessing the productivity, quality, and consequent carrying [or harvest] capacity of resources (Table 2).

Scores for browse assessment were particularly low and we know almost nothing about the grazing value of forbs and the effects of grazing on biodiversity.

Knowledge is also not spatially uniform and very little is known about the annual and seasonal productivity of some veld types. The formal knowledge on the production and consumption ecology and dynamics of communal rangelands - which can support surprisingly large numbers of livestock - is poor but local understanding of the capacity of resources might be a useful untapped source of knowledge.

How good is our knowledge on grazing management (Table 3)?

Uncertainties about carrying capacity estimates (Table 2) translate into doubts about setting

Table 3: Mean scores (1-10) for different land users on the state of knowledge on "Managing grazing animals"

Management aspect	Land User Group		
	Commercial	Communal	Game/Cons
Appropriate stocking rates	6.3	4.7	3.0
Appropriate types & mixes of animals	7.7	4.3	6.8
Appropriate grazing systems	5.0	5.0	5.0
Control of animal densities (spatial, temporal)	5.0	5.0	5.0
Control of animal movements	7.3	6.0	7.0
Resting (seasonal, annual)	6.0	7.0	7.0
Forage systems (and pastures, supplements)	8.0	4.0	6.5
Appropriate animal production systems	8.0	5.0	7.0
Mean	**6.7**	**5.1**	**5.9**

Table 4: Mean scores (1-10) for different land users on the state of knowledge on "Managing vegetation, soils and problem plants"

Management aspect	Land User Group		
	Commercial	Communal	Game/Cons
Appropriate use of fire	7.3	4.8	6.8
Pre- and post-fire management	7.2	2.3	7.0
Effects of animals on soils	2.5	2.5	2.0
Rehabilitating eroded areas	5.5	5.5	5.5
Controlling bush encroachment	6.3	6.3	5.7
Controlling alien invasive plants	6.5	6.2	6.8
Mean	**5.9**	**4.6**	**5.6**

stocking rates for grazing, and especially browsing, animals in different vegetation types. It is particularly difficult to recommend stocking rates for multi-species wildlife systems. We have a fair understanding of the principles of grazing management as the foundation for guidelines on controlling the movement of animals between grazing paddocks (camps) and across the landscape. We are sure (despite relatively little research) about our prescriptions for resting vegetation from grazing but equivocal when it comes to recommending grazing systems incorporating set periods of rest and schedules of animal movement, probably because of (unnecessary) arguments around the relative merits of continuous versus rotational stocking systems and because of the dearth of recorded knowledge on how certain vegetation types respond to grazing. Again, farmers' knowledge derived from trial-and-error and experience of what works best locally, and their rationale for management decisions, could usefully extend our knowledge on appropriate grazing management for all LUGs.

How good is our knowledge on vegetation, soil and problem plant management (Table 4)?

We have adequate knowledge on how to use fire as a tool to manage vegetation in commercial livestock and game-conservation systems but insufficient understanding of how regular burning followed by heavy

Table 5: Scores (1-10) for strength of linkages between sectors for various Land User Groups (Ccl = commercial, Cnl = communal, Cns = game/ conservation)

	Education			Research			Extension			Land User		
Group	**Ccl**	**Cnl**	**Cns**	**Ccl**	**Cnl**	**Cns**	**Ccl**	**Cnl**	**Cns**	**Ccl**	**Cnl**	**Cns**
Education	3	3	2									
Research	4	6	2	6	6	3						
Extension	3.5	2	3.5	2.5	2	1	5	2	2.5			
Land User	2	1	2.5	3	4	4.5	3	6	3.5	7	8	7

grazing affects vegetation dynamics and productivity in communal rangelands. The relative merits of block versus point-ignition burns for biodiversity conservation needs further study. While we might have procedures that work fairly well for rehabilitating eroded areas, the complex effects of animals on soils (stocks, nutrient cycles, hydrology) have not been untangled and the functional condition of rangelands is not yet routinely assessed to provide an early warning system of degradation. Decades of research have provided sound information on causes and control of bush encroachment (but we do need an update on the "state of the bush" in SA), yet this aspect scored fairly low, probably because comprehensive post-control management guidelines for problem indigenous and alien plants and rehabilitated areas have not been developed.

A succinct concluding comment on the skewed state of knowledge on veld management was provided by Justin du Toit (workshop Chair) who simply noted that "There is a reasonable amount of knowledge on how to manage good veld in commercial systems."

Another important conclusion was that critical knowledge gaps cannot be filled just by doing more experimental research but by also by learning from and with land users, who have, for a long time, being informally testing myriad farming methods in many different environments and socio-economic contexts. Effective linkages between land users, researchers, extensionists and educationists are needed if such knowledge sharing is to occur.

How good are the linkages in the agricultural knowledge and information system (Table 5)?

Groups scored the effectiveness of interactions among important actors in the agricultural knowledge and information system (AKIS) based on the degree of contact and extent of information flow and knowledge sharing, with the following questions in mind:

1. How well are linkages between Education, Research, Extension and Land-users currently functioning for the generation, sharing, adoption, adaptation and management of information and knowledge on veld and NRM (Table 5)?
2. What are the most important problems in the system?
3. What can be done to improve the system?

Land users of all types seem to interact well with each other, and so do researchers (except for game/ cons), but internal linkages were judged to be generally poor for extension and education (tertiary and training institutions). The high scores for land users suggest strong flows of local knowledge through farmers learning from each other, or they perhaps indicate a general failure of the formal knowledge generation and information delivery system. Certainly, many critical connections (e.g. research-extension; extension-land user) are weak or non-functional. Linkages for game and biodiversity conservation were surprisingly low, where the average score for external linkages was only 2.7 and the maximum score 4.5. There are few knowledgeable extension advisors to assist the many new entrants into the rapidly expanding commercial game farming industry and to provide information support to biodiversity conservation initiatives outside reserves.

Conclusions and recommendations

The traditional Transmission-of-Technology extension system based on a Receiver-to-Recipient model of communication (from research through extension to farmers) is not working well for many reasons, including a critical shortage of informed and knowledgeable personnel, few interactions among people and organisations, and a shortage of relevant and applicable knowledge on appropriate veld and natural resource management. The system could be improved by greater investment in the following:

- **People** to generate, share, apply, test and refine veld and NRM guidelines. Capacity building through training (in mentorships, learnerships, short courses; primary, secondary, FET & tertiary education) is required in all service sectors to improve knowledge and skills in technical aspects of veld and NRM, socio-economics of agricultural systems and partici-

patory extension methodology. Training and support is particularly critical for new commercial (usually resettled) farmers.

- **Places** and opportunities for people from all sectors to share knowledge and information within their organisations and with others (in a multi-way rather than one-way flow of information). Such interactions will strengthen linkages and connections and facilitate mutual learning from and with each other to create innovate solutions to local problems. Participatory action research with farmers can promote more effective and inclusive knowledge generation and sharing. Group contacts work particularly well in communal rangelands and study groups are effective for old and new commercial farmers.
- **Products** that present relevant and useful knowledge gained from research, experience and local innovation in easily accessible, user-friendly forms (sometimes in print or computer-based, but not exclusively) to meet the information needs of different groups of rangeland users. Linking veld and NRM issues to animal productivity and economic performance has been found to be an effective way of raising interest in sustainable management of veld and natural resources.

At the final plenary of the workshop a proposal by Victor Musetha of the National Department of Agriculture for the formation of a **National Veld and Forage Working Group** was accepted. This group will comprise representatives from interested national and provincial government, non-government, educational and private groups involved or interested in veld and natural resource issues. Its main purpose will be to strengthen linkages among organisations and people to promote more effective generation, sharing and application of management guidelines for appropriate veld and natural resource management.

Acknowledgements

The workshop was funded by the National Department of Agriculture, chaired most ably by Justin du Toit, and its findings documented comprehensively by Freyni du Toit. I thank Tanya Karalic for organising logistics and the following group session leaders for their input: Terry Everson, Alan Short, Debbie Jewitt, Luthando Dziba, Chris Dannhauser, Peter Scogings and Kevin Kirkman.

Short-term influence of fire in a semi-arid grassland on (5): seedling establishment

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Introduction

Fire can be seen as one of the largest anthropogenic influences on terrestrial eco-systems after urban and agricultural activities (Van de Vijver 1999). Whether lightning or man caused these unforeseen fires in both arid and mesic grasslands, they not only have a short-term influence on the functioning of the grassland ecosystem, but may also have a residual effect on the following growing seasons, depending on successive climatic conditions and post-fire management (Scott 1971; Tainton and Mentis 1984; Snyman 2003a, b, 2004). The drier the grassland, the less important fire becomes as an ecological process (Everson 1999).

Though only limited information exists on the influence of fire on seed germination and seedling establishment in the higher rainfall areas (Zacharias *et al*. 1988; Adams 1996) this information is totally lacking for the drier areas (Booysen and Tainton 1984). Some workers have indicated that fire in mesic grasslands may enhance the germination of, for example, *Themeda triandra* (West 1951; Trollope 1984) as a result of modification to the environment. In contrast, fire alone could depress the germination of this species and stimulate it in *Heteropogon contortus* (Zacharias *et al*. 1988). Seed longevity of grass and dicotyledonous weeds of arable lands has been relatively well investigated (Froud-Williams *et al*. 1984; Roberts and Boddrell 1984; Colosi *et al*. 1988), but unfortunately there are fewer studies on natural vegetation (O'Connor 1997). The aim of this study was therefore to quantify the short-term (two years) influence of a one-time fire (head and back) on the seedling establishment of sweet grassland in a semi-arid climate

Procedure

The research was conducted in Bloemfontein (28°50'S; 26°15'E,

altitude 1350 m), which is situated in the semi-arid (summer annual average 560 mm) region of South Africa. The study area is situated in the Dry Sandy Highveld Grassland (Grassland Biome) with a slope of 3.5%. Soil in the study area is mostly fine sandy loams of the Bloemdal Form (Roodepoort family – 3 200). Clay content increases with soil depth from 10% in the A-horizon (0 to 300 mm), to 24% in the B1-horizon (300 to 600 mm) and 42% in the B2-horizon (600 to 1200mm).

The research was conducted on 18 plots of 10m x 10m each, with an edge effect of 5m around every plot. The three treatments included fire burning against the wind (back fire), with the wind (head fire) (Trollope 1978), and a control with no burning taking place. The layout was a fully randomised design with three replications for each treatment. Half of the burn plots were burnt on 30 August 2000 and the other half on 23 August 2001. Every plot was therefore burnt only once during the trial period. The head and back fire treatments were applied on the same day to ensure that the two types of fires were comparable over a similar range of environmental variables. The burn treatments were applied when the soil and grass fuels were initially very dry and then spring rainfall thoroughly wetted the soil causing the grass sward to become relatively green. Burning took place in the morning with a light wind blowing. To limit the fire to every burnt plot, the plants surrounding each plot were cut short and soaked before burning. The plots were excluded from any grazing over the two-year trial period.

The fuel load was estimated by cutting 10 quadrats (0.5m x 0.5m each) in the control plots adjacent to the burnt plots (Snyman 2000), which only comprised the growing season's production. The fuel-water content was estimated by harvesting ten grass samples at random from tufts of the dormant grass species in the plots. The fuel water was expressed as a percentage on a dry matter basis.

The mean length of the flames was estimated visually once the fire was burning uniformly. The rates at which the head and back fires moved over the plots were measured by a stopwatch. The wind velocity was recorded at the start, during and at the end of the fire with a hand anemometer held at a height of approximately 1.7m. Wind velocities recorded during the fire were assessed to be most representative for that time of the year. Air temperature and relative humidity were measured immediately prior to burning with a whirling psychrometer.

The fire behaviour model of Trollope (1999) was used to predict the fire intensities to which the treatment blocks were subjected for each season's burning. Fire intensities were estimated and classified into one of the categories proposed by Trollope and Potgieter (1985). The procedure for recording fire intensity

(10mm under the soil, at ground level, grass canopy height and one meter above ground level) by chrome-alumel thermocouples connected to a portable electronic temperature recorder, is fully discussed by Snyman (2003a) and Snyman (2005). The mean grass canopy height was 230 ± 25mm on average for the August 2000 and 2001 fires. Basal cover and botanical composition were determined with a bridge-point apparatus, where 500 points (nearest plant and strikes) were recorded per plot before the fire as well as 1, 4, 8 and 20 months after the fire.

Thirty tufts of the dominant grass species per treatment were randomly selected and permanently marked with steel pins. The total number of flowering tillers in each of these tufts were noted every second month as it was difficult to identify only the shoots of a specific month which turned reproductive. A tiller was only noted when the inflorescence had already appeared. For the species *Cymbopogon plurinodis*, *Digitaria eriantha*, *Eragrostis superba*, *Sporobolus fimbriatus* and *Triraphus andropogonoides*, only 15 tufts were selected per species as there were not a sufficient number of tufts per treatment.

My definition of successful seedling recruitment is that a seedling must survive to at least one growing season or to flowering (if this occurs within 12 months of germination). Seed germination and seedling survival in the field are closely linked to seasonal climatic conditions. Therefore it is important that observations should take place almost daily in the field, to accurately determine the survival percentage of seedlings over a season. If not regularly monitored, it may happen that some seedlings surviving only for a few days, due to variable climatic conditions, will not be monitored. For the above practical reasons it was therefore decided to only note the survived seedlings at the end of a growing season in this study. It was also attempted, as far as possible, to classify seedlings in month of initial germination. The problem occurring with this was that it was very difficult to identify some of the seedlings germinating during the different months, per species. To obviate this problem, seedlings of the 20 most dominant species germinating over that period were randomly chosen and tagged with steel pins, painted in different colours and inserted into the soil nearby, at the end of every second month (middle October – before seed set, December – after first seed production and February – after second seed production). These marked plants were used to classify the seedlings per species, which were identifiable and survived at the end of the growing season, into groups based on month of initial germination. Only the number of survived seedlings per species over a season were obtained and not the percentage survival of the already

germinated seeds. This was obtained by counting the seedlings in 30 randomly distributed quadrats ($1m^2$ each) per treatment at the end of every growing season (March) for that specific season. Seedlings germinating up to and in the respective month over the season were differentiated. The distance between seedling and closest mature plant (regardless of species) was also noted every time. The distance was measured from the edges of tufts.

Results and discussion

Fire behaviour – head and back fires

The environmental conditions during the August 2000 and 2001 fires were very similar. If these environmental parameters obtained with this study for the August 2000 and August 2001 fires respectively of aboveground phytomass production (1453 and 1200 kg/ha); fuel-water content (18 and 21%); wind speed (2.44 and 2.33 m/s) and relative humidity (43 and 41%) were built into the fire behaviour model of Trollope (1999) the predicted fire intensity should have been 1145 and 766kJ/s/m respectively. Therefore, the fire intensities of the two seasons ranged between a moderately hot and cool fire (Trollope and Potgieter 1985).

The head fire was on average 6.7 times faster than the back fire. The flames of the head fires reached heights of twice those of back fires. The intensity of the fire 10mm under the soil in case of both the back and head fires did not vary much, with a respective range of temperature increase of only 9°C to 15°C and 9°C to 21°C. At ground level and canopy height the back fire exceeded 100°C and 400°C respectively. In contrast the head fire had temperatures of less than 100°C at ground level, but exceeded 500°C at 1m above the ground. The reason for the higher intensity of the head fire at 1m above ground lies in the greater flame length of head fire (1.0m vs. 0.5m) which ensures that this stratum above the ground still forms part of or is immediately adjacent to the zone of flaming combustion. The overall conclusion is that back fires are more intense than head fires at ground level, whereas head fires are hotter than back fires at levels above the canopy of the grass sward. Head fires have a greater potential for developing higher temperatures than back fires at all levels given the appropriate environmental conditions.

Botanical composition

The experimental plots were in good condition before the fire with a grassland condition score of only 13% lower than that of the benchmark site. The benchmark site was especially dominated by *Themeda triandra*, which caused this difference in grassland condition to that of the experimental sites. The grassland condition score (expressed as a percentage of that in a benchmark

site) decreased by only 3.3% due to the fire.

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

Basal cover

The basal cover significantly ($P<0.05$) decreased in both the head and back fires, to such an extent that it was still 11% lower (average for head and back fires) than the unburnt grassland after two growing seasons (Table 1). One month after the fire the basal cover already decreased by 66% ($P<0.05$) due to the fire (for head and back fires). As expected, the back fire had a greater influence on basal cover, though not significant ($P<0.05$), than the head fire. The first month following the fire, the impact of the back fire on the decrease in basal cover was 18.18% greater ($P>0.05$) than that of the head fire and after two years only 1.48%. Only the cover of the living plant parts was noted and not the dead parts still present in the tufts.

Flowering over the season

The plants in the study area normally follow two growth cycles, namely in the pre-season, peaking about the end of October and a second period peaking middle of February in the post-season. During these two periods the grasses turn reproductive. Due to

Table 1 Basal cover (%) for the burnt and unburnt grassland, measured 1; 4; 8 and 20 months after burning. Least significance (LSD) is calculated at the 1% level. Data are means and standard errors.

Time after burning **(months)**	Unburnt	Head fire	Back fire	t-value
1 LSD = 2.06	7.25 ± 0.51	2.75 ± 0.30	2.25 ± 0.31	0.91
4 LSD = 2.01	7.20 ± 0.62	3.85 ± 0.21	3.50 ± 0.32	0.86
8 LSD = 0.89	7.25 ± 0.61	5.25 ± 0.56	5.20 ± 0.51	0.77
20 LSD = 0.70	7.50 ± 0.51	6.75 ± 0.43	6.65 ± 0.42	0.56

Table 2: Cumulative number of tillers (average per tuft) for the burnt (first and second season after burning) and unburnt grassland for each species, measured every second month. Flw = Flowering tillers; Veg = Vegetative tillers

Species	Month											
	October				December				February			
	Unburnt		Burnt		Unburnt		Burnt		Unburnt		Burnt	
	Flw	Veg	Flw	Veg	Flw	Veg	Flw	Veg	Flw	Veg	Flw	Veg
Aristida congesta	7	3	7	3	9	4	9	4	12	5	12	5
Cymbopogon plurinodis	2	11	4	4	3	13	4	6	5	20	9	11
Digitaria eriantha	0	16	0	6	4	21	3	12	7	30	6	22
Eragrostis chloromelas	6	22	7	10	6	28	8	16	18	32	17	26
E. lehmanniana	5	9	6	10	5	14	6	10	12	14	10	12
E. superba	7	8	8	8	7	10	8	10	10	13	12	13
Elionurus muticus	5	19	13	20	7	28	16	32	9	42	19	32
Panicum stapfianum	2	2	0	2	5	4	0	4	6	7	4	4
Sporobolus fimbriatus	8	16	8	16	10	20	9	18	15	30	12	28
Themeda triandra	8	24	6	20	9	32	6	24	17	40	11	32
Triraphus andropogonoïdes	9	7	8	6	10	7	9	6	10	7	9	6

the average and well-distributed rainfall for the 2000/01 and 2001/02 growing seasons, most grasses could also produce seed twice per growing season, during this study period. The 2000/01 and 2001/02 growing seasons respectively received 573 and 811mm rain versus the long-term average of 560mm per annum for this area. As the head and back fires did not have a large impact on seed formation, also for the first and second season following burning, the average numbers of flowering tillers per tuft of every species and for the 2000/01 and 2001/02 seasons are presented in Table 2.

The species forming most seed culms per tuft over the growing season was *Elionurus muticus* (burnt), *Eragrostis chloromelas* (regardless of burning) and *Themeda triandra* (unburnt) with 19, 18 and 17 seed culms per tuft respectively (Table 2). *Cymbopogon plurinodis* and *Digitaria eriantha* formed the fewest seed culms per tuft over the growing season with an average of only 5 and 7 culms per tuft in unburnt grassland. More tufts of the pioneer species *Aristida congesta*, which is more poorly perennial, turned reproductive than those remaining vegetative. *Themeda triandra* and *D. eriantha* were the two climax species of which very few shoots turned reproductive at the end of the growing season, compared to the available vegetative shoots. *Elionurus muticus* was the species most stimulated for seed formation due to the fire and to a lesser extent *C. plurinodis*, while *T. triandra* was not much influenced by fire. When the total number of reproductive shoots formed over a season for both burnt and unburnt grassland is compared, they are precisely the same. On average for all the grass species, fire had therefore no influence on seed formation.

It was almost impossible to differentiate *Tragus koelerioides* tufts from each other due to the stolon growth characteristic of this species. Therefore the seed formation of this species was not noted. The *Eragrostis* species would always seed first regardless of burning.

Seedling recruitment into gaps and their survival in the field

The density of the survived seedlings for the head and back fires differed non-significantly ($P>0.05$) from each other for both growing seasons (Figure 1). Unfortunately, the percentage survival of the grass species which did germinate per month, was not monitored, but only the number surviving at the end of the growing season. The unburnt grassland had more or less the same seedling density for the two seasons in all months. The second season following the fire had an immense increase in seedling survival over all months compared with the first year following the fire. In both seasons, burning influenced seedling survival negatively ($P<0.05$). Also clearly shown in Figure 1 is that regardless of fire, most seedlings occurred

during the second half of the season. This trend may possibly relate to the lifting of dormancy by certain grass species (Simpson 1990; Cavers 1995) or possibly the production of more seed.

The seedling establishing closest to the mature plant was not necessarily of the same species. The distance between seedling (regardless of species) and mature plants varied between 25mm and 85mm in unburnt grassland. In case of the established seedlings, 68% were closer than 50mm from the mature plants and the rest further away. In burnt grassland, the average distance between seedlings (also regardless of species) and the mature plants varied from 20mm to 55mm. In this case, 71% of the seedlings were closer than 40mm from the mature plants, with the rest establishing further away. The seedling establishment of burnt grassland in general happened closer to the mature plants than in unburnt grassland. The surviving seedlings, regardless of burning, generally established more successfully closer to the larger mature plants and fewer further away from existing tufts. The better protection and shading of these seedlings by the larger tufts against the onslaught of climatic elements may be the most important reason for this better survival (Pugnaire and Lazaro 2000). No specific grass species in any treatment exclusively established further or closer to the mature plants.

A total average of 0.86, 0.53 and 0.43 seedlings/m^2 (Figure 1) of 8, 12 and 12 species respectively for unburnt, head fire and back fire survived in the gaps over the first season after burning (Table 3). During the second season following the fire, the seedling survival due to fire was higher (average 0.7 plants/m^2), but the species diversity generally decreased to 10. Species richness grows more with fire and again decreases the second season following the fire.

The only grass species occurring only in the burnt plots were *Aristida congesta*, *Tragus koelerioides,* as well as the forb, *Geigeria aspera*. It was very difficult to identify *T. koelerioides* as seedling for a specific month because of its creeping growth form. In relation to the rest of the species within a treatment, the first-mentioned two grass species initially produced many seedlings, but with a sharp decline the second year following the burning. Although expressed in relation to the rest of the species within a treatment (Table 3), the seedling establishment of *Eragrostis chloromelas*, *Themeda triandra* and *Elionurus muticus* were heavily decreased by the fire. *Cymbopogon plurinodis* only had seedlings surviving in the unburnt grassland, though unfortunately the percentage of seedlings which did germinate and not survive, is not known. The trend was that species *Digitaria argyrograpta*, *E. superba*, *E. muticus*, *Sporobolus fimbriatus* and *Triraphus andropogonoides* all better survived

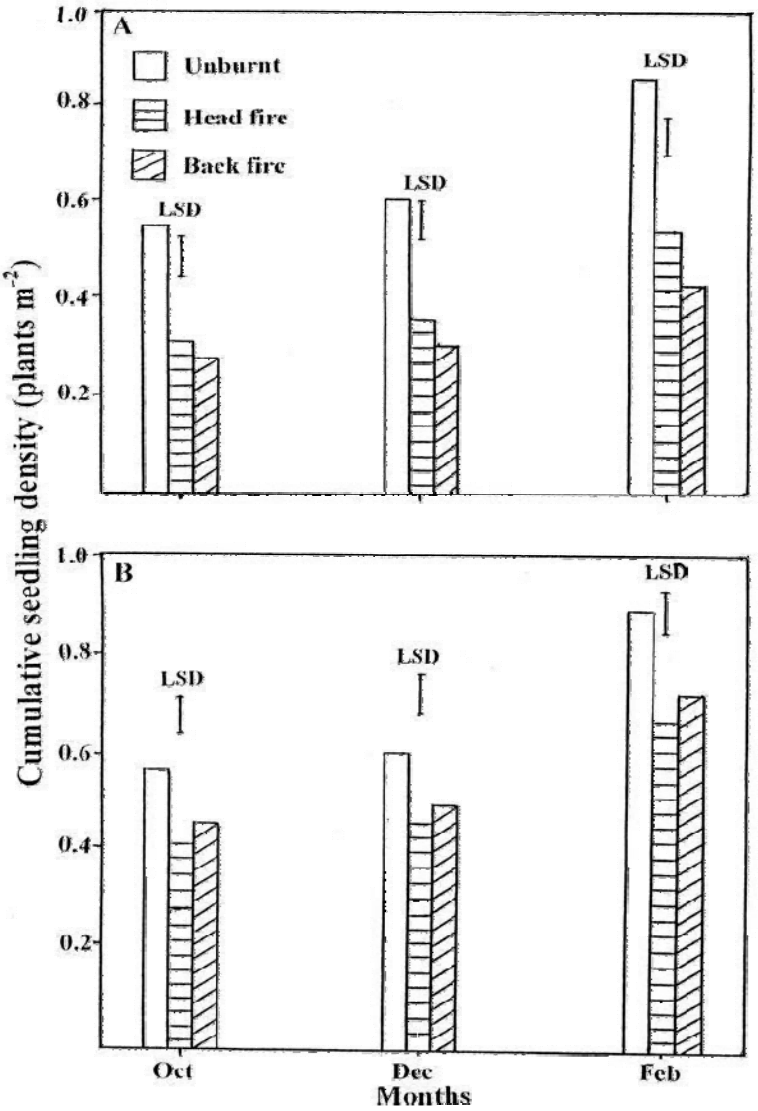

Figure 1: Cumulative seedling density (mean number of survived seedlings/m^2) for unburnt and burnt (first = A and second = B season after burning) grassland, measured at the end of the growing season (March), which germinated respectively up to October, December or February each growing season. Least significant differences (LSD) are calculated at the 1% level.

Table 3: Relative species frequency (%) of survived seedlings for the burnt (first [1] and second [2] season after burning) and unburnt grassland, measured in the field in April of the 2000/01 and 2001/02 growing seasons

Species and ecological status	October					December				
	Un-burnt	Burnt				Un-burnt	Burnt			
		1		2			1		2	
		H	B	H	B		H	B	H	B
Decreaser:										
Digitaria eriantha	12.6	9.4	9.1	10.5	12.2	5.2	14.4	1.0	6.2	13.1
Sporobolus fimbriatus	3.0	3.2	6.2			2.9				
Themeda triandra	51.1	11.4	11.2	42.4	31.3	38.7	15.0	18.6	30.0	21.4
DECREASER TOTAL	**66.7**	**24.0**	**26.5**	**52.9**	**43.5**	**46.8**	**29.4**	**19.6**	**36.2**	**34.5**
Increaser II(a)										
Cymbopogon plurinodis	1.7									
Digitaria argyrograpta		3.1	2.2	1.0	2.1		2.4			1.2
Eragrostis chloromelas	12.7	3.7	4.7	6.8	9.2	16.7	10.7	10.3	11.1	10.4
E. lehmanniana	1.1	3.6	3.2	2.1	3.1		3.2	3.0	2.4	3.9
E. superba	4.0	2.3	3.9			6.7				
Increaser II(b)										
Elionurus muticus	13.8	3.1	4.0	19.2	17.4	29.8	3.2	5.1	20.0	14.3
Triraphus andropogonoïdes		5.5	11.7		7.2					
Increaser II(c)										
Aristida congesta		14.2	12.0	6.5	6.8		16.1	19.1	6.1	7.1
Tragus koelerioides		40.5	31.8	11.5	10.7		35.0	42.9		
Geigeria aspera									24.2	28.6
INCREASER II TOTAL	**33.3**	**76.0**	**73.5**	**47.1**	**56.5**	**53.2**	**70.6**	**80.4**	**63.8**	**65.5**

and which germinated during Sept/Oct, Nov/Dec, Jan/Feb of each season. (H = head fire and B = back fire).

February					Total for season				
	Burnt					Burnt			
Un-burnt	1		2		Un-burnt	1		2	
	H	B	H	B		H	B	H	B
21.5	7.3		20.0	22.2	11.0	6.1	3.8	5.6	6.5
					1.7	2.9	3.1		
40.0	14.3	20.0	30.0	22.2	47.4	11.7	7.6	32.2	31.2
61.5	**21.6**	**20.0**	**50.0**	**44.4**	**60.1**	**20.7**	**14.5**	**37.8**	**37.7**
					2.1				
	2.0					2.2	1.8	0.9	1.3
17.6	9.6	12.7	17.5	15.6	16.2	9.9	9.8	10.6	10.6
	1.6	4.0	6.3	2.4	0.2	2.0	3.4	5.2	5.7
4.2					3.1	1.2	2.0		
16.7	6.2	4.1	2.2	2.1	18.3	4.0	3.1	18.5	12.0
						2.0	6.9		1.8
	13.1	18.1	4.0	2.1		15.8	17.5	7.0	7.2
	32.7	30.0	20.0	33.4		31.0	26.0	10.9	5.9
	13.2	11.1				9.2	8.1	9.1	13.7
38.5	**78.4**	**80.0**	**50.0**	**55.6**	**39.9**	**79.3**	**85.5**	**62.2**	**62.3**

with germination in the pre-season, while *T. triandra* throughout maintained a good survival regardless of time of germination. The seedlings of the species *A. congesta* and *T. koelerioides* were the only ones that seeded in to the same year of germination.

Conclusions

The fire responses are particularly interesting in this semi-arid grassland type in comparison with the mesic, fire dependent *Themeda* grasslands of the eastern seaboard of the country. In contrast to the rapid decline in *T. triandra* cover in the absence of fire in the KwaZulu-Natal grasslands for example, it seems to persist without burning for decades in the more arid grasslands. This suggests climate control of arid central grasslands and fire control of eastern mesic grasslands.

The study shows fire-stimulated flowering in some species (*E. muticus*), but apparently none in *T. triandra* and most of the other grasses. It is also shown in the study whether seedling recruitment is fire-stimulated or not. Short-lived species (*A. congesta, T. koelerioides*) are fire-stimulated, as is *G. aspera*, but most of the dominant perennial grasses are not. Although *T. koelerioides* often comes up after a prolonged drought, it is not certain whether fire acts in a manner equivalent to drought in reducing grass cover and stimulating germination of plants with dormant seeds or whether there is a specific fire cue for these species (such as smoke-stimulated germination). Therefore, a question to be addressed in future, is if the fire-stimulated species are also drought-stimulated species.

Unlike many studies of post-burn soil conditions, the study also showed clear evidence for hotter, drier soils after burning. Often, the reduction of plant cover and therefore evaporation results in drier surface soils but moister deeper soils than unburnt vegetation.

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11th Agrisson Congress: Report-back

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The 11th congress of the Agricultural Scientific Society of Namibia (Agrisson) was held recently in the auditorium of the Geological Survey of Namibia, in Windhoek. Twelve very interesting reports, varying from the theory of determining land cover to practical issues such as how to reduce the number of cattle in overgrazed communal areas were presented to an audience of about 50 people.

The guest speaker, Dr. Scott Turner of the State University of New York, started off the proceedings by giving a talk on “Termites, Water and Soils”. Dr. Turner has been investigating termites of the fungus-growing genus *Macrotermes* for a couple of years now in Namibia, trying to resolve the question whether they are pests in rangeland management, or not. There are 500 kg of termites for every person on earth and termites account for two-thirds of the macrofauna biomass in soils. *Macrotermes* collect 1½ tons of

dead plant matter annually per hectare which they chew and feed to a fungus of the genus *Termitomycetes*. The fungus converts the hard, virtually indigestible fibrous plant matter into more easily digestible sugars, which it uses as nourishment. The fungus, 3 to 6kg of it, is kept in the core or nest of the termite mound, just below soil level. The termites in turn feed on the fungus, obtaining energy and proteins from it. For optimum fungus production, it has to be well supplied with chewed plant matter and the mound has to be kept warm and moist at all times, very much as in a vegetable hothouse. Air conditioning is thus an important aspect of the "gardening skills" of termites. This is achieved by building an earthen chimney over the nest core, creating the characteristic mounds or hills typical of our semi-arid savanna rangelands. The chimney points northwards to achieve better warming by intercepting the maximum amount of solar radiation and regulates the temperature and humidity in the mound.

The soil used to construct the earthen chimney is extracted from deep below the termite mound, where the soil is moist. Records from mine shafts exist where termites were encountered at a depth of 100 meters below the surface! Sterile termite workers stick moist soil onto the chimney, humidifying the mound in the process. The soil is washed down again from the chimney when it rains, creating the typical outwash pediment around the mound. Since sub-soil usually contains more mineral nutrients than topsoil, the pediment represents an island of fertility that encourages vigorous plant growth and is the reason why trees often grow on the same site (see Picture 1). Termite workers have to repair the chimney continually, redistributing about 800 – 1 000 kg of moist soil from deep down to the surface within the 80 days of the Namibian rainy season. The termite colony may house as many as 2 million individuals and their metabolic activity and oxygen

Picture 1: Termite mounds encourage vigourous plant growth through increased soil nutrients at the surface

consumption is equivalent to that of one goat. As there are up to four termite mounds per hectare of savanna rangeland in Namibia, termite foraging behaviour has a significant impact on the ecology and carrying capacity of the range.

Termites are also able to channel water into the lower soil regions immediately underneath the mound by forming bowl-shaped calcite deposits below the mound. These are impermeable to water, resulting in sub-soil water flow towards the mound. This favours the establishment of deep-rooted trees on sites frequented by termites in the past. The calcite minerals are formed when the methane produced by termites during forage-chewing reacts chemically with the calcium-containing ground water at the relatively high temperatures of the mound. How termites manage to form these mineral deposits into basins is not yet known.

Termites thus have a big impact on savanna ecology, soil formation and soil water contents. They consume 90% of the dead wood and 25% of the herbaceous litter to fuel their activity, enriching the soil in the process. Although it may strike the rancher as wasteful, considering that his animals could have used this forage, the termite is indispensable to rangeland ecology and the range would be less productive without termites of the genus *Macrotermes*. Furthermore, competition by *Macrotermes* probably limits the numbers of *Hodotermes,* the feared harvester termite.

Next up was Dr. Louis du Pisani of the Ministry of Agriculture (Agro-Ecological Zoning Laboratory), explaining global warming and its possible effects on Namibia to the audience, and Dr. Paul Jessen, the Director of Agricultural Research and Training, who emphasized the huge contribution that science and technology can make to the development of the Namibian nation, especially in the field of agriculture. He suggested amongst others that local agricultural scientists should team up more often with others from the SADC region to enhance the ability of the subcontinent to develop new technologies for the agricultural sector. Dr. Jessen has since left his post as Director in the Ministry of Agriculture to serve as the co-ordinator: agricultural research and training in the SADC region.

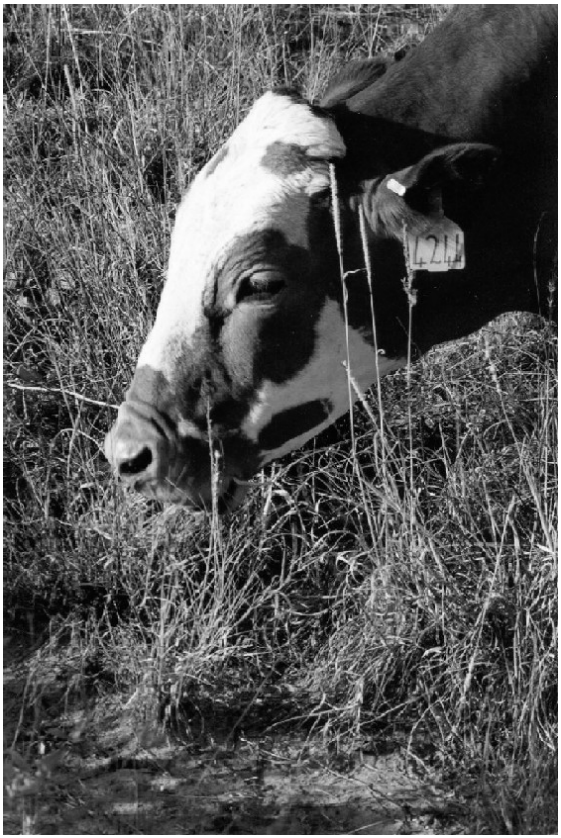
Thereafter, Dr. Klaus Fleissner of the Ministry of Agriculture (Crop Production research), who has been investigating the cultivation of Bambara groundnuts in northern Namibia for many years, informed the audience that northern Namibians preferred to consume cream- rather than red-seeded varieties, because the latter contained 25 times more tannin than the former, making the red-seeded varieties bitter and less palatable. However, the low tannin content of the preferred cream-seeded varieties makes them more vulnerable to microbial attack during germination, e.g. damping-off, which causes poor

establishment. Special cultivation techniques such as dressing the seed with the appropriate pesticide or beneficial micro-organisms are thus required to enhance production of the preferred Bambara groundnut varieties.

Albert Calitz of the Ministry of Agriculture (Agro-Ecological Zoning Laboratory) then informed the audience of the usefulness of earthworms, who can turn any kind of organic waste into high-value organic fertilizer by passing the waste through their digestive system and producing vermicompost. Such organic decomposition results in nutrient recycling that can add more plant nutrients to the soil than chemical fertilizer, in addition to nearly 400 types of soil microbes that enhance and stimulate plant growth, vigour and health and may increase plant production several-fold. Earthworms also have a role to play in municipal waste and refuse disposal and conversion to compost and in urban agriculture, while earthworm enzymes even have medicinal and cosmetic applications!

Ibo Zimmermann of the Polytechnic of Namibia (School of Natural Resources and Tourism) next elaborated the beneficial role that lactic acid bacteria, phototrophic bacteria and yeasts can play in farming. Students of the Polytechnic of Namibia have done some trials, or facilitated trials by farmers who can easily and cheaply multiply effective micro-organisms from stock culture. The multiplied micro-organisms were then used to clear blocked drains, control red spider mites on tomatoes, improve germination of some plant seeds, lengthen the shelf life of fresh fruits, convert forage into silage, reduce the algal content of standing water, convert mahangu husks into valuable chicken feed, and many other applications.

Dr. Alex Verlinden of the Desert Research Foundation next reported on a range survey conducted in a 20 000km^2 communal grazing area in the Oshikoto region, reconciling local knowledge and opinions with data collected by satellite, geographic information systems and aerial photography. More than 77% of the communal grazing land was considered to be in poor condition and only 4% was considered to be in good condition, protected primarily by its distance from watering points or by fences. Nearly 60% of the grazing land was bush encroached, resulting in declining cattle productivity especially during the dry season. Unusually for a communal grazing area, 40% of the grazing land was fenced, but only 10% of fences belonged to smallholders, indicating that large farmers restricted previously unfettered access to some of the most productive grazing lands to themselves. Such fencing is in large part the reason why traditional, regular movement of livestock between villages and cattle posts (annually) and sporadic relocation of cattle posts (every 10 – 20 years) is no longer taking place; most live-



Picture 2: changes in beef cattle production relate to their diet

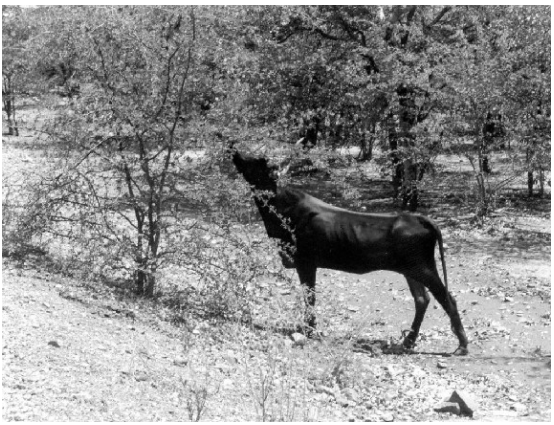
stock is thus kept permanently at far-away cattle posts due to the lack of grazing in settled areas, with disastrous results for the condition of the grazing land. Traditional grazing reserves in the communal areas of the Oshikoto region are under pressure of settlement and fencing. The most limiting resource in most areas is no longer lack of dry season water but lack of good grazing lands. As a result, rangeland degrades rapidly, food security declines and rural poverty increases.

In a similar vein, Jacque Els of the Ministry of Agriculture (Large Stock Research) explained that the stocking rate at which cattle are kept on the rangeland has significant implications for the productivity of cattle. In a trial of 20 years in the Omaheke region, it was found that the calving and weaning rate of cows decreased with an increase in stocking rate and the birth and weaning mass of calves decreased

with an increase in stocking rate. This resulted in a significant decrease in the productivity of individual cows as stocking rate increased, although total beef production per hectare increased. Afterwards, Axel Rothauge of the Neudamm Agricultural College explained that the changes observed in beef cattle productivity are related to what cattle eat (Picture 2). As the stocking rate of cattle increases, they are forced to eat plants that they do not prefer and that are less nutritious, because the palatable, preferred plants have already been overgrazed. If cattle have a choice, they rely on only three highly-preferred species of perennial grasses (*Schmidtia pappophoroides, Anthephora pubescens* and *Eragrostis lehmanniana*) for three-quarters of their diet, but are forced to select other plants, especially woody plants, at higher stocking rates, resulting in a significantly less nutritious diet and declining animal productivity. Mutjinde Katjiua of the University of Namibia (Faculty of Agriculture and Natural Resources) went further by explaining that, in bush-encroached communal areas of the Omaheke region, cattle browse for 71% of their time in the dry season, because grazing is virtually unavailable (Picture 3). Simply clearing the bush from encroached land is thus not an option considering the important contribution of woody plants to especially the protein and phosphorus status of free-ranging cattle.

In an effort to find ways of increasing the number of cattle marketed from the northern communal areas, where 29% of Namibia's cattle graze on only 9% of its land surface, and thus relieve the pressure on the environment, Bertus Kruger of the Desert Research Foundation of Namibia suggested that part of the solution lies in improved quarantine facilities and management of cattle during the compulsory quarantine period. Abattoirs located in the northern communal areas slaughter less than one-tenth as many cattle as abattoirs in the commercial areas of Namibia, despite roughly equal

Picture 3: Cattle browsing as a result of poor grass production



numbers of cattle grazing communal and commercial areas. It is commonly accepted that communal cattle are not of the type favoured by abattoirs, but decent management during the compulsory quarantine period before auctioning resulted in a steep increase in the number of cattle marketed and bought for slaughter. Quarantine facilities would also have to be brought closer to communal farmers. In addition, government incentives would be required to reduce the cost of quarantining cattle to the communal farmer.

Finally, Celeste Espach of the Ministry of Agriculture (Agro-Ecological Zoning Laboratory) introduced a new research project to the audience. Celeste plans to describe, classify and eventually map the land cover and land use of Namibia in order to develop land use systems best suited to Namibia's different agro-ecological zones, better match land resources to land use requirements, increase production and sustainability, protect the environment and maintain natural biodiversity and climate systems. At issue were the techniques by which land cover is derived from remotely sensed images and validated on the ground to ensure the highest possible accuracy of the information. It was pointed out that methods to achieve high statistical accuracy are available, but that the high cost and insufficient human capacities were limiting factors. A pilot trial to map land cover and land use in the Khomas region had indicated that it would be feasible to upscale the regional pilot trial to the whole country.

After every presentation, there was ample time for questions to the presenters and indeed, interested readers are encouraged to contact the presenters. To conclude its business, the Agricultural Scientific Society of Namibia (Agrisson) decided on its executive at the end of the congress. Willie Nauhaus was re-elected unanimously as chairperson of Agrisson, with Axel Rothauge serving as deputy, Marina Coetzee as secretary, Celeste Espach as treasurer and Ibo Zimmermann serving as editor. Please feel free to contact the executive for further information about Agrisson and its regular activities to disseminate agricultural-scientific information to the Namibian public.

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