PROCEEDINGS OF THE AUSTRALIAN RANGELAND SOCIETY

BIENNIAL CONFERENCE

Official publication of The Australian Rangeland Society

Form of Reference

The reference for this article should be in this general form:

Author family name, initials (year). Title. In: Proceedings of the nth Australian Rangeland Society Biennial Conference. Pages. (Australian Rangeland Society: Australia).

For example:

Bastin, G., Sparrow, A., Scarth, P., Gill, T., Barnetson, J. and Staben, G. (2015). Are we there yet? Tracking state and change in Australia's rangelands. In: 'Innovation in the Rangelands. Proceedings of the 18th Australian Rangeland Society Biennial Conference, Alice Springs'. (Ed. M.H. Friedel) 5 pages. (Australian Rangeland Society: Parkside, SA).

The Australian Rangeland Society

Overview of rangeland degradation caused by Opuntia-invasion in semi-arid zones of South Africa, implications on grazing strategies, carbon sequestration and agricultural land values

Lukas Chipfupa[AC], Florence V. Nherera[B] and Pieter Fourie[A]

[A]Central University of Technology, South Africa

[B]Agricultural Research Council - Animal Production Institute (ARC-API), South Africa

[C]Corresponding author. Email: lucas1620@yahoo.co.uk

Keywords: rangeland degradation, grassland, *Opuntia humifusa*, SNAP model, carbon sequestration, invasive species

Summary

Degradation of rangeland and soil as consequences of land use poses threat to sustainable agriculture. Degradation could be as a result of overgrazing and climate change. This could result in changes in species disappearance, species composition and abundance, with high losses in highly palatable grass species. The changing landscape in semi-arid areas such as the Western Free State reflected by the overwhelming invasion of *Opuntia humifusa* is a notable measure of rangeland degradation as a result of climate change and under-preparedness in veld managers to manage grazing environments. The adaptability and naturalization of *O. humifusa* in the semi-arid rangeland of the Western Free State could be attributed to climate change. Without intervention, desertification and/or permanent ecological changes are inevitable and this may result in economic value depreciation of invaded farms. The rangeland degradation also depletes the capacity of rangeland as a carbon sequester and carbon sink.

Rangeland degradation and associated effects

In South Africa, thousands of plant species from other parts of the world have been introduced for a range of purposes; as crop species, for timber and firewood, as garden ornaments, for stabilizing sand dunes and as barriers and hedge plants. *Opuntia humifusa* commonly known as creeping prickly pear originated from North America (Henderson, 1999) and it invades arid grassland and savannas. *Opuntia* species are propagated both sexually and asexually (through seeds and cladodes). Prickly pear (*Opuntia ficus indica*) was introduced to the Cape over 300 years ago. More than two million hectares were invaded during the early part of the 20th century severely affecting agriculture outputs. In the Namakaroo woody invaders, notably mesquite (*Prosopis spp*) have invaded large areas of alluvial plains and seasonal and ephemeral watercourse. Several cacti (*Opuntia spp*) and saltbushes (*Atriplex spp*) have invaded large areas of the Nama-karoo biome and succulent biomes and the thicket biome in the Eastern Cape. The invasive cacti have invaded 20000 km^2 since 1932. Half of the area invaded consisted of dense infestations which resulted in little natural vegetation for grazing animals and led to huge livestock mortalities. The highly irritant spines on the prickly pear plants also render it unpalatable (SAPI, 2012). A continuously overgrazed landscape depreciates the environment regressing outputs in livestock and wildlife and also affecting the micro-fauna and flora, a cause of concern for land managers (Kraaji and Milton, 2006).

Degradation is characterized by a loss in plant cover and topsoil, a decline in palatable climax grasses and an increase in less palatable annual grasses species. The invasion of creeping prickly pear in Karoo biome results in displacement of grasses and herbaceous legumes. Due to overgrazing coupled with seasonal variability in rainfall received in Karoo biomes, causes the increased spread of creeping prickly pear faster. According to this national (van Wilgen et al., 2001), about 10 million hectares of South Africa has been invaded by the approximately 180 species that were mapped. Several cacti (*Opuntia* species) and saltbushes (*Atriplex* species) have invaded large area of Nama karoo and

succulent karoo (winter rainfall) biomes (Milton et al., 1999). The Namakaroo (semi-desert shrubland, summer rainfall) is probably the fourth most invaded biome. South Africa relies on biological control methods such as cactus moth (*cactoblastis cactorium*) and cochineal (*Dacylopius opuntiae*).

Degradation is a function of changes in population dynamics, explained by species diversity/richness and trophic structures. The result is decimation of grazing landscape evidenced by the rapid invasion of *O. humifusa* and other invasive plants. The creeping behaviour of *O. humifusa* results in reduction of grazing area and grazing value of rangelands. At the current rate of spread, sub-optimal off-take in ruminant livestock production in the Western Free State region due to loss of palatable species and herbaceous legumes is inevitable.

Challenges imposed by cacti invasion in South Africa

The problem of *O. humifusa* invasion and spread is magnified due to lack of planning and national control strategies for effective utilization of semi-arid rangelands invaded camps for optimal production of ruminant livestock that would suppress rate of spread and also rehabilitation of invaded environments. Intervention strategies such as chemical and biological control are either not readily available or not affordable for ordinary farmers. Biological control using the cochineal stands antagonistic to current efforts of developing dryland fodder banks of the exotic spineless varieties introduced from South America, as cochineal can devastate these plantations; creating a major scientific dilemma. Additionally, the fact that there is research deficiency on this critical component which is already putting a down turn on the ruminant livestock industry, rangeland productivity and consequently carbon fixing capacity, warrants urgent attention.

Understanding mechanisms on the destructive behaviour of invasive *Opuntia* to the meat and wool production in semi-arid areas, and assessment of strategies for managing and reducing further rangeland degradation on cactus-invaded landscapes is of paramount importance. Because rangeland degradation have long term impacts on the productivity of rangelands as carbon sinks, it is imperative that this aspect of changing patterns in carbon sinking be considered, especially in South Africa where there is massive invasion in already sensitive environments of the arid rangelands. One major way that degradation occurs is through the loss of soil organic carbon from a lack of carbon inputs and losses due to erosion from overexposure of bare ground (Li et al., 2008; Marasani et al., 2008 and Ritchie, 2012). Loss of soil organic carbon (SOC) not only reduces the nutrient base for plant production, it also can affect the proportion of rainfall that infiltrates and is held by soil (Maraseni et al., 2008). Soil organic carbon in grasslands and savannas represents one of the largest reservoirs of carbon on earth. Due to wide spread of unsustainable land use due to overgrazing, loss of native herbivores, excessive fires and the potential to reverse the impacts of these uses, SOC is one of the more important potential sinks of green house gases in the effort to mitigate climate change. Rangeland managers control the intensity and timing of grazing by controlling when and how many grazing animals are stocked on an area of rangeland. These decisions affects carbon levels through impacts on net primary productivity, fate of plant residues, plant community structure and redistribution of nutrients through feces and urine (Bremer, 2008).

Cactus plantation initiative

The Nama-karoo (semi-desert shrubland, summer rainfall) is probably the fourth most invaded biome. The arid and semi-arid regions (dry zones) in South Africa receives annual rainfall ranging from 201 mm to 600 mm, and covering 49% of the total land surface in South Africa. The Nama karoo biome is 24.48% of the total land surface and overally 12.1% of the land is arable in South Africa. The percentages indicate that quite a significant area in South Africa is vulnerable to climate change; prone to drought and decimation by invasive plants, affecting livestock outputs. Hence the need for intervention to broaden fodder banks. The spineless cactus varieties is being planted or cultivated as fruits and fodder in arid and semi-arid regions of South Africa. To date 1500 hectares has been

cultivated for fruits and 3000 hectares for fodder. Other intervention approaches should involve strategic utilization of invaded grazing camps.

Conclusion

Environmental awareness and stewardship and garnering policy support for restoration of degraded areas and also curbing rapid spread of *O.humifusa* is the ultimate goal.

References

Bremer, E. (2008). Potential of rangelands to sequester carbon in Alberta. Alberta Sustainable Resource development.

Henderson, L. (1999). The Southern African Plant Invaders Atlas (SAPIA) and its contribution to biological weed control. African Entomology Memoir No. 1: 159-163.

Kraaij, T. amd Milton, S.J. (2006). Vegetation changes (1995-2004) in semi-arid Karoo shrubland South Africa: Effects of rainfall wild herbivores and change in land use. Journal of Arid Environments 64 (174-192).

Li, C.L., Hao, X.Y., Zhao, M.L., Han, G.D. and Willms, W. D (2008). Influence of historic sheep grazing on vegetation and soil properties of a desert steppe in Mongolia. Agriculture Ecosystems and Environment, 128: 109-116.

Maraseni, T.N., Mathers, N.J., Horms, B., Cockfield, G., Apan, A. and Maroulis, J. (2008). Comparing and predicting soil carbon quantities under different land-use systems on the Red ferrosol soil of South east Queensland. Journal of soil and water conservation 63: 250-256.

Norval, J. (2010). Profit from soil improvement. Animal focus, Farming SA.

Ritchie, M. (2012). Plant compensation to grazing and soil carbon dynamics in tropical grassland. PeerJ, 2: e233

SAPIA (2012). Focus on cacti in South Africa. SAPIA News No. 25.

Van Wilgen, B. (2004). Scientific challenges in the field of invasive alien plant management. South African Journal of Science 100:19-20.