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Ecosystem drivers in rangelands; perceptions of drought and climate change

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Abstract: Water availability is the major driver of ecosystem function throughout the rangelands of most of Australia. The only exception is in the rangelands at high elevations where temperature also becomes important. Otherwise, ecosystem activity starts when water becomes available and ceases when the water supply has become exhausted. Our native plants and animals are adapted to these stop-go ecosystems and have evolved appropriate breeding systems. There have been no major mass extinctions such as have occurred in the northern hemisphere in recent geological times. The breeding systems of those native Australian grasses that have been studied, particularly those that have done well since the European invasion, indicate that they are well adapted to cope with future climate changes.

In a continent where rangeland ecosystems are well adapted to the episodic availability of water, the term 'drought' is inappropriate and should be discarded. Instead, the managers of all commercial rangeland animal production enterprises need to accept that their activities should be adjusted so that they can survive periodic shut-downs when water is not available. Then, when water becomes available again, ecosystem activities have re-commenced and pasture growth is well under way, grazing can re-commence. Managers, if they haven't already done so, must redesign their commercial activities to survive the dry periods. If most managers can accept these ecological realities, there are important social and economic implications for the whole of Australia. Part of this system re-design must take into account the general predictions for future Australian climates. That is, that weather extremes will become more frequent, there will be a general warming and there will be more frequent summer rainfall events in the southern parts of the continent and more winter-rain in the north.

Additional keywords: water, stop-go ecosystems, pasture plant breeding systems, redesign, rangeland enterprises.

Introduction

The first convicts and their jailers who arrived at Sydney Cove in 1788, came from an environment where the growth and reproduction of crops and pasture plants were governed precisely by temperature and day-length changes throughout the year and it was only occasionally that water availability interfered with the ordered seasonal sequences in plant and animal life cycles (Jones 1933). The frustrations of the early attempts to produce crops to feed the new colony were well described by Watkin Tench, a captain of the marines who came to Australia with the First Fleet in 1788. Soils to the west of present day Parramatta were reasonably suitable for grain-growing, but no matter what time of year crops were planted, most died from lack of rain. It was early recognized (Tench 2012) that the soils of the Hawkesbury flood plain were better for agriculture but the settlers were fearful of the enormous floods. Without warning and often with no apparent rain, floods up to 7 m deep would suddenly appear and sweep all before them.

Water the driver

The dramatic effects of heavy rainfall events in Australia are well illustrated in the prologue to 'How a continent created a nation' by Libby Robin (Robin 2007). The banded stilt is a small coastal bird in Western Australia and its area extends into South Australia. By the late 1920s, no one had recorded this species nesting but every few years, whole colonies would disappear, to re-appear some months later.

Finally, in the very wet winter of 1930, a large breeding colony was found at Lake Grace, a saline lake in inland WA. Huge flocks of the birds were breeding and feeding on the brine shrimps in the lake. Another immense breeding colony was then found on Lake Callabonna in inland South Australia in January, 1931. The driver of the breeding of this small bird is flooding rains a long distances from its regular habitat and temperature and day-length are unimportant. As Libby Robin says, we must learn to 'think like a banded stilt' if our primary industries are to flourish across the breadth of Australia.

Australian native forage plants (including grasses, legumes and other herbaceous species) are well adapted to irregular rainfall patterns and respond with growth (and often reproduction) whenever rainfall events occur within a wide band across the middle of Australia (Lodge and Whalley 1989; Mitchell *et al.*2015). The native herbaceous vegetation within this area has not undergone repeated mass extinctions from the Pleistocene glaciations as occurred in the rangelands in the northern hemisphere (Mithen 2003). This lack of mass extinctions and the following rapid revegetation, has had important implications for the breeding systems of our flora, their capacity to survive periodic lack of soil water and to respond rapidly when abundant soil water re-appears (Groves and Whalley 2002; Robin 2007; Whalley *et al.* 2013.

The effects of the relative atmospheric pressure changes across the Pacific Ocean (the El Nino, southern oscillation or ENSO) on Australian rainfall have now been joined by the Indian Ocean Dipole (IOD) improving seasonal weather predictions. The IOD refers to the differences in sea-surface temperatures between the western and eastern parts of the Indian Ocean. How these two influences interact is illustrated in Fig. 1 (Welsh 2017). Note the general north west to south east orientation of the rainfall patterns and that in 1993, with an El Nino event coupled with a negative IOD, the southern and western parts of Australia received well above average winter rainfall whereas in 2007, with a La Nina event and positive IOD, the winter rainfall in this region was very low, but above average in the northern parts.

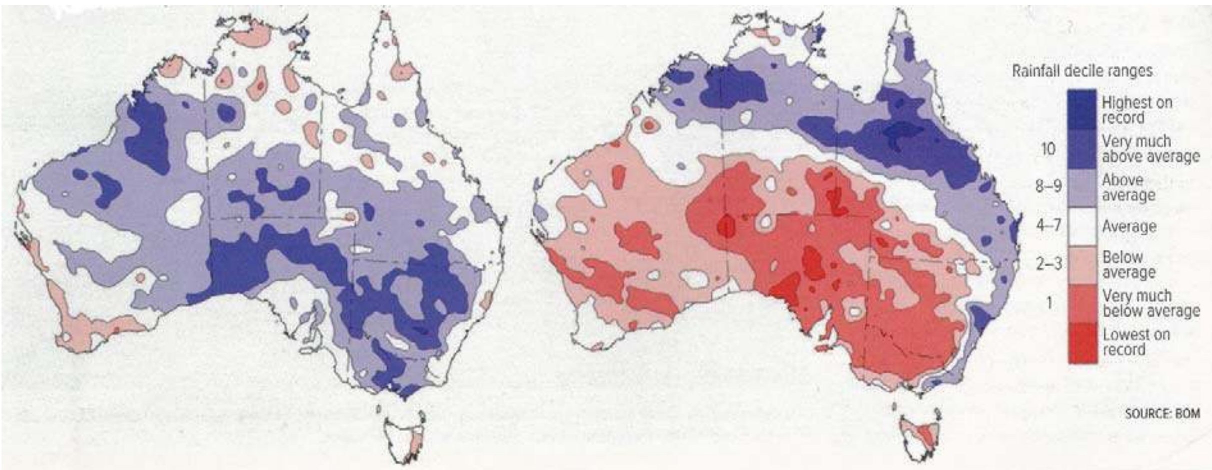

Fig. 1. Australian rainfall deciles for June–October during the anomalous years (left) 1993 (El Nino and negative IOD) and (right) 2007 (La Nina and positive IOD).

'Drought' is an emotive term and arouses visions of a bare countryside, starving stock and the bones of those that did not survive. These visions are used to great effect to encourage city dwellers (by far the majority of our population in Australia) to allow government assistance to those landholders who allow their landscapes to reach that stage. However, facing the reality of animal production in stop-go ecosystems means that livestock need to be moved off the land while substantial groundcover remains and this is feasible with modern transport. Feral grazing animals, whether native or otherwise, remain a problem. What is also well known, is that when it does rain again, sufficient rest from grazing and defoliation is essential for the resilient native forage species to recover.

The first person to use this principle was Sidney Kidman who, during the 1880s, conceived and implemented the idea of owning two chains of stations, stretching form the well-watered north down both sides of the Lake Eyre basin to within easy droving distance of Adelaide (Kidman 1983). However, he was limited in his ability to move stock away when water ceased to be available and he was not aware of the importance of rest following rain. The result was that some of his properties became severely degraded, as was Fowler's Gap Station, north of Broken Hill, when I first visited it in 1952.

The Purvis family at 'Woodgreen' station, north of Alice Springs are an example of modern day landholders, who have been able to design their livestock production to allow for the dry periods and to take full advantage of the capacity of native forage species to persist in our variable environment (Norton and Reid 2013, Rangelands, Woodgreen). They have used conservative stocking rates so that they do not have to completely de-stock when the forage plants stop growing and with the clever use of fire have improved their property over a period of 50 years. In a higher rainfall situation, Karen and Tim Wright have similarly improved their property 'Lana', west of Uralla so that they have not had to import feed for their livestock since the 1990s (Norton and Reid 2013, Native pastures, Lana). A third example is the producers of organic beef from grazing lands surrounding the Lake Eyre basin for OBE Organic, Australia. Their Business Planning and Improvement Manager, Dr Andrew Blinco gave a talk on their operations at a Rural Focus Symposium at the University of New Ebgland in 2016. I asked him if their beef suppliers move livestock around the basin, depending on where rain has fallen and which streams a flowing, so that pastures are allowed to recover following dry times and he said that they certainly did (OBE Organic 2016).

Conclusions

The calls for government assistance for landholders in 'drought declared' regions simply encourages landholders to retain livestock long after they should have been moved off the country. What is really needed is a re-design of the livestock enterprises throughout Australia, and certainly in the rangelands, so that the land is rested during dry times until the resilient native plant species have recovered following substantial rainfall and can provide forage for livestock production again. This would result in substantial regeneration of the country involved as described above in three successful applications of these principles.

References

Groves, R. H., and Whalley, R. D. B. (2002). Ecology of Australian grasslands and some major grass genera. *In*: 'Flora of Australia.' Vol. 43, pp. 157–82 (CSIRO Publishing: Melbourne, Vic.)

Jones, M. G. (1933). Grassland management and its influence on the sward. Pt. I. Factors influencing the growth of pasture species*. Empire Journal of Experimental Agriculture.* **1**, 43–57.

Kidman. (1983) *Australian Dictionary of Biography* **9**, 583–585.

Lodge, G. M., and Whalley, R. D. B. (1989). 'Native and natural pastures on the Northern Slopes and Tablelands of New South Wales - a review and annotated bibliography.' Technical Bulletin No. 35. (NSW Agriculture and Fisheries Sydney, NSW.)

Mitchell, M. L., Norman, H. C., and Whalley, R. D. B. (2015). Use of functional traits to identify Australian forage grasses, legumes and shrubs for domestication and use in pastoral areas under a changing climate. *Crop and Pasture Science,* **66**, 71–89.

Mithen, S. (2003). 'After the Ice: A global human history 20,000–5,000 BC.' (Weidenfield and Nicholson: London, UK.)

Norton, D. A., and Reid, N. R. (2013). Rangelands, ‘Woodgreen’ and Native pastures, ‘Lana’. *In*: ‘Nature and farming: sustaining native biodiversity in agricultural landscapes’. pp. 167–171 and 172–177. (CSIRO Publishing: Collingwood, Vic.)

OBE Organic. (2016). Available at: http://www.obeorganic.com/#sm.0000svd8fpbbaedlwll1dwyubiv0n (accessed 10 August 2017).

Robin, L. (2007). ‘How a continent created a nation.’ (University of New South Wales Press: Sydney, NSW.)

Tench, W. (2012). ‘Watkin Tench, 1788.’ (The Text Publishing Co: Melbourne, Vic.)

Welsh, J. (2017). Indian Ocean Dipole: the new one to watch. GRDC Groundcover, Issue 29, 6.

Whalley, R. D. B., Chivers, I. H., and Waters, C. M. (2013). Revegetation with Australian native grasses - a reassessment of the importance of using local provenances. *The Rangeland Journal* **35**, 155–166.

Caption for **Fig. 1**.

Fig. 1. Australian rainfall deciles for June–October during the anomalous years (left) 1993 (El Nino and negative IOD) and (right) 2007 (La Nina and positive IOD).