

PROCEEDINGS OF THE AUSTRALIAN RANGELAND SOCIETY
19th BIENNIAL CONFERENCE
Official publication of The Australian Rangeland Society

Copyright and Photocopying

© The Australian Rangeland Society 2017. All rights reserved.

For non-personal use, no part of this item may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior permission of the Australian Rangeland Society and of the author (or the organisation they work or have worked for). Permission of the Australian Rangeland Society for photocopying of articles for non-personal use may be obtained from the Secretary who can be contacted at the email address, secretary@austrangesoc.com.au

For personal use, temporary copies necessary to browse this site on screen may be made and a single copy of an article may be downloaded or printed for research or personal use, but no changes are to be made to any of the material. This copyright notice is not to be removed from the front of the article.

All efforts have been made by the Australian Rangeland Society to contact the authors. If you believe your copyright has been breached please notify us immediately and we will remove the offending material from our website.

Form of Reference

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

Author family name, initials (year). Title. In: Proceedings of the 19th 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).

Disclaimer

The Australian Rangeland Society and Editors cannot be held responsible for errors or any consequences arising from the use of information obtained in this article or in the Proceedings of the Australian Rangeland Society Biennial Conferences. The views and opinions expressed do not necessarily reflect those of the Australian Rangeland Society and Editors, neither does the publication of advertisements constitute any endorsement by the Australian Rangeland Society and Editors of the products.



The Australian Rangeland Society

Ecosystem drivers in rangelands; perceptions of drought and climate change

R.D.B. Whalley

Botany, University of New England, Armidale NSW 2351.

Email: rwhalley@une.edu.au

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 recommence. 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

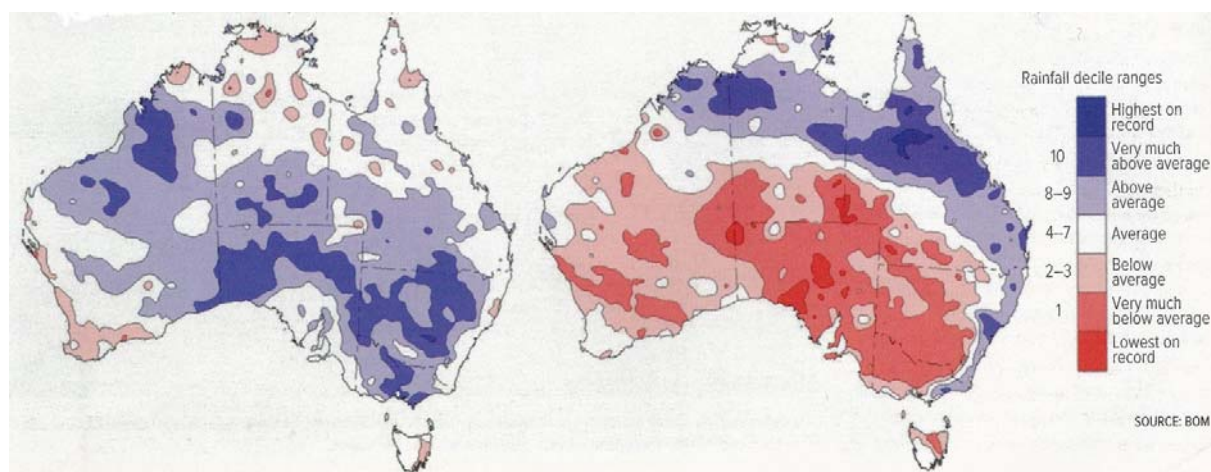
The dramatic effects of heavy rainfall events in Australia are well illustrated in the prologue to 'How a continent created a nation' by Libby Robin (Robin 2007). The banded stilt is a small coastal bird in Western Australia and its area extends into South Australia. By the late 1920s, no one had recorded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

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

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

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

67



70

71

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).

72 ‘Drought’ is an emotive term and arouses visions of a bare countryside, starving stock and the
 73 bones of those that did not survive. These visions are used to great effect to encourage city dwellers (by
 74 far the majority of our population in Australia) to allow government assistance to those landholders who
 75 allow their landscapes to reach that stage. However, facing the reality of animal production in stop-go
 76 ecosystems means that livestock need to be moved off the land while substantial groundcover remains
 77 and this is feasible with modern transport. Feral grazing animals, whether native or otherwise, remain a

78 problem. What is also well known, is that when it does rain again, sufficient rest from grazing and
79 defoliation is essential for the resilient native forage species to recover.

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

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

100 **Conclusions**

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

108 **References**

- 109 Groves, R. H., and Whalley, R. D. B. (2002). Ecology of Australian grasslands and some major grass
110 genera. *In: 'Flora of Australia.'* Vol. 43, pp. 157–82 (CSIRO Publishing: Melbourne, Vic.)
- 111 Jones, M. G. (1933). Grassland management and its influence on the sward. Pt. I. Factors influencing the
112 growth of pasture species. *Empire Journal of Experimental Agriculture*. **1**, 43–57.
- 113 Kidman. (1983) *Australian Dictionary of Biography* **9**, 583–585.
- 114 Lodge, G. M., and Whalley, R. D. B. (1989). 'Native and natural pastures on the Northern Slopes and
115 Tablelands of New South Wales - a review and annotated bibliography.' Technical Bulletin No. 35.
116 (NSW Agriculture and Fisheries Sydney, NSW.)
- 117 Mitchell, M. L., Norman, H. C., and Whalley, R. D. B. (2015). Use of functional traits to identify Australian
118 forage grasses, legumes and shrubs for domestication and use in pastoral areas under a changing
119 climate. *Crop and Pasture Science*, **66**, 71–89.
- 120 Mithen, S. (2003). 'After the Ice: A global human history 20,000–5,000 BC.' (Weidenfield and Nicholson:
121 London, UK.)

- 122 Norton, D. A., and Reid, N. R. (2013). Rangelands, 'Woodgreen' and Native pastures, 'Lana'. *In: Nature*
123 *and farming: sustaining native biodiversity in agricultural landscapes*. pp. 167–171 and 172–177.
124 (CSIRO Publishing: Collingwood, Vic.)
- 125 OBE Organic. (2016). Available at: <http://www.obeorganic.com/#sm.0000svd8fpbbaedlwl1dwyubiv0n>
126 (accessed 10 August 2017).
- 127 Robin, L. (2007). 'How a continent created a nation.' (University of New South Wales Press: Sydney,
128 NSW.)
- 129 Tench, W. (2012). 'Watkin Tench, 1788.' (The Text Publishing Co: Melbourne, Vic.)
- 130 Welsh, J. (2017). Indian Ocean Dipole: the new one to watch. GRDC Groundcover, Issue 29, 6.
- 131 Whalley, R. D. B., Chivers, I. H., and Waters, C. M. (2013). Revegetation with Australian native grasses -
132 a reassessment of the importance of using local provenances. *The Rangeland Journal* **35**, 155–
133 166.

134 **Caption for Fig. 1.**

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

137