**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:
Anderson, L., van Klinken, R. D., and Shepherd, D. (2008). Aerially surveying Mesquite *(Prosopis* spp.) in the Pilbara. *In*: 'A Climate of Change in the Rangelands. Proceedings of the 15$^{th}$ Australian Rangeland Society Biennial Conference'. (Ed. D. Orr) 4 pages. (Australian Rangeland Society: Australia).

## PERENNIAL SPECIES RICHNESS AND DISTANCE FROM WATER IN *CASUARINA PAUPER* (BELAH) WOODLAND.

*Martin E Westbrooke*

University of Ballarat, P.O. Box 663, Ballarat, VIC 3353.

### BACKGROUND

*Casuarina pauper* (Belah) woodland occurs from southern Queensland through western New South Wales to inland Western Australia on a variety of soils. Data from stands in Mallee Cliffs National Park and the Scotia country with a history of low grazing pressure (Morcom & Westbrooke 1990; Westbrooke *et al.* 1998), suggest the community may be characterised by a far richer understorey than is currently seen in most sites. Because of its low fodder value *C. pauper* has been cleared by ringbarking or chaining over large areas to promote pasture growth (Cunningham *et al.* 1981). Much of the *C. pauper* woodland in southern NSW and the Victorian Mallee has been cleared for cropping.

### METHODS

Two hundred and twenty quadrats within *C pauper* woodland on pastoral leases and conservation reserves in NSW, SA and Victoria were assessed to determine community structure and floristics. To enable valid comparisons between quadrats only perennial species were included in analyses. Each 50m x 50m (0.25ha) quadrat was selected as a uniform stand of vegetation, obvious ecotones being avoided. Perennial species occurring at each site were recorded along with evidence of grazing by sheep and rabbits, length of grazing history, time since reservation and distance from water which were assigned ordinal classes or values. The distance to the nearest permanent or semi-permanent water source for stock was determined from on-ground observation, reference to maps and analysis of a Landsat TM image obtained following very high rainfall in 1992-93. Following this rainfall event all ground tanks, whether or not they were maintained, were holding water. Stepwise multi-variate regression was used to give an understanding of the site variables most important in determining species richness.

### RESULTS

Seventy five trees, shrubs, climbers and woody parasites were recorded from the 220 study sites. Correlation coefficients for the relationship between perennial species richness and the six habitat variables are given in Table 1.

Table 1. Correlation coefficients for the relationship between species richness and the six habitat variables for all quadrats, for pastoral quadrats and for conservation quadrats. *, P = <0.05; **, P = <0.01

| Variable | All Quadrats | Pastoral quadrats | Conservation quadrats |
|---|---|---|---|
| **Distance from water (DIS)** | 0.7378 ** | 0.7774 ** | 0.6691 ** |
| **Grazing level (ALLGRAZ)** | 0.6318 ** | 0.6007 ** | 0.4871 ** |
| **Stocking rate (SHEEP)** | 0.5792 ** | 0.6476 ** | not relevant |
| **Rabbit abundance (RAB)** | 0.6928 ** | 0.6177 ** | 0.6903 ** |
| **Period of grazing (TIME)** | 0.3233 ** | 0.1985 * | 0.3864 * |
| **Time since reservation (RES)** | 0.2892 ** | not relevant | 0.4182 ** |

The analysis for all sites yielded a regression equation with three steps accounting for 75% of the variance in species richness.

$$\mathbf{SR = 19.1 + 3.3 \times DIS - 2.8 \times RAB - 7.7 \times RES\ (r^2 = 75.3,\ p = <0.001)}$$

The equation infers that species richness will increase with distance from water and time since reservation but decrease with increased rabbit grazing. Grouping of sites according to their distance from water clearly shows this relationship (Table 2). Comparison of the species frequency of individual species at sites close to (n=69) and distant from water (n=53) indicates those species that decline under the impact of grazing (Table 3).

Table 2. Mean perennial species richness of quadrats in relation to distance from water.

| Category | Distance from water (km) | Species richness |
|---|---|---|
| 1 (n=53) | >2 | 18.8 (10-22) |
| 2 (n=93) | 1-2 | 11.4 (5-18) |
| 3 (n=69) | <1 | 6.5 (1-16) |

Table 3. Perennial species frequency for quadrats distant (>2km) and close (<1km) to water

| Species | % >2km | % <1km | Species | % >2km | % <1km |
|---|---|---|---|---|---|
| *Acacia burkittii* | 15 | 5 | *Maireana pentatropis* | 53 | 12 |
| *Acacia colletioides* | 62 | 20 | *Maireana pyramidata* | 15 | 18 |
| *Acacia osswaldii* | 38 | 14 | *Maireana radiata* | 2 | 6 |
| *Acacia sclerophylla* | 2 | 0 | *Maireana sedifolia* | 47 | 5 |
| *Atriplex stipitata* | 42 | 11 | *Maireana trichoptera* | 17 | 0 |
| *Atriplex vesicaria* | 26 | 15 | *Maireana triptera* | 11 | 2 |
| *Beyeria opaca* | 6 | 0 | *Maireana turbinata* | 8 | 0 |
| *Chenopodium curvispicatum* | 70 | 15 | *Nitraria billardierii* | 13 | 9 |
| *Chenopodium desertorum* | 66 | 11 | *Olearia muelleri* | 45 | 5 |
| *Chenopodium nitrariaceum* | 2 | 0 | *Olearia pimeleoides* | 64 | 15 |
| *Cratystylis conocephala* | 2 | 0 | *Pimelea microcephala* | 17 | 5 |
| *Dodonaea viscosa ssp. ang.* | 64 | 15 | *Pittosporum phylliraeoides* | 17 | 3 |
| *Einadia nutans* | 21 | 5 | *Rhagodia spinescens* | 6 | 5 |
| *Enchylaena tomentosa* | 83 | 56 | *Rhagodia ulicina* | 2 | 0 |
| *Eremophila deserti* | 13 | 3 | *Santalum acuminatum* | 23 | 5 |
| *Eremophila glabra* | 49 | 8 | *Scaevola spinescens* | 21 | 3 |
| *Eremophila oppositifolia* | 21 | 3 | *Sclerolaena diacantha* | 30 | 10 |
| *Eremophila scoparia* | 13 | 2 | *Sclerolaena divaricata* | 6 | 0 |
| *Eremophila sturtii* | 47 | 18 | *Sclerolaena obliquicuspis* | 49 | 47 |
| *Eriochiton sclerolaenoides* | 8 | 2 | *Sclerolaena patenticuspis* | 49 | 22 |
| *Exocarpos aphyllus* | 64 | 18 | *Senna artemisioides ssp. fil.* | 47 | 11 |
| *Grevillea huegelii* | 25 | 5 | *Senna artemisioides ssp. pet.* | 43 | 11 |
| *Leichardtia australis* | 21 | 3 | *Senna artemisioides ssp. x cor.* | 47 | 11 |
| *Lycium australe* | 17 | 5 | *Templetonia egena* | 47 | 5 |
| *Maireana appressa* | 4 | 0 | *Westringia rigida* | 9 | 0 |
| *Maireana brevifolia* | 6 | 12 | *Zygophyllum aurantiacum* | 23 | 2 |
| *Maireana georgei* | 19 | 3 | | | |

## DISCUSSION

The idea that sites a long distance from water may be important refuges for plant species in the rangelands is not new. Ratcliffe (1938) made3 the same observation during a study of the impact of rabbit grazing in South Australia. In this study species richness of quadrats was related to a number of factors relating to past grazing pressure. The visible manifestations of stock grazing are the result of up to 150 years of impact, and current stocking rates may therefore be a poor indicator of grazing damage. Total grazing pressure including impact of sheep, rabbits, macropods and goats is difficult to determine for the present and is at best speculative for the past. Stocking rates, even where available, are at a paddock level and the grazing pressure may vary considerably across the paddock. Available water has a strong influence on grazing pressure. Distance from the nearest permanent or semi-permanent water proved to be the best surrogate measure of long-term grazing pressure. The high correlation between species richness and distance from water found in this study is in contrast to that found in a study of eight sites in arid Australia (Landsberg *et al.* 1996). Those assessments were however based on only six points ranging between 0.5 and 9km from water. Freidel (1997) found fewer species at heavily grazed sites but no consistent trend of increasing species richness with distance from water but Freidel's study differed from the present one in that it was based on herbaceous species recorded from small quadrats. The herbaceous layer shows high seasonal fluctuations and these may obscure the effects of grazing (Austin *et al.* 1981).

## REFERENCES

Austin, M.P., Williams, O.B. and Belbin, L. (1981). Grassland dynamics under sheep grazing in an Australian Mediterranean type climate. *Vegetatio* **47**, 201-211.

Cunningham, G.M., Mulham, W.E., Milthorpe, P.L. and Leigh, J H. (1981). 'Plants of Western New South Wales'. (NSW Government Printer: Sydney.)

Freidel, M.H. (1997). Discontinuous change in arid woodland and grassland vegetation along gradients of cattle grazing in central Australia. *Journal of Arid Environments* **37**,145-164.

Landsberg, J., James, C.D., Morton, S.R., Hobbs, T., Stol, J., Drew, A. and Tongway, D. (1996). The relationship between the provision of artificial water sources in arid and semi-arid Australia, and changes in biodiversity. Interim report to the Biodiversity Unit, Department of Environment, Sport and Territories, Canberra.

Morcom, L. and Westbrooke, M.E. (1990). The vegetation of Mallee Cliffs National Park. *Cunninghamia* **2(2)**, 147-165.

Ratcliffe, F.N. (1938). 'Flying Fox and Drifting Sand.' (Chatto and Windus: London.)

Westbrooke, M.E., Miller, J.D. and Kerr, M.K.C. (1998). The vegetation of the Scotia 1:100 000 map sheet, western New South Wales *Cunninghamia* **5(3)**, 665-684.