Proc. Sixth Ann. Conf. Grassld. Soc. NSW, pp 8- 12.

PERENNIALS IN THE PASTORAL ZONE:

THE CONTRIBUTION OF PERENNIALS TO STABILITY AND PRODUCTIVITY OF RANGELANDS IN THE PASTORAL ZONE

Tony Grice

Rangelands Research Officer
NSW Agriculture & Fisheries, COBAR NSW 2835

Abstract. *The rangelands support a wide range of perennial plants that contribute to or detract from stability and productivity. The low production per unit area and extreme climatic fluctuations demand that management focus on maintenance of desirable perennials. There are few economic options for recovering perennials once they are lost or seriously depleted. Timing is critical in the application of the options that are available.*

A perennial plant is one that persists for longer than twelve months. During its life it may go through periods when it is metabolically inactive and the above ground parts may disappear completely. Regrowth will occur as environmental conditions become suitable. This definition covers a wide range of growth forms and growth patterns. All trees and shrubs are included as are many herbaceous or non- woody plants. Perennials are important in practically all natural vegetation types. They provide physical structure, much primary productivity, a diversity of habitats and resources for other organisms. They stabilise the soil and greatly influence the cycling of water and nutrients. They may also play these roles in pastoral systems as well as contribute directly to animal production.

Rangelands consist of land occupied principally by native vegetation, whose pastures are essentially unimproved by fertilizers, irrigation or the sowing of more productive species. Pastoralism is extensive with relatively little managerial input. Much of Australia's rangelands are arid or semi-arid, and rainfall is erratic. Rangelands cover about 70% of Australia and support a significant proportion of the country's cattle and sheep (Beale, Johnston and Heussler, 1990). Approximately 50% of N.S.W. can be regarded as rangelands and they support about 19.3 million sheep or 37% of the state's flock (Grice *et al.*, 1989).

Apart from anything else, given the area of land involved, it is most appropriate that this Conference, in dealing with the theme "Perennials - the Key to Pasture Stability", consider the role and management of perennial plants in our rangelands.

This paper will:

- identify the main types of perennial plants that occur in the pastoral rangelands;
- describe their major roles;
- outline their current status;
- highlight their management requirements.

THE ROLES OF PERENNIALS IN THE RANGELANDS

Typically, the rangelands support a large number of plant species, both perennial and annual. They vary in their usefulness and any one may contribute to productivity, to landscape stability or to both. A particular species may have both benefits and deleterious effects. To help understand this complexity it is appropriate to group rangeland perennials into five categories:

GRASSES

Perennial grasses contribute to the pastures of all our main rangeland types. They may at times make up a large part of the herbaceous layer.

The perennial grasses contribute substantially to the forage supply. In general, livestock prefer palatable and more nutritious annuals (Muir, 1990). They take a higher proportion of perennial grasses when the palatable annuals are unavailable.

Where perennial grasses have been ungrazed for some time a large amount of material of low palatability and nutritive value may accumulate. This is especially true for the longer-lived grasses such as *Eragrostis eriopoda* (woollybutt), *Astrebla* spp. (Mitchell grass) and *Triodia* spp. (spinifex). This material can be used as fuel for shrub-controlling fires. Brief periods of heavy grazing could lead to greater productivity from the grasses by promoting new growth.

Grasses are important in stabilising the soil surface. Where there is a good cover of perennial grasses, infiltration of rainfall into the soil is likely to be higher. Pressland and Lehane (1982) recommend that in mulga lands, perennial grass basal cover greater than 2% will significantly reduce runoff, soil erosion and loss of soil nutrients.

The perennial grasses are important competitors of shrub seedlings. A vigorous stand of perennial grasses will reduce the chances of survival of shrub seedlings. They are also the major source of fuel for fires that will kill established shrubs of certain species and small shrubs of any species (Hodgkinson *et al.*, 1984). There is widespread acknowledgement that perennial grasses have declined in many areas (Harrington *et al.*, 1984). This helps explain the proliferation of endemic shrubs that has been widely reported.

Competition between grasses and annuals is important. Where there is a high biomass of perennial grasses, the density of and production from annuals is likely to be reduced (Weston and Moir, 1969). Pasture management can thus involve a trade-off between high production in good seasons and longer-term stability.

In other areas, there has been an increase in less desirable grasses at the expense of the original dominants of the pasture layer. This phenomenon has been reported in the Mitchell grasslands of Queensland where *Aristida* spp. have increased in areas where *Astrebla* spp. have been weakened (Filet, 1990). Certain species of perennial grass contribute to vegetable contamination of wool. The most important ones are *Stipa* spp. and *Aristida* spp. (Sloane, Cook and King Pty Ltd, 1988).

PERENNIAL FORBS

Basically, a forb is a herbaceous plant that is not a grass. The group includes a diversity of species examples being *Boerhavia diffusa* (tar vine) and *Ptilotus* spp. (foxtails). Graetz and Wilson (1980) found that they may at times contribute to the diets of both cattle and sheep but annuals, perennial grasses and chenopods were often preferred. The importance of the perennial forbs to animal production and pasture stability varies greatly between range types.

CHENOPODS (saltbushes, bluebushes etc)

Perennial chenopods are important components of many rangeland types. Large areas of western N.S.W., especially on the Riverine Plains and in the Barrier Ranges, are dominated by plants such as *Atriplex nummularia* (old man saltbush), *A. vesicaria* (bladder saltbush) and *Maireana pyramidata* (black bluebush) (Oxley, 1979). Most woodland communities also support pastorally significant chenopods like *Sclerolaena* spp. (copperburrs), *Rhagodia* spp. and *Enchylaena tomentosa* (berry saltbushes).

These plants contribute significantly to livestock diets. While perennial *Atriplex* spp. and *Maireana* spp. are not eaten in large quantities when palatable annuals or grasses are available, they do provide a maintenance forage during dry periods (Leigh and Mulham, 1966; Leigh, 1971; Wilson, 1979; Graetz and Wilson, 1980).

The larger perennial chenopods are important in minimising wind erosion by reducing wind velocities at ground level (Marshall, 1970). To be effective a minimum density of shrubs is required. Some of the *Sclerolaena* spp. (poverty bushes) are unpalatable by virtue of the long spines that occur on their fruits. In some areas these species have replaced more desirable *Atriplex* spp. (Moore, 1953).

SHRUBS OTHER THAN CHENOPODS

The so-called woody weeds already occupy large areas in western New South Wales. Indications are that some 20 million hectares are either already infested or are under threat. The main species involved are *Dodonaea attenuata* (narrow leaf hopbush), *Eremophila sturtii* (turpentine) and *E. mitchellii* (budda). Other significant species include *Cassia nemophila* (punty bush), *Callitris glaucophylla* (white pine) and *Acacia aneura* (mulga) (Sloane, Cook and King Pty Ltd, 1988). On heavy soils of river floodplains *Eucalyptus largiflorens* (black box) and *E. microtheca* (coolabah) occasionally reach densities high enough to suppress pasture growth. The introduced *Prosopis* spp. (Mesquite) also has the potential to become a major weed in NSW as it has done in parts of Queensland.

The proliferation of endemic shrubs has been a crucial change over large areas of Australia's semi-arid woodlands. When areas such as the Cobar district were first settled for pastoralism, they were relatively open. Trees were present but not dense. Shrubs occurred as scattered individuals or perhaps in small relatively dense patches throughout an otherwise open grassy woodland (Harrington, 1984).

European settlement brought several important changes. Large numbers of domestic stock were introduced. Rabbits invaded. The large kangaroos increased as reliable artificial waters were established. This lead to a decline in the grasses that formerly

dominated the ground layer. A less dense and less vigorous perennial grass component meant reduced competition for shrub seedlings and a reduced probability of fire that had the potential to kill particularly small shrubs but also established plants of species such as hopbush, mulga and white pine.

Some rangeland shrubs, such as *A. aneura*, are relatively palatable though they usually only provide a maintenance ration for livestock. Others, especially *E. sturtii* and *E. mitchellii* are virtually inedible.

Shrubs at high densities have a number of effects. They compete with herbaceous plants for water, nutrients and light. This leads to a reduced biomass of the more productive pasture plants. Ground cover is reduced and so the soil is at greater risk of erosion particularly from overland flow of water. Livestock management is also made difficult by high shrub densities. Mustering of stock is less efficient and this affects shearing and disease control. Shrubs can also provide shelter for predators such as feral pigs.

TREES

Trees have both positive and negative attributes as regards productivity and stability of rangelands pastures.

Herbage yield and basal cover increases with decreasing tree density (Pressland, 1976). Trees compete with herbage plants for soil water and nutrients. Mechanical clearing of trees can reduce runoff and increase soil moisture levels but these effects may be temporary, as the soil surface irregularities resulting from clearing, are reduced (Johns, 1981; 1983).

Trees and shrubs can influence the redistribution of water. For example, *Eucalyptus populnea* (poplar box) woodlands contain "thickets" of trees and shrubs separated by "inter-thicket" areas of low tree and shrub density. There is significant redistribution of water from inter-thickets to thickets. This redistribution can be an important factor affecting pasture productivity (Johns, 1981). Patchiness can contribute to landscape stability and where critical patchiness breaks down there can be further soil degradation and a loss of productivity (Tongway and Ludwig, 1990).

A number of species in western New South Wales are useful browse species. Examples are *A. aneura*, *Geijera parviflora* (wilga), *Brachychiton populneum* (kurrajong) and *Heterodendrum oleifolium* (rosewood). In general, they would contribute more to animal intake when conditions are dry. In south west Queensland, *A. aneura* is still lopped or pushed as a drought fodder.

Curtailment of recruitment due to grazing has been reported in several common tree species, including *A. aneura* (Preece, 1971), *A. sowdenii* (western myall) (Correll and Lange, 1966), *A. burkittii* (Crisp and Lange, 1976) and *H. oleifolium* (Wisniewski and Parsons, 1986).

MANAGEMENT REQUIREMENTS

I will highlight the management requirements of perennial plants in the rangelands by discussing the perennial grasses and "woody weeds" of the semi-arid woodlands that grow on soft-red soils between Cobar and the Darling River.

This area consists largely of sandy dunes and calcareous inter- dunal depressions. Dunes are dominated and stabilised by the long-lived perennial grass *Eragrostis eriopoda* (woollybutt) but also support a variety of other grasses. Long-lived perennial grasses are sparse in the interdunal depressions, where the most common perennial grasses are *Stipa* spp. Narrow leaf hopbush is a common woody weed, and often forms dense stands that permit little pasture growth.

These pastures change considerably when they are totally rested from grazing (Grice, 1990). The main changes apparent are:

- Pasture biomass increases;
- Individual tussocks of palatable perennial grasses grow much larger and live longer (Grice, 1989a; Grice and Barchia, in prep.). They also seed more prolifically (Grice, 1988; Hodgkinson and Terpstra, 1989);
- Short-lived, less desirable perennial grasses, such as *Stipa* spp. and *Aristida* spp. may be reduced in abundance (Grice, 1989b);
- The response of cool-season annuals may be reduced;
- Perennial forbs and sub-shrubs increase.

The perennial grasses play vital roles in maintaining the stability and productivity of the rangelands especially in the semi-arid woodlands. Responses observed when grazing pressure is reduced suggest that grazing management can be crucial in promoting perennial grasses.

Management practices that favour perennial grasses include generally light stocking rates, strategically timed resting of pastures, early destocking when drought is impending and reduction of the grazing pressure exerted by rabbits, kangaroos and feral goats.

Light stocking will reduce woody weed establishment by maximising competition between grasses and shrub seedlings and increasing the probability of an effective use of fire in shrub control. Strategically timed resting may help increase seed output of the more palatable perennial grasses and further improve the likelihood of effective fires. Fires may be possible once in ten years and these infrequent opportunities must be taken. The timing of fires is important so that loss of forage is minimised and greatest use is made of available fuel. Shrub germination and establishment events should be carefully identified and monitored. It

is desirable to rest a pasture after it has been burnt to allow recovery of grasses and other herbage.

Early reduction of stock numbers with impending drought will reduce pressure on perennials. Less heavily grazed grasses are better able to respond to rain when it comes. This will enhance forage production from the perennials. Finally, kangaroos, goats and rabbits have a major impact upon rangeland pastures and effective grazing management will often require control of these species.

The rangelands are characterised by low production per unit area and extreme climatic fluctuations. These features demand that particular attention be paid to the management of perennial pasture components. Once a desirable perennial has been lost or depleted natural recovery is often very slow. There are few options for management to economically intervene to promote recovery. The same holds for situations in which an undesirable perennial plant has proliferated. Management should focus on maintenance and prevention. This may involve sacrificing some short- term production for the sake of long-term stability.

REFERENCES

Beale, I.F., Johnston, B.G. and Heussler, J.H.S. (1990). A review of research for the Australian rangelands sheep industry. Australian Wool Corporation, Melbourne.

Correll, R.L. and Lange, R.T. (1966). Some aspects of the dynamics of vegetation in the Port Augusta - Iron Knob area, South Australia. *Transactions of the Royal Society of Australia*, **90**:41- 44.

Crisp, M.D. and Lange, R.T. (1976). Age structure, distribution and survival under grazing of the arid-zone shrub *Acacia burkittii*. *Oikos* , **27**:86-92.

Filet, P.G. (1990). The ecology and control of whitespear grass (*Aristida leptopoda*) and feathertop (*A. latifolia*) in mitchell grass in south west Queensland. Report to the Australian Wool Corporation, Queensland Dept Primary Industries.

Graetz, R.D., and Wilson, A.D. (1980). Comparison of the diets of sheep and cattle grazing a semi- arid chenopod shrubland. *Australian Rangeland Journal*, **2**:67- 75.

Grice, A.C. (1988). Grass dynamics in the semi-arid woodlands of western N.S.W. *Working Papers of the 5th Australian Rangeland Conference* , Longreach.

Grice, A.C. (1989a). The effect of grazing by sheep and kangaroos upon the survival of grasses in a semi-arid woodland of south eastern Australia. *Proceedings of the XVIth International Grassland Congress*, Nice, France, 1077-1078.

Grice, A.C. (1989b). Ecology of Stipa and Aristida in native pastures of western New South Wales. "Weed, invertebrate and disease pests of Australian sheep pastures", *AWC Research Review Conference*, Ballarat.

Grice, A.C., Curran, G., Date, W., Murphy, J., Muir, S., Roshier, D., and McCloy K. (1989). Agriculture in the rangelands of western New South Wales. N.S.W. Agriculture & Fisheries.

Grice, A.C. (1990). Pasture changes following exclosure in eastern semi-arid woodlands. *Working Papers of the 6th Australian Rangeland Conference*, Carnarvon.

Grice, A.C. and Barchia, I. (in prep.) Grazing-induced mortality of endemic grasses in the semi-arid woodlands of western New South Wales.

Harrington, G.N., Friedel, M.H., Hodgkinson, K.C. and Noble, J.C. (1984). Vegetation Ecology and Management. In "Management of Australia's Rangelands",Edited by G.N.Harrington, A.D.Wilson, and M.D.Young, *CSIRO*, Melbourne.

Hodgkinson, K.C., Harrington, G.N., Griffin, G.F., Noble J.C. and Young, M.D. (1984). Management of Vegetation with Fire. In "Management of Australia's Rangelands", Edited by G.N.Harrington, A.D.Wilson and M.D.Young, *CSIRO* , Melbourne.

Hodgkinson, K.C. and Terpstra, J.W. (1989). Grazing pressure by sheep; consequences for pasture stability in an Australian mulga woodland. *Proceedings of the XVIth. International Grassland Congress*, Nice, France, 1069-1070.

Johns, G.G. (1981). Hydrological processes and herbage production in shrub invaded poplar box (*Eucalyptus populnea*) woodlands. *Australian Rangeland Journal*, **3**:45-55.

Johns, G.G. (1983). Runoff and soil loss in a semi-arid shrub invaded poplar box (*Eucalyptus populnea*) woodland. *Australian Rangeland Journal*, **5**:3-12.

Leigh, J.H. (1971). Diet selection and the effects of grazing on the composition and structure of arid and semi-arid vegetation. In "Studies of the Australian Arid Zone II Animal Production", Edited by A.D. Wilson, *CSIRO*, Melbourne.

Leigh, J.H. and Mulham, W.E. (1966). Selection of diet by sheep grazing semi-arid pastures of the Riverine Plain 1. A bladder saltbush (*Atriplex vesicaria* Hew. ex Benth.) - cotton bush (*Kochia aphylla* R. Br.) community. *Australian Journal of Experimental Agriculture and Animal Husbandry*, **6**:460- 467.

Marshall, J.K. (1970). Assessing the protective role of shrub dominated vegetation against soil erosion by wind. *Proceedings of the 11th International Grassland Congress*,Surfers Paradise, Australia.

Moore, C.W.E. (1953). The vegetation of the south-eastern Riverina, New South Wales, I. The climax communities. *Australian Journal of Botany*, **1**:485-547.

Muir, S.J. (1990). The nutritive value of selected forage species in western New South Wales. *Final Report to the Australian Wool Corporation.*

Oxley, R.E. (1979). The perennial chenopod lands of Australia. In "Studies of the Australian Arid Zone IV Chenopod Shrublands", Edited by R.D. Graetz and K.M.W. Howes, *CSIRO*, Perth.

Preece P.B. (1971). Contributions to the biology of mulga II. Germination. *Australian Journal of Botany*, **19**:39-49.

Pressland, A.J. (1976). Possible effects of removal of mulga on rangeland stability in south-western Queensland. *Australian Rangeland Journal*, **1**:24-30.

Pressland, A.J. and Lehane, K.J. (1982). Runoff and the ameliorating effect of plant cover in the mulga communities of south western Queensland. *Australian Rangeland Journal*, **4**:26-20.

Sloane, Cook and King Pty Ltd (1988). The economic impact of pasture weeds, pests, and diseases on the Australian wool industry. *Australian Wool Corporation*, Melbourne.

Tongway, D.J. and Ludwig, J.A. (1990). Vegetation and soil patterning in semi-arid mulga lands of Eastern Australia. *Australian Journal of Ecology*, **15**:23-34.

Weston, E.J. and Moir, K.W. (1969). Grazing preferences of sheep and nutritive value of plant components in a Mitchell grass association in north-western Queensland. *Queensland Journal of Agricultural and Animal Sciences*, **26**:639-650.

Wilson A.D. (1979). Management of the natural pastures of south-western New South Wales. *Australian Rangeland Journal*, **1**:351-362.

Wisniewski, J.E. and Parsons, R.F. (1986). Regeneration of *Heterodendrum* in arid south-eastern Australia. *Proceedings of the Royal Society of Victoria*, **98**:87-95.