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POTENTIAL PROBLEMS WITH TREE AND SHRUB REGENERATION IN CENTRAL AUSTRALIA

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Abstract

Several pasture types in central Australia are undergoing important changes. Trees and shrubs are increasing on some alluvial soils. *Acacia*, *Cassia*, *Eremophila* and *Eucalyptus* species form locally dense stands. *Acacia aneura* (mulga) is increasing on red earth plains where run-on is favourable. Changed fire patterns appear to be an important cause of change.

Absence of regeneration of trees and shrubs is apparent in other parts of central Australia, particularly in association with calcareous soils, salt pans and some river frontages. It is likely that seedlings and juvenile plants are destroyed chiefly by rabbits, but that grazing by cattle will also cause losses at times.

Pasture production may be suppressed as woody plants increase; the use of fire is recommended to control the increase.

Landscape stability and topfeed resources may be lost as woody plant populations decline. Control of rabbits and cattle are recommended to allow regeneration.

Introduction

Substantial changes in woody plant populations on some arid rangelands since the advent of European man have been reported in

Australia and the U.S.A. (e.g. Humphrey 1958, Moore 1969).

No measurements are available of tree and shrub populations in central Australia, prior to 1980. However, anecdotal information and direct observation suggest that growth and recruitment has been extensive in some areas but largely absent in others. Problem species are often similar to those recorded elsewhere in Australia (e.g. Hall *et al.* 1964, Anon. 1969).

This paper presents evidence of increase and loss of woody plants in central Australia. The likely causes and effects of change and the management implications are discussed.

Increase in Woody Plants

Informants from cattle stations both north and south of the MacDonnell Ranges have reported increases in trees and shrubs since a period of exceptionally high rainfall from 1973 to 1978. In the northern Alice Springs region, where the average rainfall is up to 300 mm per annum, *Acacia, Eremophila* and *Cassia* species have all increased. A station owner who has lived in the northeast since 1924 has seen "nothing like it before".

On some stations in both the northwest and northeast of the region, the increase in *Acacia aneura* (mulga) is of great concern to the owners/managers. Mulga appears not to be invading land beyond its previous boundaries to any great extent, but rather to be thickening up wherever run-on is favourable. Where the problem occurs, the density of mulga 0.1 - 0.5 m in height can exceed 1000 individuals ha^{-1}, while the density of all height classes together can exceed 3000 individuals ha^{-1} (unpubl. data). Thickets of juvenile *Acacia estrophiolata* (ironwood) are apparent on many alluvial soils and extensive regeneration of *Acacia kempeana* (witchetty) is occurring on others. *Acacia victoriae* and *Acacia murrayana* also form locally dense stands on alluvial soils wherever rainfall or run-on are favourable.

Eremophila species, particularly *E. duttoni, E. maculata and E. sturtii* now cover considerable areas of alluvial soils bordering

creeklines and on floodouts and plains. The predominance of young plants in areas which would otherwise be treeless floodouts implies a recent invasion by these species.

The *Cassia nemophila - C. artemisioides - C. sturtii* group and *C. oligophylla* are increasing markedly on many alluvial soils. Areas reported to have been shrubless or nearly so prior to the 1970s have a dense cover of these species. The *C. desolata - C. helmsii* group has also increased but is generally limited to soils either on or close to ranges. On open woodland sites where excessive increase in woody plants has been detected (methodology adapted from Tennant and White 1959), the density of woody plants of 0.1 - 0.5 m height is greater than 1000 individuals ha^{-1} and can exceed 3000 individuals ha^{-1}; the equivalent values for woody plants of 0.5 - 1.0 m height are 400 individuals ha^{-1} and 1500 individuals ha^{-1} respectively. *Cassia* spp. may constitute 80% or more of these plants (unpubl. data).

In waterways and areas subject to inundation throughout the Alice Springs region, *Eucalyptus camaldulensis* (river gum) and *E. microtheca* (coolibah) have formed dense stands in some instances. In the northwest region of saltlakes and limestone subsoils, *Melaleuca glomerata* (tea-tree) seedlings have invaded some alluvial plains and largely suppressed pasture species.

Opinion is divided amongst local pastoralists as to whether or not increasing trees and shrubs constitute a serious threat to pasture production. One owner/manager with long experience in the northeast reported similar increases in *Cassia* following big rains in 1921, 1926 and 1947 but that all populations were diminished by ensuing drought. Another, quoted above, said that the increase during the 1970s was unique. Several informants, while acknowledging a major increase in woody plants, believed that either pasture production would not be disadvantaged or that any disadvantage would be counteracted by the introduction of buffel grass. Other informants were concerned that mulga and *Cassia* in particular would suppress valuable pasture. Many found that mustering was made considerably more difficult where woody plants had increased.

Causes of increase

It is unlikely that increases in woody plants have a single cause. Since the advent of European man to the arid rangelands, several factors which influence plant populations have changed, although one may have had the predominant effect. Changed fire practices and/or grazing by introduced livestock are considered to be major causes by authors both in Australia and the U.S.A. (Humphrey 1958, Anon. 1969, Moore 1969, Barney and Frischknecht 1974, Harrington *et al.* 1979, Shinn 1980). Other causes include water redistribution, clearing, and ringbarking (Batianoff and Burrows 1973, Beeston and Webb 1977). A common feature of many Australian reports is that increase or invasion followed periods of above average rainfall (Anon. 1969, Moore 1969, Beeston and Webb 1977, Booth and Barker 1979, Harrington *et al.* 1979, R.W. Condon pers. comm.).

In central Australia, the existence of a "woody weed problem" has not been widely recognised, but the case for its likely expansion can be supported.

Fire is a feature of Australia's environments and species are adapted to survive particular fire regimes (Gill 1975). Prior to the arrival of European man, there were two important sources of ignition - lightning and Aboriginal man. Lightning may have been an indiscriminate fire lighter, but Aborigines were skilful users of fire and their fires had a critical impact on much of Australia's vegetation (Jackson 1968, Jones 1969, Hallam 1975, Hodgkinson and Griffin in press). There is considerable evidence for the widespread use of fire in central Australia by Aborigines, prior to European man's arrival (e.g. Basedow 1915, Carnegie 1973, Giles 1979, Griffin and Friedel 1981) and for continued Aboriginal use of fire in recent times (Griffin and Friedel 1981, R.G. Kimber pers. comm.). The use of fire by pastoralists was more common prior to a severe drought (1958-65) than at present, but some pastoralists continue to fire their spinifex country. However, the alluvial landscapes are now only burnt by wildfires ignited accidentally or by lightning. In general, such fires are less frequent, hotter and more extensive than pre-European fire regimes, and their season of occurrence may be different.

Consequently, there is good evidence for changed fire usage in the landscapes where trees and shrubs are increasing. On the other hand available evidence does not suggest that grazing is a major cause of woody plant increase, but studies are continuing. Disturbance by clearing, ringbarking or water redistribution has not occurred.

The process of woody plant increase appears to take the following course in central Australia. Extended above average rainfall stimulates massive germination and survival of all plant species. Failure of fire to occur as soon as the vegetation will burn enables woody plant seedlings to become established (probably within one year of germination). Juvenile woody plants can withstand fire from an early age; up to 84% of ironwood juveniles 0.1 - 1.0 m in height and probably between one and five years old survived fires of different intensities at Alice Springs (G.F. Griffin pers. comm.). Wildfire may occur after fuel has accumulated to a dangerous level over several years and may kill some young and mature woody plants. However, many species have the capacity to produce basal shoots, and seed germination will be stimulated by fire (Hodgkinson and Griffin in press). With favourable seasons, these new seedlings will also become established. A sequence of years of high rainfall, without fire in the first and subsequent years will almost certainly lead to a significant increase in trees and shrubs. Such sequences have occurred at about 20 year intervals in central Australia since the 1860s.

It appears that the central Australian landscapes on alluvial soils (footslopes, plains and levees) are probably "anthropogenic grasslands" (Vogl 1974). In other words, the climax vegetation which is possible with the present climate is a shrubland, and the open grasslands which presently exist are a "fire subclimax", maintained only by the deliberate application of fire. Drought, disease and herbivores must always have reduced woody plants from time to time, but fire at critical periods has been the major agent for maintaining tree and shrub populations at a relatively low level.

Decrease in woody plants - and its causes

Lack of regeneration is apparent in other areas of central Australia, particularly where they are more arid. Rainfall is lower in the south than in the north, so that suitable conditions for germination occur less often. However, exceptionally high rainfall occurred throughout the region during the 1970s, so that it might be expected that extensive regeneration of woody plants would follow. There are at least three possible reasons for the absence of regeneration. Firstly, germination and establishment failed due to locally unfavourable conditions; this is most unlikely. Secondly, seedlings established but were eaten and, thirdly, seed supply was totally depleted by previous germination and consumption. Of these two alternatives the former is most likely, as sufficient mature trees still exist in most areas to replenish the seed supply.

A significant feature of the southern region, in addition to greater aridity, is the greater proportion of calcareous soils and salt pans. These, and river frontages, are favoured habitats for rabbits. Thus, much of the better cattle grazing country in the south is also infested with rabbits.

No measurements are available of woody plant populations in the southern Alice Springs region. In the north, rabbits are far less common. However, during measurement of open woodland sites in the north, one area was encountered where rabbit warrens were extensive. Table 1 shows that no juvenile trees and shrubs to 1 m high were present, there were two individuals ha^{-1} between 1 and 2 m high, and 13 trees ha^{-1} above 2 m in height. These latter presumably predate the arrival of rabbits in the area. Informants indicated that rabbits were present in the area by 1910 and probably earlier.

Table 1

Number of trees and shrubs per hectare in open woodland in the northern Alice Springs region

	Height Class				Total
	0.1-0.5m	0.5-1.0m	1.0-2.0m	2.0m & Above	
Median of 22 sites without rabbits	639	169	97	59	1060
Range of 22 sites without rabbits	33-3254	32-1687	11-869	3-233	105-5844
Rabbit site	0	0	2	13	15

Informants from cattle stations in the southern region have said that large scale death of mature trees and shrubs was uncommon during drought. However, in country inhabited by rabbits, young trees and shrubs were either eaten or ringbarked. Many species were affected including mulga, witchetty, *Eucalyptus* spp., *Atriplex vesicaria* (bladder saltbush), *Maireana astrotricha* and *Chenopodium auricomum* (both called bluebush in central Australia). Saltbush and bluebush were utilised by cattle during drought but were not preferred. Cattle ate *Eucalyptus* spp. and *Acacia* spp. when available. Thus, it appears that grazing by rabbits is the primary cause of decrease in woody plants, although cattle grazing probably exacerbates the problem at times. Studies to be undertaken in the southern region should clarify the situation.

The problem of failing regeneration of woody plants has been reported in other parts of arid southern Australia. Grazing by livestock and/or rabbits has been the major cause (e.g. Hall *et al.* 1964, Cunningham and Walker 1973, Henzell and Lay 1981); seasonal fluctuations are not responsible for long term failure. Widespread death of mulga during drought or following fire is normal in arid Australia (e.g. Beard

1968, Condon 1969, Fox 1979), as is regeneration after occasional highly favourable seasons (e.g. Everist 1949, Hall *et al.* 1964, this paper). The absence of regeneration is not simply due to unfavourable seasons; grazing causes a reduction in the mulga population despite seasonal fluctuations (e.g. Cunningham and Walker 1973).

Implications for management

The invasion of an area by trees and shrubs or a major increase in pre-existing populations is not in itself an undesirable process. However, when invasion or increase occurs, the ground storey species may be reduced or eliminated (e.g. Humphrey 1958, Anon. 1969). In pasture lands, where palatable ground storey species are replaced by less palatable or unpalatable trees and shrubs, a serious loss of animal production will follow.

Excessive regeneration of woody plants should be controlled, to maintain pasture production. Fire is the most economical tool available to land managers for control, but it should be used before shrub density increases so much that adequate fuel levels can never be achieved. Control burning is probably necessary within one year of germination. A subsequent burn, given sufficient fuel, may be needed to destroy new seedlings and resprouting rootstocks (Ralph 1980).

The failure of trees and shrubs to regenerate in favourable seasons will eventually lead to their disappearance. When they are long lived, the absence of recruitment may not be apparent because the mature plants will continue to dominate the visual landscape for many years. Since woody plants may be valuable for maintaining landscape stability, as habitat for native animals, as browse and shelter for livestock, for providing construction materials, firewood and so on, the potential loss of the resource is important. If the resource is to be maintained, control of rabbits is essential at all times; grazing by cattle probably needs to be restricted following substantial rains, to aid the survival of newly established seedlings.

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