GRAZING EFFECTS ON SHRUB AND TREE GROWTH OF ARID AND SEMI ARID REGIONS OF W. A.

G.E. Brockway, B.Sc. Adel.

Until less than a century ago, the inland vegetation of this State was unique in that it had never felt the impact of extensive grazing - Australia had no aboriginal pastoral people. While we can examine and record the changes which are taking place, something approaching the final picture, which under present methods of exploitation must eventuate, is to be found in other parts of the world. I will, therefore, quote from a report bearing on this problem prepared by J. Messines at the F.A.O. Technical Meeting on Forest Grazing held at Rome in 1954.

He states, inter alia,

> "An obvious feature of the arid and semi-arid zones is the fragile nature of the forest. True, trees adapt themselves to dry climates, except desert or pre-desert climate, and where the vegetation has been left alone, large tracts of presently denuded and erosion-ridden land could be under forest cover. But for thousands of years man and his animals have been destroying the natural forest. The inhabitants of the arid regions have always been, and still are, predominantly pastoral, and by clear-cutting and overgrazing, they have caused the forest stands to shrink or completely disappear."

and

> "Without going into all the causes, we may say that intensive forest grazing inevitably removes the undergrowth, and in arid regions constitutes a permanent threat of relatively rapid stand annihilation."

In referring to arid area forests, Messines obviously refers to a vegetation of the type which covers or has covered sections of inland Australia.

An observer at this symposium might well ask where does a forester come into this picture. The vegetation of the non agricultural sections of the arid and semi-arid areas of the world is normally evaluated from the point of view of its grazing or browsing value, this vegetation being too scattered in distribution and low in value to be economically harvested by means other than the mouths of grazing animals. Commercial forestry on the other hand is normally restricted to those areas receiving

at least thirty inches of annual rainfall - four times that of much of our pastoral country.

The widespread mining activities throughout the inland of this State, commencing some seventy years ago, created a demand for great quantities of fuel and mining timber (amounting over this period to some 30 million tons in all). This had to be cut from the indigenous forest, much of which was and is held under pastoral lease. While such pastoral leases do not confer on the holder exclusive rights to forest produce thereon, it has still been necessary for the Forester to ensure that while authorising forest produce to be removed, he should cause as little loss or inconvenience as possible to the pastoralist. The reconciling of such conflicting interests has not been simple and some understanding and appreciation of the factors involved has been essential.

Changes in vegetation can be brought about by direct physical removal selectively of certain components of a plant community, but it is seldom as simple as that - particularly with the trees and larger shrubs which are themselves, by their very size protected, at least in their mature stages, from such direct action by browsing animals.

Changes must be looked for in the more vulnerable links in their life cycle and in the site changes resulting from the changed biological set up introduced with the pastoral industry.

I propose to deal with three zones, viz:

(1) The Southern Eucalypt Zone;

(2) The Mulga Zone; and

(3) The Kimberley Region.

The Southern Eucalypt Zone covers an area of some 170,000 square miles, the greater portion of which lies above the 9" isohyet.

While the greater proportion of this carries heath, scrub or mallee of extremely low grazing value, it also includes extensive areas of tall Eucalypt woodland with an understorey of sclerophyllous shrubs, in which a wide range of genera are represented. Prominent, however, are the acacias, cassias, grevillias, eremophilas and the more succulent and palatable Chenopodiaceae, the saltbushes (Atriplex and Rhadogia) and Kochias.

The western portion of this zone constitutes the wheatbelt from which the greater part of native vegetation - particularly the woodland sections has been removed. Any grazing effect on the fragments of native forest which remain are of little economic moment, although they are at times disturbing to farmers who have retained groups of forest for protection purposes. It is found that if such timber patches are used for holding heavy concentrations of stock, the ground vegetation is destroyed, the natural surface soil is removed by wind, leaving a hard and at times polished impervious soil surface, marked during dry periods with fine cracks which follow the course of the main surface roots. Crown deterioration of the component trees sets in, ultimately leading to death; regeneration does not take place.

Cases have been observed where obstructions such as dumps of old machinery have caused an accumulation of sand around individual trees, with obvious benefit to them, resulting, one would assume, from the better water absorption of the drift sand. This crown deterioration contrasts strongly with the crown improvement often observed on isolated trees left in cultivated paddocks or in belts where stocking by animals is light.

Beyond the wheatbelt, i.e. below about the 12" isohyet, no widespread systematic clearing of the native vegetation has taken place. Of the forested portions of the region, some six or seven million acres has been cut through for an average of about 4 tons of wood per acre.

Until very recent years, grazing on the bulk of this area has been light and confined almost wholly to cattle. For this we can attribute two reasons. Firstly, the lack of natural underground water which necessitated expensive dam construction and secondly, because of the retarded development and low palatability of the understorey species (most of them falling in the "palatability 4" group used by Jessup) under the original Eucalypt stand. An increased shrub development has followed the felling of the Eucalypts.

Consequently, over the greater portion of this zone, Eucalypt regeneration following cutting has not been subjected to intensive grazing and has been fairly copious with the exception of those areas where blue bush and salt bush have been the predominant understorey.

On limited areas where there have been concentrations of stock, e.g. near dams, dairies, etc. there is a general absence of regeneration and a much reduced shrub population. With the vigorous post war expansion of pastoral activities in the zone, entailing water conservation, fencing, and stocking with sheep, a vegetational deterioration on a more extensive scale appears

inevitable. This will mean a selective removal of the more palatable shrubs leaving the cassias, eremophilas and dodoneas, etc. There has been no protracted drought during post war years hence a complete assessment of the ultimate effects is not yet possible.

During the period 1925-31, efforts were made to regenerate sandalwood in the Kalgoorlie District. A study of the seasonal conditions under which germination and subsequent establishment could take place indicated that in only one year in four could this occur. Furthermore, destruction of plants by rabbits (sheep were excluded) was almost inevitable unless protection were given to individual plants. Yet sandalwood is a species not normally heavily browsed in its mature state.

Since the introduction of the sheep and the rabbit, natural regeneration of sandalwood is virtually unknown. Observations on this species and others associated with it indicate that a species which stock will browse even lightly when mature, stock will destroy when it is small.

Leaving the Eucalypt Zone proper, we pass through a transitional belt, in which several Eucalypts, acacias, and Casuarina cristata are prominent, and into the mulga zone. Passing North from Kalgoorlie, this transitional belt has a width of from 25 to 30 miles, between Broad Arrow and Goongarrie.

While specifically the term mulga is accepted as applicable to Acacia aneura in its several forms, it is, with certain qualifying terms, sometimes applied to other species, e.g. hop bush mulga (Ac. craspedocarpa) and Irish mulga (Ac. resinomarginea). In a more general sense it is also applied to a whole acacia association, which also includes minor genera such as eremophila, cassia, eucalyptus, callitris, etc. with, in good seasons, a grassy or herbaceous understorey.

The components of this association are extremely drought resistant and are mostly of a dull blue-grey colour. The acacias bear phyllodes of various widths, some (e.g. Ac. tetragonophylla) being needle-like and pungent, but they lack the prominent protective spines typical of so many acacias found in arid areas overseas, (e.g. Ac. arabica, Ac. jacquemontii, etc.)

In view of the great value of the mulga country for the production of fine wools, it is remarkable that so little is known concerning the conditions necessary to ensure its perpetuation. In brief, the pastoralist is reaping something he did not sow and is leaving nature to attend to replacements. She tends to rebel at such treatment and her reactions are not always predictable.

Interesting and valuable work was done in this State by G.F. Melville and Dr. J.E. Nicholls which established the value of

mulga foliage as a drought fodder, but they dealt with the matter rather from the standpoint of the effect of the plants on the animals and not the animals on the plants. With an exhaustible product, such as this, it is insufficient to work out ways and means of utilizing it without prescribing ways and means of ensuring its replacement. In other States, particularly valuable contributions have been made by S.L. Everest in Queensland and H.W. Jessup in South Australia.

It is now receiving attention in this State from officers of the Department of Agriculture and C.S.I.R.O. in the Wiluna District.

My own observations of the mulga country extending over a third of a century have left me in no doubt that a serious deterioration of the stand has taken place under grazing - and it is continuing. However, when one considers the vastness of the zone, so many combinations of site conditions, irregular and spasmodic rainfall widely differing patterns and intensities of stocking and the range of plant species and strains it is not possible to do more than draw a very general picture.

While different strains of Acacia aneura posses different degrees of palatability, none of them are heavily browsed, if some of the other plants of a less permanent nature are available. Workers associated with the zone during periods of plenty tend, therefore, to fail to appreciate the part which mulga plays in times of drought emergency - when stock will even lick up the fallen mulga leaves sometimes seen collected round ants' nests. Jessup writes of mulga in South Australia during drought:

> "However, the foliage and pods of the mulga themselves are very palatable and although stock soon trim the foliage up to the height they can reach, dry leaves are constantly shed from the trees."

and

> "Shrubs are a valuable reserve in the early stages of drought, but if the dry period is prolonged they provide little more than sticks for the stock to graze. The mulgas, however, continue to shed leaves from their canopies, so that in a prolonged drought they are of much greater value as a food reserve than shrubs."

Pastoralists themselves, who have spent many years in the mulga, fail to agree on the value of the species. As examples of this I refer firstly to a pastoralist in the Paynes Find District who welcomed the activities of post cutters, who were operating without authority on his station, because they opened

up the stand and allowed other plants to grow, and secondly, to a pastoralist in another district who when there was a possibility of firewood cutters from a local goldmine operating on his station, registered his disapproval in no uncertain terms. To him the mulga was the "lifeblood" of his industry and the mine operators "here today and gone tomorrow bandits who would reduce the country to impotency and drive the pastoralists to ruin." He referred also to a reduction in carrying capacity of this station from a sheep to 20 acres to a sheep to 40 acres in a matter of 20 years.

While stand deterioration is undoubtedly proceeding, direct physical damage by sheep to the larger shrubs and trees is not possible, although where cattle are depastured, and that is of minor incidence only, some breaking down of crowns does occur. Felling of mulga for fence posts has been necessary while during droughts felling for fodder and even pushing down by a Valentine tank has taken place.

Some of the areas devastated in this way, though individually quite large, actually represent a very low proportion of the zone. Control of cutters was in most cases poor and felling unsystematic and destructive.

Mulga does not appear to be a long lived tree, my estimate would be 100 to 150 years - I cannot agree with some observers who have suggested a figure of forty years. Under the harsh conditions of its environment, once it loses vigor its decline can be rapid. Even in ungrazed country a high proportion of scattered dead trees is almost universal but in this connection we must not lose sight of the great durability of mulga timber.

On country subject to grazing these scattered deaths can still be observed, but in addition we here have extensive blocks or belts of dead mulga and associated species in some cases covering many hundreds of acres.

While dead trees in ungrazed country are eventually replaced by regeneration, this is rarely the case in grazed areas. I say 'rarely', because it is possible at times, even in fairly heavily grazed paddocks, to find occasional small mulga plants either lightly grazed or even quite untouched. One must therefore look further than the physical destruction of the plants themselves for the answers and an examination of the low ground cover and the soil surface itself provides the clue.

Grazing is almost wholly by sheep which eat off the vegetation very close to the ground. Overstocking rather than understocking is to be expected since the capital invested in improvements necessitates as high a return per unit area as possible. The desire to maintain carefully built up flocks and

the eternal hope that the season will break can lead to heavy overstocking in drought periods.

The mulga soils consist typically of a sandy surface layer sometimes only an inch or two deep, interlaced with roots of grass and ephemeral herbage. Even when these plants have died the roots persist. Below this surface layer the soil is compact and less sandy.

Destruction of this minor ground vegetation by grazing and the cutting up of the surface soil by the feet of sheep reduces it to a condition in which it is extremely subject to movement by wind action. A progressive site deterioration sets in. The removal of the sandy surface layer exposes the less pervious soil which presents a scalded and at times polished surface. With the water absorptive power of the site reduced, its value as a seed bed is destroyed, even if seed after escaping the attention of foraging insects or animals can lodge in such a surface.

It is the story so frequently repeated in nature with both flora and fauna, the destruction of a species brought about by the destruction of the site or habitat. These various destructive processes react on one another. The larger trees are affected and crowns are reduced and in such a deteriorating environment it is not possible to develop any sort of stable ecological community.

As the older specimens die they are not being replaced in sufficient density by regeneration. Trees under arid conditions, particularly those which do not protect their own individual sites by low branching need mutual protection. Heavy reduction of vegetation density can, in the mulga, prove fatal. This became evident in woodcutting operations when as an anti-erosion measure, operators are required to leave seven trees per square chain. The trees so retained rather than benefiting from the reduced competition, frequently are adversely affected and deaths are not uncommon.

That site deterioration involving the destruction of the seed bed is a strong factor affecting regeneration is demonstrated by the lines of young mulgas, at times almost hedge like in appearance, to be seen for considerable distances bordering road formations. Here soil disturbances has created a seedbed and water lodgement at the road edge has encouraged subsequent development.

It is not my purpose to discuss, in this paper, ways and means of arresting this deterioration and ensuring of regeneration. The availability of such information would not necessarily mean that it would be applied on any wide scale. The first step would appear to be to make the pastoralist himself

regeneration conscious. He frequently deludes himself in this respect, claiming that everything is alright, young mulga is not palatable to sheep and is consequently not interfered with. He is primarily concerned with the effect of plants on animals - not animals on plants.or plant habitats.

One pastoralist with whom I spent several hours recently, examining these matters on his property, cheerfully remarked that in the short period he had spent with me he had seen more young mulga plants than he had noticed for a long while.

Brief mention might be made of the Kimberleys. This area has received little attention from Foresters but I wish to make a few brief observations. Two factors appear to be at work affecting the tree flora - fire, which kills the mature trees and grazing - or lack of seed - which prevents regeneration.

Extensive heavily grazed areas in the Halls Creek region show only dead Eucalypts and no regeneration or understorey.

In pine areas (Cal. intratropica) West of Forrest River Mission, a high proportion (at least 50%) of the pine is fire killed and no regeneration less than 25 years of age (by ring counts) could be found. Observations on Callitris glauca regeneration in N.S.W. indicate the serious effects of grazing.

In heavily grazed land Bauhinia cunninghamii is plentiful and seeds heavily, but regeneration is absent. All trees appear to be of an age which would place their origin before the days of the pastoralist. Small trees which appeared to be younger proved to be shoots from old rootstocks.

Coolibah can be seen regenerating on heavily grazed river flats in the Fitzroy Crossing area.

How do our inland vegetative associates compare with those overseas?

I can only speak with first hand knowledge of the Rakhs of West Pakistan.

Although these areas have been grazed for many centuries, they still carry a heavier animal stocking than our own semi-arid areas. In the case of the Cholistan desert in Bahawalpur a figure of one beast per five acres is reported.

To some extent, the pattern of grazing may have an effect. Growth takes place during the monsoon while much of the grazing is by stock from the hills which are brought down during the winter, after the vegetation has a good start.

The regeneration pattern however appears to offer the clue. R.N. Parker writes "Except in the case of Salvadora which regenerates fairly well in dense shady clumps, growth is mainly due to root suckers which Prosopis, Capparis and most of the Rakh species produce."

This method of reproduction has enabled them to persist in spite of some of the most efficient seed foragers in the animal world - those species of desert goats and sheep whose absurdly long ears sweep the ground as they graze, exposing seeds and scraps of vegetation mixed with the surface soil layer.

Such plants have a decided advantage over trees such as our own which rely almost wholly for their perpetuation on seed fall.

REFERENCES.

EVERIST, S.I. Mulga in Queensland. Queensland. Dept. of Agriculture and Stock. Bulletin 49.

FOOD and agriculture organization of the United Nations. Rome. FAO/TMFG/2. 8 March 1954.

Technical meeting on forest grazing, Rome, 29th. March - April 1954. Grazing and forest production - arid and semi-arid zones. Item II - A (part) of the Provisional Agenda; by J.Messines. 6.p.

HOLMES, J. MacDonald

Soil erosion in Australia and New Zealand. Sydney, A. & R., 1945. 296p.

JACKS, G.V. The rape of the earth; by G.V.Jacks and R.O.Whyte. London, Faber, 1939. Reprinted 1949. 313p.

JESSUP, R.W. The soils, geology and vegetation of north-western South Australia. Roy. Soc.S.A. Trans. 74:199-273.

MELVILLE, G.F. An investigation of the drought pastures of the Murchison District of Western Australia. J. Dep. Agric. W.A. 24(1) 1947 : 1-29.

NICHOLS, J.E. The behaviour of sheep browsing during drought in Western Australia. pp.66-73 in British society of animal production, London. 2nd meeting, 1944. The British Sheep Industry. London, B.S.A.P., 1944.

NICHOLS, J.E. Investigation in the pastoral areas of Western Australia. Aust. Inst. Ag. Sci. J. 4(1) 1938: 10-17.

PARKER, R.N. A forest flora for the Punjab, with Hazara and Delhi. 3d. ed. Lahore, Govt. Pr., 1958. 584p.