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ESTABLISHMENT, MANAGEMENT AND PROTECTION

BACKGROUND FACTORS INFLUENCING THE OCCURRENCE AND TREATMENT OF EUCALYPT WOODLAND IN AUSTRALIA

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1. The Range of Types

Before European colonization took place a considerable proportion of the continent of Australia was covered by savannah woodland or high forest in which eucalypts were the dominant trees.

The size of the trees varied with rainfall and temperature, but was usually remarkably good for the conditions under which they grew. In areas receiving an annual rainfall of less than 15 inches the trees might be between 6 and 30 feet in height. Most of the better savannah woodland received from 15 to 30 inches of rain per year in the cool temperate zone or from 30 to 60 inches in the tropics and was characterized by veterans with a height of 60-100 feet. In the wet schlerophyll high forest the height of the dominant veterans was about 150 feet over a wide range of latitude, the annual rainfall varying from 40 inches or more in cool temperate parts to 70 inches or more in the tropics. The best forest sites of southern Australia, receiving an annual rainfall of 50 inches or more, carried eucalypts which attained heights of 150-250 feet over areas of hundreds of thousands of acres, and heights of 250-300 feet in limited localities.

While the interaction of rainfall and temperature was the main factor which controlled the size of the trees, other influences played their part. Better forests developed on the good soils than on the poor soils. Exposure to storm winds was also significant. The very tall eucalypts were situated in areas where severe cyclonic winds were uncommon.

2. Natural Succession

(a) The Effect of Fire and Grazing before European Colonization

Grazing and fire have been very significant factors in the eucalypt woodland but their effect has varied with the nature of the forest type.

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The native grazing animals of Australia were marsupials which do not crop the grass close like the sheep or the rabbit. This was a favourable factor in the eucalypt forest. Nearly all the savannah woodland species develop lignotubers, and these structures were able to establish themselves in one good season and make trees in later favourable times. The native Australian grasses tended to form clumps with a little bare ground between them rather than swards, and this also assisted eucalypt regeneration. It should be stated, however, that in the absence of grazing and fire the eucalypts will regenerate through dense grass swards in a few years if there is a good seed supply.

It is likely that the eucalypt woodland experienced periodic fires even before human occupation. The widespread presence of understorey species bearing seeds adapted to germination following fire suggests a long fire history.

The known human occupants of Australia have all burned the woodland. The aborigines were stone age hunters. They congregated where game was not abundant. The savannah woodland was one of these localities. The wet schlerophyll forest and the very dry areas were relatively poorly stocked with animals and supported few aborigines.

The aboriginal hunter frequently sought his game with the aid of fire. It was not in his interests to start large conflagrations. He knew the danger of a large fire, but he did not have effective means of suppressing flames of appreciable size. It was inevitable that his fires would get out of control at frequent intervals. The effect of his fires was to keep much of the savannah woodland very open, and to favour the lignotuberous eucalypts against genera which might be more tolerant but less fire resistant.

Most of the high quality eucalypt forest of Australia abutted upon savannah woodland which was regularly burned by the aboriginal hunter. When the hunting fires got away they burned into the good forest to an extent which varied with the weather conditions. Sometimes they moved short distances as ground fires and did little damage, but in the years of very high temperatures and severe winds they developed to major crown fires which sometimes devastated extensive areas. The effect of these fires in the high forest has been to restrict some species and extend others.

Fire is the one factor which permitted the establishment and maintenance of eucalypt forest on many sites of high quality in southern Australia. In these localities the eucalypts would have been replaced by more tolerant genera if major fires had not recurred at intervals. The intervals may have been as long as 300 years in some places.

The occurrence of some valuable eucalypts has been restricted by fire. Some species have barks which are very sensitive to fire and they are of limited occurrence because of this factin spite of good natural vigour.

(b) Fire and Grazing after European Colonization

The aboriginal hunter deliberately burned the savannah woodland to obtain food. He did not deliberately burn the high forest to any extent because it did not contain much game.

The earlier European colonists depended on the savannah woodland to support their flocks and herds. The hunting fires of the native were a nuisance to them. Grass would be destroyed early in the summer and not be available for the new type of grazing animals introduced by the European. The animals themselves might be endangered by the fires also. The aboriginal soon disappeared from the savannah. In this class of country the advent of the European decreased the incidence of fire in many places. Unfortunately the reverse was the case in the better forests. While the native hunter could get little benefit from firing the high forest, the European could obtain profitable grazing for his cattle on the succulent shoots which developed when trees and shrubs were destroyed and the forest was opened up. The European greatly increased the amount of burning in the better forest, with unfortunate results for the mature trees. The damage caused is partly offset by the fact that the opening up of the canopy by fire permitted the establishment of advance growth on the forest floor. This advance growth gives the Australian forester of to-day a chance to reestablish a healthy and vigorous forest with the aid of protection and a little treatment.

(c) Succession in the absence of Fire and Grazing

Nearly all eucalypt forests in Australia owed their nature to fire and grazing at the time the forester took charge of them. The first result of protection from fire and grazing in all of them is a much closer and darker forest in the course of two or three decades. Eucalypt advance growth develops rapidly and understorey species multiply. If protection without utilization were carried on for a long period the result would vary with the nature of the forest. The tall eucalypts 150-300 feet in height would be replaced by more tolerant genera. The dry schlerophyll forest, and the better savannah woodland at low altitude, might be invaded to some extent by tolerant genera but could probably maintain themselves as somewhat open forests in which the eucalypts were prominent. The high mountain woodland might remain stable as an open parklike eucalypt forest with large trees and grass on the forest floor.

The notes given will show the pronounced effect of fire and grazing, and the lesser effect of soil and storms, in the natural eucalypt forest. When man regenerates these stands he must replace the effect of fire by his own work. The forester outside Australia who wishes to plant eucalypts should also take note of the effect of fire in Australia. He may be justified in experimenting with species over a wider range of sites than that on which they are found naturally.

3. The Effect of Utilization

The aboriginal made little use of the eucalypt forest. The European destroyed many millions of acres of it to establish farms and pastoral holdings and is now attempting forest management over perhaps 20,000,000 acres.

(a) The Effect of Utilization in the Savannah Woodland

The better savannah woodland has nearly all gone to farm or pasture in southern Australia. Some of the trees were felled and utilized for farm purposes, railway sleepers, etc. but most were ringbarked. The ringbarked trees have supplied firewood of high quality for three generations of Australians and they will be sadly missed when they disappear

as they inevitably must. In some localities far too many live trees have been removed and there is already a shortage of trees for shelter or for farm purposes. The position is being aggravated by the fact that some of the worst enemies of the eucalypts of the savannah are scarab beetles which feed on grass roots in the larval stage and on eucalypt foliage when mature. The increase in the proportion of grassland to trees with colonization is leading to progressively more severe attacks on the remaining trees by mature beetles. The solution of this problem must be to develop unpalatable strains of eucalypts or plant trees of genera which are not attacked by the insects.

(b) The Effect of Utilization in the better Forest with a Mature Height of under 150 feet

Most of the eucalypt forest with a mature height under 150 feet is composed of fire-resistant species. The virgin forests were irregular with a preponderance of old trees. The old trees would occasionally fall because of the combined effect of wind and fire, and regeneration would come up in the resulting gap. A considerable range of ages and sizes developed in the course of time. When this class of forest was first utilized by the European the best trees were taken for industry. Then the Forest Services introduced minimum exploitable girths at a relatively early date in order to keep some control over utilization. The inevitable result was the development of utilization by selective fellings. Groups of regeneration came up in the gaps made by the selective fellings and the growth of older trees near the gaps was stimulated. These stimulated trees provide the mill logs for a later felling cycle and so the stage is set for further selective fellings.

The selective fellings have led to a silvicultural system now well known as "The Australian Group Selection System". The typical theoretical example of the past was an irregular forest composed of groups of trees of even age which regenerated in small cleared areas made by successive fellings. The ages should be multiples of a planned felling cycle in any one compartment. The typical example of the future is likely to consist of an irregular forest where some trees are taken for industry from convenient areas planned in advance, and the remaining dominants of all sections of the sequence of size classes are stimulated by their removal. It will be possible to carry on the eucalypt forest mainly with the aid of trade fellings and without the use of fire. The disturbance of the soil by snigging and the opening up of the stand by the fellings will permit adequate eucalypt regeneration to develop. Assistance apart from trade fellings in the form of liberating seedlings from competitors and vines, some thinning of saplings, and where necessary a little enrichment planting, will greatly improve the quality of the future forest.

(c) Utilization and Regeneration in the High Quality Forest over 150 feet in Height

There is a mature height limit close to 150 feet which represents the height at which it is desirable to change from selective fellings to clear fellings in a eucalypt forest. Stands less than 150 feet in height can be managed indefinitely by selective fellings. If the forest is taller than 150 feet selective fellings are difficult to execute effectively, though not impossible, and the light relationships of the

resulting gaps are not suitable for the satisfactory establishment of eucalypt regeneration. The wall of surrounding trees is too tall for the radius of the gap and tolerant genera are likely to take control. Moreover, many of the very tall eucalypt forests are even-aged stands of one fire sensitive species which regenerated after some past disaster. It is desirable to carry this type on as an even-aged forest. Should it prove practicable to thin the stands for commerce the yield obtained from them will be increased appreciably.

4. Likely Future Developments in Australia

(a) Improving the Stocking on Valley Soils

In many parts of the better eucalypt forest of Australia the best soils are in the valleys and they are poorly stocked with desirable trees. There are two reasons for this. Firstly, past fires were usually more severe on the slopes and ridges, and the fires favoured the eucalypts. In the valleys tolerant weed species were stronger and strangling vines frequently led to the suppression of scattered eucalypts. Secondly, the traditional road of much of the eucalypt forest was a ridge road because it was trafficable in all weathers. Valley roads which permitted better exploitation of the best soils were not popular because their use was restricted to the drier periods. Valley tracks will be made much more use of in the future. With their aid it will be practicable to utilize the better soils effectively, and forest production will be improved.

(b) Organisation of Felling Areas

Some planning of fellings has been practised in Australia for many years and at present there is a strong move for better control and better planning of the location of utilization. This will permit the Services to adhere to working plans, to protect the forests from wind, and to aid regeneration by a well conceived pattern of age classes.

(c) Edges of Seed Trees

It has become apparent that the usual type of seed tree left in clear cuttings is not suitable for its purpose. As in all forests the best seed bearing eucalypts are the dominants, but the dominants are wanted for industry. To get over the difficulty the pattern of fellings will be designed so that an edge of mature forest sheds seed on to a recently felled coupe, rather than scattered seed trees of inferior quality.

(d) Insects and Eucalypt Regeneration

The surplus seed of most forest types has provided food for a variety of forms of animal life. In the case of the eucalypts the seed is small and the main seed eating animals are ants and other small insects. These creatures may rob most of the seed produced by an edge of seed trees and be a significant factor in reducing the amount of regeneration obtained. Recent insecticides such as chlordane and deildrin have proved effective in suppressing seed-robbing insects on an experimental scale. They can be applied cheaply and may prove useful on a larger scale in certain cases where full regeneration is required in high quality forests.

(e) Broadcast Sowing of Seed

There is usually an adequate seed supply to regenerate areas not already colonized by advance growth in the eucalypt forests with a mature height under 150 feet, if the felling units are not too large. Against this, seed may be in short supply in the older even-aged high quality forests over 150 feet in height. These forests carry a heavy volume, and utilization by clear felling usually leaves an area where the soil has been well churned up, but where there is an interlocked mass of broken smaller logs. The areas are not large but they are difficult to plant by hand. They are almost ideal for broadcasting from a helicopter if means can be found to pellet the eucalypt seed to give it more weight. A small helicopter could be carried close to the area by transporter. A suitable insect repellent might be added to the pelleting material.

(f) Enrichment Planting

Two decades ago a eucalypt tree had little money value in Australia and enrichment planting could not be considered. This is not the case to-day. The present and likely future value of eucalypt logs makes it essential that full stocking should be obtained in the better forests. Experience has shown that the favourable branch shedding habit of the genus permits trees of good form to develop from scattered regeneration in the irregular stands, whereas poor form results from corresponding spacings in cleared areas. This favourable form resulting from scattered regeneration in the selection forest makes it possible to complete the stocking of many areas by enrichment planting with relatively few plants. It is also possible to introduce elite trees to a stand by enrichment planting.

Enrichment planting in Australian eucalypt forests is done with individually tubed stock and not from heavier containers containing a number of plants. The reason why tubed stock is necessary is that it is possible to climb over criss-crossed useless logs and slash with a few tubes, but not with a heavier container.

(g) Properties of Gaps

The gaps in the eucalypt forest in which regeneration develops are biological units which can be made use of in regeneration problems. The lighting of the gaps depends upon the nature of the surrounding wall of vegetation, the shape of the gap and the relationship between its height and width. By regulating these factors it is sometimes possible to control the nature of regeneration in mixed forests.

(h) Yields from Different Species and Behaviour of Species

In the mixed eucalypt stands the individual species have varying degrees of tolerance, varying reactions to fire, varying crown and root habits, and varying growth rates. In the past it has seemed that the trees with the fastest individual growth rates would produce the most timber. It now seems likely that the future will show, as it has elsewhere, that the best yield per acre per year from the soil, and the best forest in the end, may come from growing the more tolerant species on a longer rotation.

(i) Working towards Greater or Less Irregularity in Compartments

In the irregular stands managed by the Group Selection System it is possible to increase or decrease the range of sizes in compartments by organising successive fellings so that they create more groups on the one hand or extend older groups on the other. It is not yet clear which is the better method. An increase in irregularity of compartments may produce the better biological unit. Against this, it is practicable to decrease irregularity and obtain compartments completely stocked with trees of pole size or larger. In the case of fire-resistant species it is practicable to control burn compartments of this nature without great harm to the trees, a fact that may be very useful near forest boundaries.

5. The Application of Australian Experience Overseas

(a) The Use of Savannah Woodland Species

Savannah species will not be of much importance in the Australian timber trade of the future, but they should be of great interest in overseas localities where the eucalypts are used to reafforest difficult areas. The savannah species have evolved in spite of repeated firing, and they are particularly hardy. Many of them do not make trees of milling quality in close association, but others could make a useful forest. The trees which are likely to make a good forest have some of the normal characteristics of tolerance such as a higher degree of branching than is usual for the genus. Overseas foresters would do well to study crown characteristics of available specimens in local arboreta before selecting species for extensive work.

(b) The Use of Species from the very Tall Forests

The eucalypts from the forests of very high quality may be of less interest overseas than the species from the savannah. The eucalypts occupy the high quality forest as a result of fire and more efficient genera can be found for these areas. The crown structure of the eucalypts is ideal for rapid growth of individual trees, but not so well suited for the production of a large volume of high quality saw logs per unit area.

(c) Tree Growth and Wood Quality in the absence of Leaf-eating Insects

Eucalypts grow much faster in suitable localities outside Australia than within Australia provided the leaf-eating insects which have evolved with the genus in Australia are not introduced also. The faster growth of the trees overseas may be accompanied by poorer wood quality than is obtained in Australia because growth stresses have not had time to adjust themselves. The position can be assisted by increasing the length of the rotations over which the trees are grown.

(d) Selection of Varieties

Overseas foresters should pay as much attention to the strain of a species introduced from Australia as to the species itself. Many of the species are very variable, particularly those which occur over a wide range of latitude. Some strains may make good forest trees and vice-versa. Expenditure of appreciable funds on strain selection and

collection from elite trees within the strain is likely to prove a very profitable investment.

(e) The Difference between Australian and Overseas Market Conditions

In most places in Australia it is impossible to dispose of a considerable proportion of the woody material produced in the eucalypt forests. The better logs are utilized and the remainder are left criss-crossed on the ground, making access within a compartment difficult. The overseas countries most interested in eucalypts are usually short of all woody products. In these countries eucalypt plantations are established on well-prepared fully cleared land. Even the smaller logs are likely to be saleable. The different market conditions may lead to strongly contrasted methods of treatment, each of which is right in its locality. Both the Australian and the overseas forester should bear this in mind.