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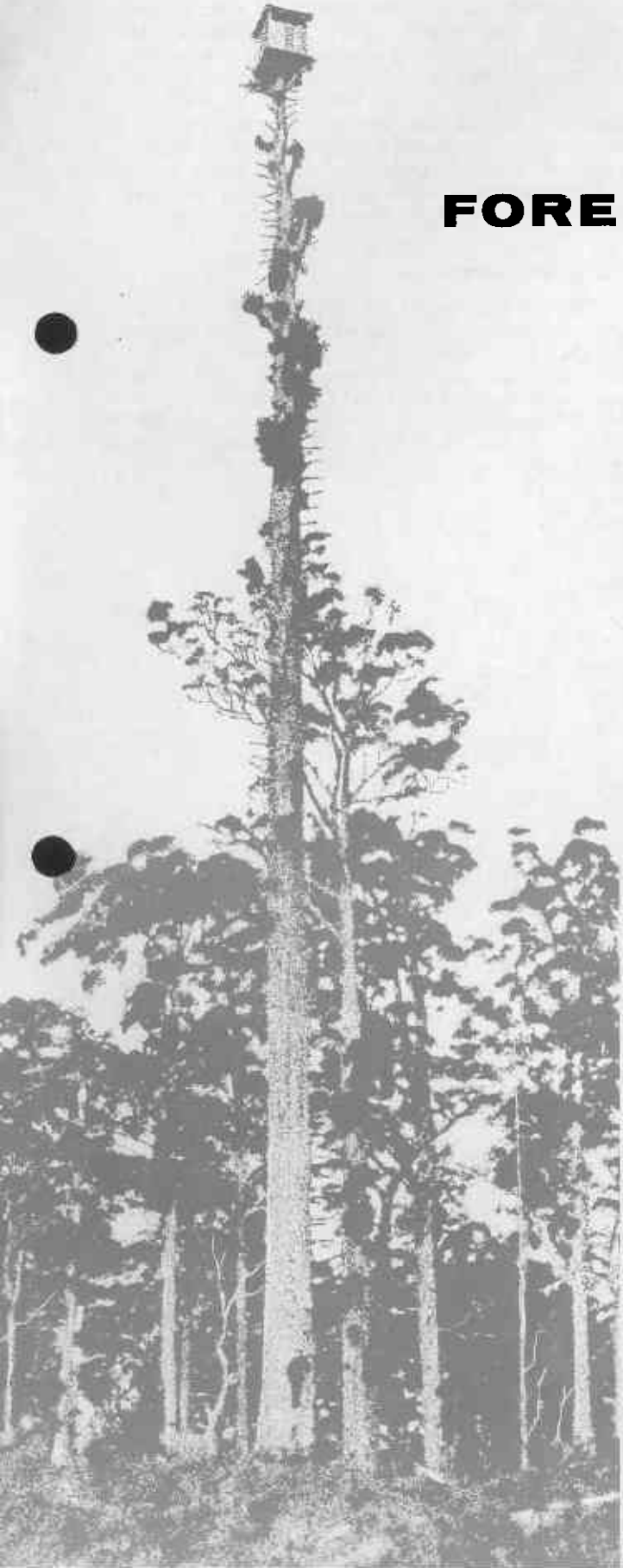

CLEAR FELLING WITH SEED TREES IN KARRI *(Eucalyptus diversicolor)*

by

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SUMMARY

A selection system was used in karri (*Eucalyptus diversicolor* F. Muell.) prior to 1968. Waste of smaller karri stems and the inter-mixed marri (*E. calophylla* R.Br.), inevitable in clear felling, were the main reasons for its adoption. However, the development of a wider market has weakened the case for its retention so that the advantages of clear felling could be realized. A large-scale trial was devised to test a system of clear felling with seed trees under present conditions.

The operation, including utilization, seed fall prediction, specification, timing and control of regeneration burn, seed fall, germination and subsequent removal of seed trees, led to the adoption of clear felling with seed trees as standard practice.

INTRODUCTION

For 30 years prior to 1968 the karri (*Eucalyptus diveriscolor* F. Muell.) forest was managed on a group selection silvicultural system (Jacobs 1955). The principal reason for the adoption of a selection system was the waste of small and intermediate size stems, inevitable in clear felling. Secondly, it was possible to retain the potentially salable marri (*E. calophylla* R.Br.) occurring in mixture with karri. Finally, a faster cutting rate through the forest made possible quicker salvage of extensively fire-damaged stands and earlier provision of access for fire control (W. Aust. For. Dept. 1962).

The gradual widening of the karri market from the traditional large section, high quality product to scantling sizes, together with its likely expansion into poles and pulp, cast doubt on the basic justification of the selection system, as the waste caused by clear felling was likely to be negligible. The logging of marri-rich areas could be avoided, pending the apparently imminent development of markets for marri as both sawlogs and pulp. Furthermore, prevention of damage to retained growing stock during regeneration burns had proved difficult in the selection system and was likely to be even more difficult for the younger size classes during logging and regeneration in subsequent cutting cycles. The system was suspected of causing as much fire damage as it prevented.

The silvicultural characteristics of karri favour even-aged management (Jacobs 1955; White 1971). Clear felling promised other benefits such as economy of logging, easier supervision and regeneration and protection of the more compact areas. With the arguments for selective cutting weakened, the benefits of clear felling could be realized. A trial was proposed to test the feasibility of clear felling under present conditions. A large-scale (at least 40.5 ha) trial was judged to be the best approach.

The Experimental Area

The trial was located in Gray Block, about 27 km west of Manjimup. The total area was 58.2 ha occupying the ridge, slopes and benches between two minor streams flowing into Pine Creek, a main tributary of the Donnelly River (Fig. 1). The ridge was aligned NW-SW and all aspects except NW were included. Slopes were moderate (up to 20°) and rounded rather than irregular.

FIGURE 1: *Map of the experimental area.*

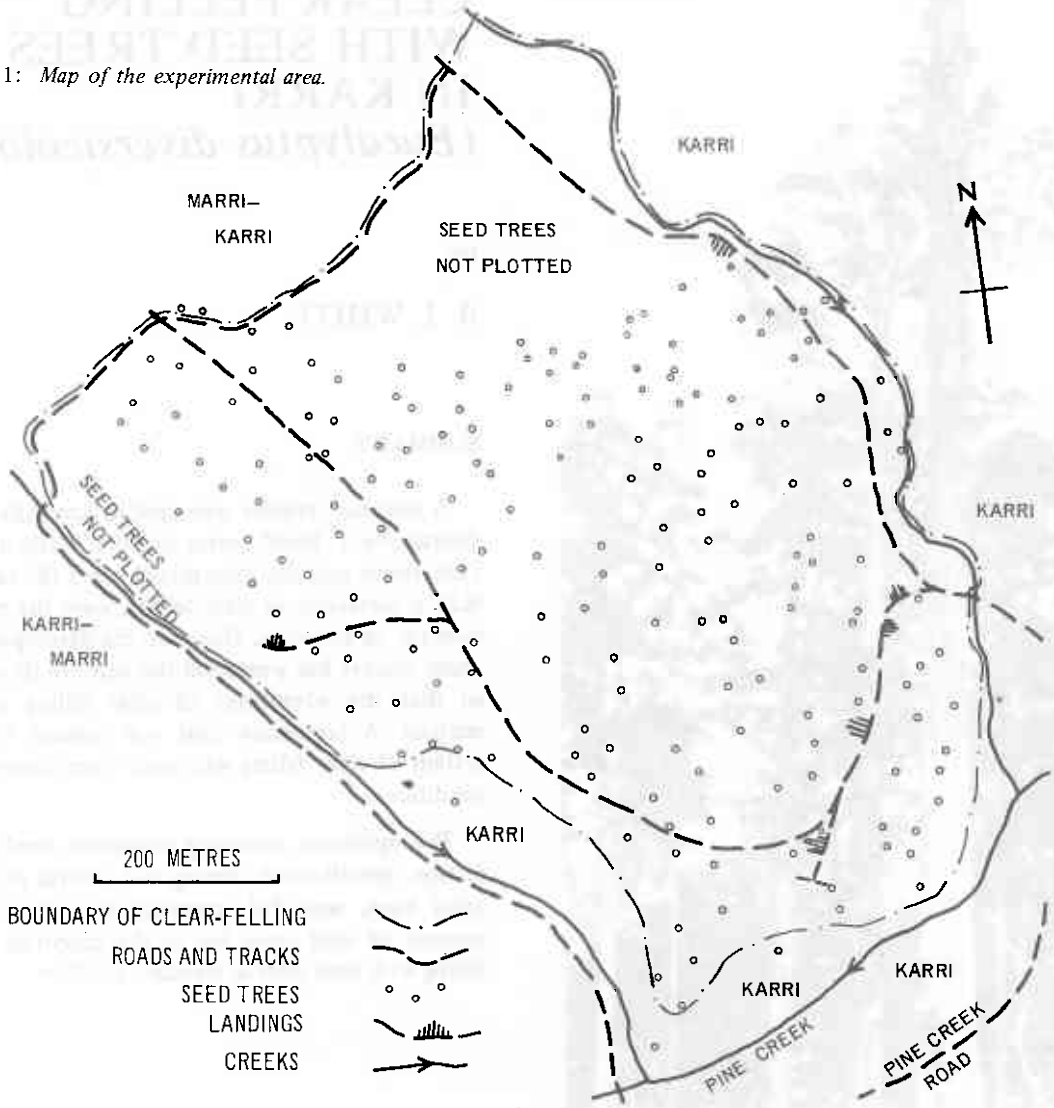

TABLE 1

Stand Composition

	Karri					Marri
	Girth (b.h.o.b) cm					
	152	152-274	274 +	Total	Total Salable	
Stem volume –						
Karri (m^3/ha)	0	17	666	683	549	0
Karri-marri (m^3/ha)	4	16	140	160	146	67
Stem numbers –						
Karri (stems/ha)	0	7.4	29.6	37.0	–	0
Karri-marri (stems/ha)	9.6	7.4	11.1	28.1	–	34.3

The forest type varied somewhat over the experimental area. On the slopes the type was pure virgin karri with a codominant height exceeding 61 m; westwards from Pine Creek it merged into a karri-marri mixture. Cutting ceased where the stand became marri dominant. A heavy understorey of *Casuarina decussata* Benth. occurred over parts of the area. The principal scrub species was netic (*Bossiaea laidlawiana* Tovey and Morris). Table 1 presents measurements from a 0.4 ha sample of pure karri, codominant height 70 m, in a stand adjacent to the experimental area, together with average values for a massed karri-marri mixed forest with 70 percent crown cover and a codominant height greater than 52 m. These latter values are average for Gray Block.

METHODS

The prescription adopted and the dates on which the treatment took place are given below.

1. Clear fell all stems except 2.5 to 5 seed trees per hectare: Mar.-Oct. 1966.
2. Remove marri and Casuarina: Mar.-Oct. 1966.
3. Burn for regeneration coincident with seed year: 10 Jan. 1967.
4. Appraise regeneration: Jun. 1967.
5. Remove seed trees following establishment of regeneration: Oct.-Nov. 1967.

Seed tree specifications required that they be dominants or codominants not less than 3.7 m, g.b.h.o.b. and have long straight boles and vigorous, healthy crowns. Two to five trees per hectare were left, spaced not more than 60 m apart. Earlier work (O. W. Loneragan, W. Aust. For. Dept., pers. comm.) has indicated that one tree would adequately seed 0.4 ha; the rest was safety margin to cover poor seed year or heavy seed loss.

A count after logging showed an actual density of 3.75 seed trees per hectare over 37.3 ha. Checks on crown cover by measuring sample tree crown area and by densiometer showed that the crown area actually retained was between 1000 and 1500 m^2/ha.

During logging, bulldozer operators were encouraged to use new trails when returning unladen from landings, so that more scrub was knocked down to make fuel. Cull karri trees, marri and Casuarina were either bulldozed or felled by power saw. Logging and preparation of the area for regeneration burning was completed by October 1966, by which time 81 percent of the available log volume had been removed (Table 2).

TABLE 2

Log Volumes Removed

Operation	Volume Removed (m^3)	
	Average/ha	Total
Main logging	305	17 774
Seed tree logging	69	4 030
Total	374	21 804

RESULTS AND DISCUSSION

Seed Supply

The availability of seed and the correct timing of the regeneration burn in relation to it are vital to the success of this system. Late 1966 coincided with the onset of the best seed crop for a decade: the estimated supply was 1.16×10^6 seeds per hectare, or four times the amount usually recommended for successful regeneration (Table 3).

TABLE 3

Seed Production

	Seed (million/ha)	
	Before burn	After burn
Under crowns	1.48	1.68
In open	0.84	1.28
Average	1.16	1.48

By December 1966, 85 percent of the seed capsules were considered mature enough to supply viable seed. Though seed supply was expected to be greater the following spring, the decision to burn promptly in January 1967 was made to take advantage of optimum fuel conditions. Slash and litter were 3 to 9 months old, dry enough for burning, and green scrub was absent. The longer such a fuel is held the more difficult it is to burn, since the fine fuel disintegrates and the green scrub rapidly colonizes between and within the heaps. Also, planning to burn as soon as seed supplies are adequate, rather than waiting till they are at a maximum, increases the chance of obtaining the precise weather conditions prescribed for burning.

The burn was carried out on 10 Jan. 1967, resulting in an ash bed free of residual scrub. All seed trees received crown scorch, with those on and near the ridgetop scorched to total height.

Seedfall estimates after the burn (Table 3) were 28 percent greater than forecast.

Germination

Germinants on a milliacre (4.05 m^2) plot were counted at each point on a 100 x 100 m grid (Table 4). Best germination rates occurred on ash beds and the worst on landings and snig tracks.

TABLE 4

Regeneration Appraisal

Number of Milliacres	Percent Stocking by Milliacres	Germinants per Milliacre	
		Range	Mean
110	93.6	0-172	34.17

(One milliacre is approximately equal to 4 m^2)

The seedfall, germination and initial survival results might suggest the stocking of 2 to 5 seed trees per hectare was excessive, but it needs to be remembered that this seed crop was unusually good. In a poor seed year this density might well be required. Furthermore, retaining a large number of trees of excellent size and quality encourages the sawmiller to return and remove them. Seed tree density could be varied with the anticipated seed crop. This result is well within the expected precision of such estimates and and is five times the amount considered necessary.

In a simple one crop situation, where flowering occurs in the third year after the appearance of pin buds (White 1971), there are three opportunities for successful regeneration burning, namely the springs of the fourth and fifth years and the autumn of the fifth year. Where consecutive crops merge, as happened at Pine Creek, the opportunities for successful burns are increased. Recent local experience indicates that an autumn rather than a spring burn is preferable, if there is a choice. (The January burn in this trial is classed as a spring burn).

Removal of Seed Trees

The results of sampling for regeneration showed an abundant and well-distributed stocking. The seed trees were removed in October to November 1967, after the heaviest winter rains. Lest careless logging of seed trees drastically reduce stocking, the logging crews were instructed to use established landings and snig tracks and to avoid sideways movement of logs. Also, logs were to be snigged directly back past the stump to the nearest snig track, wherever possible. Crown cuts were to be completed by chain saw, so that bulldozers would be unnecessary to break any remaining wood.

Damage was reduced considerably by the use of logging arches. Where large crowns fell into regeneration, enough of the young plants survived to ensure no frequent, unstocked gaps.

Stand Development

During the 3 years since germination, growth has been rapid, particularly on ash bed where growth up to 1.5 m per year has been observed. Scrub of *Bossiaea laidlawiana, Acacia urophylla* Benth., and *Trymalium spathulatum* (Labill.) Ostf. is present, but being well dominated by the karri it is not expected to compete. Overstocking in karri was evident from the beginning. Here, marked dispersion of vigour ensures early dominance coupled with continuous stand growth.

CONCLUSIONS

Because the planning and execution of this project were free of any unexpected difficulty and the result was a fully stocked stand of even-aged seedling karri, this trial was considered a success. The experience and confidence gained from it have assisted clear felling with seed trees as a standard practice in the karri forest.

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