SECOND GROWTH KARRI FOREST.

An elaboration of notes and observations made before and during an appraisal of the Karri forest situation by the Conservator and Senior Officers - October, 1954.

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The establishment in recent years of a number of large mills in the far South and the initial development and proposed logging of the Deep - Frankland area has underlined the need for full and accurate information to provide a sound basis for management. Cruise assessment proceeds on a scale adequate to give a quantitive value to type maps prepared from aerial photographs which are now available for most of the prime Karri forest.

In addition to securing an inventory of forest capital and associated data such as site quality index, we require data on rate of growth. The important figure from the management point of view, more particularly when the forest reaches normality, is the mean annual increment on the whole forest, which is precisely the volume which may be removed annually in perpetuity.

A start has been made with the establishment of increment plots in regrowth of known ages. It is convenient here to trace firstly the development of second growth on the Big Brook Working Circle, (State Forest No. 10), of some 7,500 acres, which carried some of the finest of pure Karri stands. Volumes upwards of 10,000 cubic feet were common. (Mr. A. C. Harris measured one acre of 19,800 cubic feet). The area was cut over by State Saw Mills, Pemberton, in the mid 1920's. At that time, no form of treemarking control was practised; fallers taking all trees which they classed as millable. In effect, the cream of the forest was removed and many stems were left as being too short in the bole (less than 50 feet) or showing slight signs of incipient rot or termite attack. These trees furnished seed for the second crop and were subsequently ringbarked as having no commercial value. On today's standards, most of them would be millable.

After logging, the area was prepared for regeneration by ringbarking of Marri, felling of Casuarina and construction of tracks for access and compartment subdivision.

In the summer of 1930 (when the regeneration burn was programmed) and coincidant with copious seed in Karri crowns, a fierce uncontrolled fire swept the area, probably started from Group Settlement clearing operations or from a bush locomotive, and burned all but a few small areas which had burned in earlier years.

A generally clean burn was secured and resulted in dense regeneration, probably 30,000 to 50,000 seedlings per acre. Mr. Stewart made a number of counts of 3 year old seedlings on small quadrats and placed the number per acre at upwards of 8,000. Spot sowing of Karri on some failed areas did not prove satisfactory.

A number of buffer areas, untreated and carrying almost complete canopy of Karri and Marri were left on the periphery of the Big Brook Working Circle for periodic burning to protect the regrowth. As much of these peripheral areas was beyond normal bullock hauling distance from landings, only odd perfect stems were removed.

Development of regrowth to the present stage :

The wheatfield regeneration resulting from what amounted

to clear felling with seed trees is now in the pole stage at 21 to 25 years of age. Some thousands of seedlings on each acre did not survive the early years. Along with the Karri grew the ever present Netic (Bossaiea aquifolia) and the Hazels (Trymalium spathulatum, Chorilaena quercifolia and others), the Karri Oak (Casuarina decussata) and odd Marri which intensified the struggle for existence.

Although much of the area had carried almost pure Karri, rtain of it had been mixed Karri and Marri and on these areas the and as a rule has been converted to Karri with occasional Marri. difficulty is experienced in effecting this conversion where esired if burning after trade cutting is withheld until Karri seed is plentiful.

The existence of an average of 10 loads (estimated) per acre of Marri, much of it of poor quality, over most of the Southern forest is a major factor in any consideration of sylviculture, management, fire control or utilisation in the Karri country.

Within 30 miles of Pemberton on State Forest we have upwards of 5,000,000 loads of Marri for which a market is required. The C.S.I.R.O. is working on the tannin content of the whole tree but unless the oil industry becomes established on a very large scale; the oil industry in the United States uses 40 per cent. of U.S. tannin production in its drilling muds. Eucalypt tannin is not entirely suitable for this purpose; and/or Australia's population expands at a very rapid rate, there does not appear to be a demand either locally or overseas which would warrant the establishment of more than one major tannin extraction plant.

At present only an occasional selected Marri log is sawn by local mills and although an increase can be expected, local cutting is unlikely to greatly assist our sylvicultural problem for many years. Such a high proportion of low grade logs exist that utilisation of all grades will be necessary to achieve any substantial advantage. Ultimately, an integrated plant may be developed which saws millable logs, by-passes low grade logs and mill waste to a chipping plant for extraction of tannin and/or other wood derivatives and finally compresses the leached chip waste into a wall board or similar product.

But that is a digression. At Big Brook, sixteen one tenth acre plots in compartment 9 (age 25 years) were first measured in 1949 and again in 1954.

The number of stems per acre at 25 years has fallen to approximately 850. Of these upwards of 300 per acre are whipsticks below 9" girth (b.h.o.b.)

Girth increment on all but dominant stems is unsatisfactory. (See table 1 below).

It is apparent from the figures that the stand is greatly overstocked. Stems below 36" GBH - OB comprise a volume of stagnant wood material amounting to 2,300 cubic feet per acre, or, over the entire area of dense regrowth, upwards of 7,000,000 cubic feet. If this could be removed economically, the 40 stems per acre remaining at approximately 25 feet spacing, could be expected to gain added increment until full canopy and full utilisation of the site is again achieved.

The stand is now, at 25 years, suppressing undergrowth except where the canopy is open.

The site at Big Brook is considerably better than at Channybearup near the Lefroy Brook where another plot of known age was laid down in 1916 by Ranger Mackay under the direction of Mr. Lane Poole who noted the past history of the forest as follows:

"The country was originally a mixture of Red Gum and Karri and 40 acres which make up Location 113 were leased to Mr. G. de Courcey Lefroy as a Tillage Lease. He cleared and cultivated 23 acres and after some years, abandoned it. Mr. Giblett acquired the area on 29/12/1869. Under my advice it was purchased by the Forests Department as a demonstration area in 1916 at £2. per acre."

From Lands Department records, it has been ascertained that the Location was first taken up in 1861 and abandoned in 1867. In 1865, part of the area carried a crop of wheat which was harvested with a sickle and ground in a mill powered by a water wheel on the brook.

Mr. Lane Poole describes the plot as :

"One acre of Karri regrowth (pure). 664 trees, the smaller ones badly suppressed. The presence of old Red Gum stumps and absence of young Red Gum trees shows that in this type of country, Karri takes possession. There is a good deal of dead timber lying on the ground which will be a danger until the plot is fire belted. There are no seedlings, in fact the girths range from 7½" to 6 feet but stem analysis showed that the large trees were all between 38 and 41 years old while the smaller trees varied between 27 and 30 years. Fires occur every 9 - 12 years so that it is safe to assume that the first growth followed the first fire after 1869, viz. about 1875 and this was followed again by a fire about 1885 which promoted a second lot of seedlings."

Accepting Mr. Lane Poole's regeneration year of 1875, the plot now, after 79 years, carries 83 stems with a total volume of 9000 cubic feet and an MAI. of 114 cu.ft./ac. Undergrowth consists almost solely of bracken with a few Hibbertias, etc.

In 1928 for the Empire Forestry Conference, an area of approximately 2 acres adjacent to the plot was thinned by the removal of dominated and suppressed stems. On this area, a second plot of one acre was established in 1949. Here, in 1954, the stems number 48, the total volume is 8,490 cubic feet and the MAI. is 107 cu.ft./ac.

On the unthinned plots, the volume increment on 24 dominants over the period 1949-1954 was 56 cu.ft./annum compared with 78 cu.ft./annum on 24 dominants on the thinned plot.

Our limited information suggests that we are getting a satisfactory response to thinning at Lefroy Brook.

Although thinnings cannot at present be marketed, the establishment of a number of plots thinned to varying degrees, in regrowth of known age will provide valuable information for the future. There is also a need for some experimental sawing to determine :-

(a) The minimum size for successful normal sawing practice.

(b) Suitable techniques for sawing young fast grown stems.

(c) The sawing properties of slow grown stems in dominated and suppressed classes.

Current Sylvicultural Practice:

Regrowth at Big Brook and Lefroy Brook has resulted from what amounts to clear felling with seed trees. Ring Barking of Karri and Marri has killed a substantial volume of millable timber, created additional protection hazards and annually involves expenditure for the re-opening of tracks blocked by falling stags.

Ringbarking is generally to be avoided.

The advent of treemarking placed an important sylvicultural tool in the hands of the forester. Today sylvicultural treatment of the virgin Karri forest can be expected to vary with every change of type and quality - from single tree selection to text book group selection (check Jacobs' "Australian Group Selection"), the extreme of the latter on small areas of large over mature stems approaching clear felling with standards. The treemarker needs a sound sylvicultural approach in his work. Recent thought and discussion has focussed our ideas on the advisability of inspecting the cutting section in advance of logging in order to describe the stand and prescribe for treemarking and subsequent treatment, thus ensuring the best handling of varying forest types and careful consideration of problem areas. Our sylviculture is closely linked with considerations of economics and utilisation particularly where the stand contains a high proportion of Marri. It has been suggested that certain of these areas should be excluded from the cutting section until such time as the Marri can be utilised. Much of the Karri forest carries such an adequate proportion of intermediate sizes that logging will merely effect a thinning. Some few stands can already be said to approach normality.

It is standard practice to burn the cutting section under mild conditions in advance of logging and afterwards to clear debris from the base of stems retained and burn the tops in suitable weather. A clean advance burn is often impracticable in Karri. It may be necessary to defer the top disposal burn one, two or occasionally three years until inspection shows that seed is mature in the Karri crowns.

Approximately twelve months after flowering, the first seed ripens and adequate seed is assured for the next two ensuring years with usually some seed in the third year, but thereafter, little or no seed can be expected for one or two years until seed ripens following the next flowering.

Little work has been done on seed dispersal and until better information is available, it is accepted that seed will throw a distance equal to the height of the tree, i.e. we can expect an opening of 400 feet diameter to seed up satisfactorily. Under exceptional conditions of fierce fire and high wind, examples are known of seed thrown up to 15 chains into cleared paddocks.

Overdense regeneration is undesirable on the score that from the outset and throughout the rotation, unless some thinning is done a proportion of the stand is dominated and suppressed, i.e. stagnating and retarding the development of the elite trees. Advantages which accrue from dense stocking, are good form, early cleaning of boles and suppression of undergrowth at approximate age of 25 years. The optimum spacing to secure these advantages without gross overstocking can, I think, be determined with regard to crown diameter ratio and observation of plots of known age and density. Scattered or open stocking is to be avoided as far as possible because of poor form, heavy branching and dense, tall and persistent scrub.

It is accepted also that fire protection of regrowth is essentail for at least the first ten years until the stand reaches the stage when it can be burned under suitable conditions. Burning has been carried out periodically on the Big Brook buffer areas without apparent detriment to the stand. Gaps created by logging on these areas have regenerated and we have a forest composition and condition much as we may expect in our selection forest.

Deriving from recent discussion on the Karri forest situation, further studies should be initiated into:

(a) Thinning of regrowth to varying intensity on plots of

known age - at Big Brook and Lefroy Brook in the first instance - also consideration and limited adoption of the Queensland single tree plot method of appraisal.

(b) Crown / Diameter ratio and theoretical ideal spacing of dominants at various ages.

(c) Seed dispersal and optimum size of openings.

(d) Response of stems retained following release by trade cutting.

(e) Soils, particularly with regard to the desirability or otherwise of converting predominantly Marri stands to Karri. P_2O_5 content of certain soils carrying Marri.

(f) Soil microfauna and flora - their place in the Karri forest complex.

(g) The life cycle of the Karri wattles (Acacia pentadenia and Acacia urophylla). Acacia seed viability and germination requirements. Inhibitive effect of Acacias on Karri seedling development. (Some work is being done in this regard).

(h) Germination requirements of Karri and seedling survivals.

(i) Effect of fire on the Karri forest (including understorey). Recovery of defoliated regrowth.

TABLE I - INCREMENT DATA.

KARRI REGROWTH - AGE 25 YEARS - PEMBERTON (BIG BROOK).

(Five $\frac{1}{10}$ acre plots measured)

Girth Class (inches)	9-12	12-18	18-24	24-30	30-36	36-42	42-48	48+	
No. of Stems/Acre	100	160	117	77	51	27	11	2	Total 545 stems
Mean Annual Girth Inct. (Ins.)(1949-54)	0.018	0.058	0.152	0.368	0.668	1.026	1.026	1.42	
Basal Area/Acre (ob. -□')	4.542	18.894	25.944	32.276	25.536	27.924	21.746	17.88	Total 174.742 □'
Basal Area/Acre (ub. -□')	* 3.180	13.226	18.196	22.593	17.875	19.547	15.222	12.52	" 122.379 □'
Bole Height (to 3" dia. - ft.)	10	25	45	60	80	90	90	90	
Form Factor (to 3" Cr. diam.	0.68	0.64	0.60	0.58	0.55	0.51	0.46	0.45	(Based on 18 sample trees only)
Volume/Acre (cub.ft.)	20	210	490	790	790	920	20	500	

Volume/Acre (cub.ft.)

Total ... 4,200

" " (loads) 84

Mean Annual Increment 168 cubic feet/acre.

* BA/Ac (u.b.) = BA/Ac. (o.b.) less 30 per cent. (based on sample trees 24" - 55" G.B.H. o.b.)

TABLE II - INCREMENT DATA.

Karri Regrowth (Age 79 years - October, 1954) Plot No. 7 Channybearup.
Unthinned.

Girth Class (Ins.)	18 - 36	36 - 54	54 - 72	72 - 90	90 - 108	108+	
No. of Stems/Acre	17	20	14	22	7	3	Total 83
Basal Area/Acre (o.b.) □'	8.484	22.984	33.556	80.926	35.943	27.038	
" " " (u.b.) □'	6.363	18.387	27.96	67.46	31.27	24.33	Total 175.77 □'
Bole Height (Feet)	37	62	86	90	92	92	

Form Factor - 0.60 used - Based on sample trees - taken to bole height.

Volume/Acre - cub.ft.	141.26	689.63	1442.74	3659.03	1726.1	1343.02

" " - Total ... 9,000 cubic feet (180 loads)

Mean Annual Increment 114 " "

Volume Inct. 24 dominants (1949-54) 280 " "

M.A.I. 24 Dominants 56 " "

TABLE III - INCREMENT DATA.

Karri Regrowth (79 years - October, 1954), Plot No. 7A - Channybearup.
(Thinned 1928 to 48 elite stems)

Girth Class (Ins.)	36 - 54	54 - 72	72 - 90	90+	
No. of Stems/Acre	10	14	9	15	Total 48
Basal Area/Acre (o.b. -□')	11.131	33.700	33.101	87.268	Total - 165.200□'
" " / " (u.b. -□')	8.9	28.08	28.04	75.93	
Bole Height - Feet	62	86	90	92	
Form Factor 0.60					
Volume/Acre, o.b. ft.	331.1	1450.56	2514.16	4191.34	

" " total ... 8487.16 cubic feet (170 loads)

Mean Annual Inct. 107.4 " "

Vol. Inct. 24 Dominants (1949-54) 389.5 " "

M.A.I. 24 Dominants 78 " "