



0. Botanical description.

T.V.M. Eucalyptographia Decade 5 and C.R. Vol.2, 298.

1. Range:

Approximately from 34° to 35° south latitude within the $35''$ and over rainfall belt of Western Australia. Or more precisely the main belt is bounded on the north by a line running from Nannup to Mangimup; on the west by a line from Nannup due south to close to the mouth of the Donnelly river; on the south by the sand plains which extend for varying distances (6 miles at the Warren, 15 miles at the Shannon, and a mile or two at the Frankland) from the coast inland to Albany. On the north-east it runs from Mangimup a little to the North of the $40''$ rainfall line to Albany. An isolated patch is to be found on the extreme west between the Margaret River and Cape Leeuwin. Another isolated patch occurs around the slopes of the Porongorup Range north of Albany.

11. Topographical Range:

The configuration of the country appears to have no influence on the occurrence of this species. It is found growing around sea level at Karridale, Denmark and Nornaloo. On hills under 1000 feet between Pemberton and Mangimup. On all aspects.

12. Climate Range:

Castanetum climate. Mean temperature of 4 hottest months 65° . Unfortunately there are no temperature stations in the centre of the prime belt and I have had to use Bridgetown and Karridale for data. As with jarrah the rainfall is a winter one but the peak in June and July is an inch and a half higher than at Collie. November, December, January, February, March and April receive less than the mean monthly rain of 3.95 inches while the mean temperatures for Karridale are all over 60° , while the mean maxima are between 70° and $76^{\circ}.5$. The mean of the minima for the coldest month at Karridale is about the same as at Perth 46° , while the hottest month gives a mean of maxima of 76.8 with Perth 84.9 . The diurnal range is $17^{\circ}.8$. Summer 20° and winter 14° . The distribution of the rain is similar to the jarrah belt except that being nearer the southern cyclone belt it receives more rain in winter; and in summer misty weather and light showers are of more frequent occurrences. The rainfall is assured and its variability small.

13. Soil Range:

Karri requires a better class of soil than Jarrah. It is a light loam derived from granites and schists. When wet a bright red and a greyish red when dry. In wet weather the "whims" bog down in it and mechanically hauled logs though fitted with a steel spoon-shaped nose dig deep channels in the ground. In the dry summer the surface breaks up into very fine particles and the teams were always enveloped in a cloud of this dust as fine as snuff.

After clearing this surface soil washes down and the subsoil a tightish clayey loam remains on which agriculture is difficult. Grasses such as cocks foot and good clovers introduced from abroad establish themselves well to begin with but after a few years they disappear and bracken returns. This refers to the soil of the pure Karri, where it is found mixed the nature of the soil is different and sound agricultural land is present, except when the mixture is with jarrah where the presence of secondary laterite makes the nature of the soil more satisfactory for fruit growing. The pockets of good soil under karri, marri and blackbutt, or karri, marri and tingle, are larger on the whole than the pockets of agricultural land in the jarrah belt.

14 & 15. Forest Types:

Undergrowth

A. Pure Karri. This occurs more on the slopes and ridges than on the flat lands. The only tree underwood is karri sheoak (*Cas. decussata*) and the two banksias (*B. grandis* and *B. littoralis*) which occurs in little groups here and there. An undergrowth sometimes attains 25 feet and consists of karri wattles (*Ac. pentadema* and *Ac. Gilberti*) but this is usually restricted in its occurrence running in belts here and there. Lower than wattles, and not as a rule mixed with them, are such undergrowths as the Hazels (*Trymalium Billardieri* and *Chorilaena hirsuta*) and smaller still and again as a rule disassociated occurs the water bush (*Bossiaea aquifolium*). Now the Hazels are decidedly hygrophilous, their leaves are soft and in the case of *Chorilaena* are very hairy. Penetrate a thicket of these in summer and you would say you were in a temperate woodland, of the northern hemisphere but they are not deciduous and so the karri forest came to be called temperate rain forest. The trees and most of the shrubs however are decidedly sclerophyllous and so I have called this type wet sclerophyllous forest. Another undergrowth which covers wide areas and which in springtime makes a cloud of blue is the blue bush (*Howea elliptica*). This grows about 5 feet high. Smaller again are the banjines (*Pimelea clavata* and *P. argentea*). Two small acacias and the so called willow bushes (*Oxylobius*). Mention must also be made of the zamia palm which on a certain hillock near the Donnelly attains 15 feet in height. Blackboys and grass trees are absent. The most prevalent soil cover is bracken. Wide areas of pure karri is carpeted with bracken which is often 5 ft tall. Native grass, it is said, once grew where the bracken now occupies the whole forest floor. Certain it is that large herds of cattle roamed the country between the Donnelly and the Deep Rivers 50 years ago where today only a very small number find sustenance. These cattle cannot be left for long in the karri forest for they develop rickets from eating the zamia palms on the burnt patches and have to be moved down for a change of nutriment to the limestone and sand coastal ridge where natural grass exists. There again they can't be left very long for they develop a disease called "chipchip" due to absorbing sand; they are then said to be "coasty" and are moved back to the karri. I give these details to show you how greatly the conditions have been altered by man. Opinion at present differs as to whether the bracken is invading the woody undergrowth types - wattles, water bush, hazels and hovea. I thought it was and attributed the intrusion to fire. The value of the woody underwood is great for they make a

good litter and humus is present in the karri forest wherever they occur. They differ naturally as to the quantity of humus made and in this the hazels stand first. Nowhere is the undergrowth suppressed except under karri sheoak. These make the usual carpet of needles in which no plants will come up.

Sub-types of pure Karri type:

AI. Edaphis:

Along the larger streams which are numerous grows cedar and peppermint (*Agonis Juniperina* and *A. flexuosa*) and river *Banksia* (*B. verticillata*) and also swamp wattle (*Albizzia lophantha*).

Wet undrained land here and there carries bullich (*E. megacarpa*). In jarrah country it will be remembered it was only found on the banks of streams.

B. Karri, Marri, Blackbutttype:

Karri mixed with marri and blackbutt or islands of marri and blackbutt alone are common. According to the proportions of karri to the whole these areas have been included in the State forests or thrown open to selection by farmers. The underwood and undergrowth is similar but natural grass known as karri grass was to be found here and there under big marris. Sub-types of B. are similar to those of A.

C. Karri, Red and Yellow Tingle and Marri.

This type occurs to the south east in patches from the Deep river to Denmark though at the latter place the limit of tingle appears to have been reached. The undergrowth is different in that the wattle types are more plentiful.

Sub-type of C are similar to A. but a new melalencia occurs in the swamp type. For details see the descriptions of the tingles.

D. Karri, Marri and Jarrah.

The pure jarrah type climbs down from the ridges of ironstone into the Karri Marri type. It is more an overlapping of types than a distinct type except at Karridale. Here the mixture of jarrah and karri is more even and the mill sawed both timbers and, unfortunately, frequently sold them mixed. In this type the undergrowth at its best is bracken and at its worst the jarrah country xerophytes. Here blackboys occur, also grass trees and zamias of small size abound.

General:

Perhaps the most conspicuous difference between jarrah and karri country is the lack of logs on the floor in the latter. Jarrah is a very untidy forest for the fallen timbers lie for generations while, in the case of karri, two years will see the logs attacked by fungus and in a remarkably short time entirely destroyed.

16. Karri has been planted in many parts of the world, Spain, Algiers and notably in Cape Province in South Africa. There increments of 4 - 600 cubic feet have

been recorded per acre in the early life of the tree. What is the increment when the formation of pipe wood ceases and sound timber is put on is not known.

2. Sylvicultural characters:

21. Form above ground.

A very big tree reaching in one case a height of 278 feet. The average would, however, be 200 feet. The girths at breast height are great and 34 feet has been measured. The merchantable log is 9 feet g.b.h. The bark decorticates annually and causes deep debris at the foot of the tree. Only when a tree is sick e.g. a suppressed pole or a veteran on its last legs does the bark persist. A king among trees with a magnificent form. The barrel is always very straight and the taper is uniform and amounts to 80% or a form factor of .64 for 9' to 15' logs. The crown is compact and denser than any eucalypt of its size. It seems a little less crown shy so that in an old virgin stand the distance from crown to crown is very small not more, I think, than in pure oak. The leaves also seem more horizontal and while there is really little shade on the ground, and certainly no light demanders are suppressed, the interference by the canopy is greater than in all other eucalypt forests except tingle. Much of the light that reaches the ground comes obliquely through the tall stems and the increase of shade is most noticeable on a slope where this advantage or disadvantage is lost.

I hope to add to this information some details of actual measurements of trees. Here are the figures of a measured acre of very first quality:

Volumes per acre actually cut from Prime
Karri Forest at Big Brook Working Circle.

Area - 1 acre (5 chains x 2 chains)

No. trees merchantable 11.

Vol. per acre. 237,444 Super ft. or 395 $\frac{3}{4}$ loads.

No. : G.B.H. : Basal : Girth top : Length : Height : Form : Vol. : Approx.
Tree : : areas : of log. : of : to top : Factor : c.ft. : loads.
: : : : Log. : of tree : :

No.	G.B.H.	Basal areas	Girth top of log	Length of Log	Height of tree	Form Factor	Vol. c.ft.	Approx. loads
1	17'	23"	9'3"	92 ft.	195 ft.	.59	1253	25
2	25'9"	52	9'11"	115	230	.48	2910	58
3	18'6"	27'2	12'4"	110	275	.7	2103	42
4	13'2"	13'8	7'11"	88	150	.63	772	15 $\frac{1}{2}$
5	15'2"	18'3	6'5"	135	195	.61	1241	24 $\frac{3}{4}$
6	28'4"	63'9	14'6"	128	232	.57	4672	93 $\frac{1}{2}$
7	18'	25'8	7'3"	72	195	.49	919	18
8	22'	38'5"	13'2"	128	232	.64	3149	63
9	11'10	11'1	4'7"	96	232	.48	509	10
10	19'9"	31'	11'10"	59	209	.64	1165	23 $\frac{1}{2}$
11	15'2"	18'3	9'11"	88	209	.66	1094	21 $\frac{3}{4}$

Total Basal Area = 323 sq. feet.

Acre measured by Divisional Officer Harris. Figures published in A.F.J.

Two trees not taken to mill because they were too small had girths of 60" and so 4 sq.ft. basal area should be added making a total B.A. of 327 square feet.

The average volume per acre over 1000 acres is 3600 cubic feet.

22. Tolerance:

Karri requires large openings to regenerate. Virgin stands contain no young trees except under wide holes. Seedlings die off under big trees even when there is a good blank beyond.

23. Root system.

A very wide superficial root system quite as wide as the crown and here I think lies the explanation of seedlings failing to come through the summer. The roots of the large trees together with the bracken take up all the moisture. Not such a wind firm tree as jarrah.

24. Flowering and seeding.

No general seed year has been recorded as yet. A light flowering took place at Big Brook in October 1925 and a heavy flowering in October of 26 and 27 and a spasmodic flowering in October 28. No ripe seed was obtained in the 1926-27 summer but in January to March 28 and January to March 29 supplies of seed for sowing were obtained from felled trees. Standing trees on unburnt country still retain their seed.

So the tree buds in April - June, flowers in October and seeds January to March 1 year and 2 to 4 months later.

25. Germination and initial development of seedlings.

Seed planted on 19-6-29.
Germinated in 7 days on 26.6.29.

3 wks.2 days: 19.7.29.

This species, unlike *E.marginata* has a comparatively long stalk at this age. First 2 primary leaves are formed and 2nd two are plainly visible. The root system is not deep and several shallow laterals have already developed.

Measurements:

Cotyls 12 x 4 m.m. Prim. leaves 10 x 3.5 m.m.
Cotyl stalks: 3.5 m.m. leaf stalks 2 m.m.
Stem: 24 m.m. Root 7 m.m.

5 weeks +, 3-8-29.

Rate of development is very noticeable. Stalk, leaves and root growing quickly. The cotyledons have become more deeply emarginate. Leaves are opposite and their venation is simple and distinct. Oil dots are present.

Measurements:

Cotyls: 12 x 3 m.m. 1st pr. leaves 20 x 8 m.m.
Cotyl stalks: 7 m.m. 2nd pr. " 27 x 10 m.m.
Leaf stalks : 6 m.m. 3rd pr. " 12 x 3 m.m.
Stem: 57 m.m. Root 29 m.m.

6 weeks +: 10-8-29.

Development of stalk and leaves and the appearance of small stipule like shoots in the axils of leaves is very noticeable. Venation is more clearly defined especially the intramarginal vein. Cotyledons persisting.

8 weeks + - 24-8-29.

Cotyledons are disappearing. The height of seedling has increased rapidly. The leaves have become darker and more lanceolate. Oil dots are more numerous. Root tubers absent. Leaves are becoming sub-opposite.

Measurements:

Stalk: 108 m.m. Root: 31 m.m.

General observations:

Karri seedlings germinated very well and quickly. Their rate of growth, compared with the other eucalypts, has been very rapid. The root system is not deep and many shallow laterals are present at all stages.

Seed count 60,000. to the lb.

Seedlings attain 10 feet in 2 to 3 years.

26. Ligno tubers are not developed by karri and rapid height growth is the rule with seedlings.

27. Micorrhiza: Nothing known.

28. Post seedling development.

No sample plot data available but a 40 year old crop of karri that sprang up on an abandoned holding shows 3000 cubic feet per acre and an average increment of 2.6 per cent. Average height 75 feet. The saplings develop in height rapidly and stand very close spacing. Until they are 30 feet high the crowns mingle well. Dominants now show up well and the suppression of the remainder follows rapidly.

3 - 311. Natural regeneration takes place by seed spontaneously in holes where a big tree has fallen but the number of seedlings that survive is always very small.

312. By silvicultural methods and particularly by the use of fire good results are obtained. An examination of abandoned holdings shows that in some cases for a wide distance from the adjoining forest seed has been dispersed, has germinated well and the seedlings have developed strongly. In other cases no germination has taken place whatever and, though many years have elapsed and the trees have seeded many times, the holdings have not become stocked. The regeneration work carried out during the last two years at Big Brook is interesting and I reproduce here Stoa's notes on same.

Method of treatment:

- (a) Oak felled - completed June 1927. (No marri on the subject areas).
- (b) Burnt. February 1928.
- (c) Karri ringbarked. August 1928.

Results:

Two ten-acre areas, adjoining each other, were examined.

Area A. Sparse regeneration developed from germination in May 1928. This regeneration is quite dense in a few patches. A very heavy seedfall has occurred during the 1928-29 summer following the ring-barking and the ground now (June 1929) is literally covered with karri seedlings in the cotyledonary stage. These seedlings were to be found everywhere in dense scrub, on logs, etc. Dense growth of *Kenedya prostrata* covered the ground on the heavily burnt patches with a dense mat 1-2" in thickness. Interesting to note that on pulling up this mat karri seedlings were found covering the soil beneath. These seedlings in the cotyledonary stage appear to be suffering from want of light and will be watched for "damping off". Surprising to find that the seed had penetrated this mat and reached the mineral soil beneath.

Area B. Dense regeneration developed from germination in May 1928. Very little seed fell in 1928-29 summer as apparently almost all the seed had fallen in the previous summer following the fire. Only an odd seedling in the cotyledonary stage could be found in June 1929.

Apparently the explanation for the difference on the two areas is that area B was more heavily burnt than Area A. An important factor is the degree of ripeness of the fruits. Owing to the greenness of the fruits, although most of the seed was fertile, a hot fire was required to cause sufficient drying to permit opening of the vessels. In the coming summer with the fruits more developed and nearer the natural ripening and opening stage, a light fire may well provide sufficient for opening, or even be unnecessary. An area lightly burnt in February 1929 showed very few seedlings in the cotyledonary stage, and most of the seed vessels are still on the trees and very green.

The use of fire at the right time seems most important not only for the preparation of the seed bed but to hasten the opening of the seed vessels. These unregenerated abandoned holdings had certainly been burnt many times but the synchronising of the fire with seed years was a matter of chance.

32. Coppice:

Karri coppices strongly after it has reached a certain size which is not definitely known. Like blackbutt an inch diameter sapling will put out coppice shoots from the swelling that occurs just above the collar but these die back in the following summer and unlike a eucalypt with ligno tubers they do not grow again.

4 - 46. Artificial regeneration. No data.

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5. Tending after seedling stage.

Thinning is most desirable but until a market can be found for karri poles no thinning is practicable.

6. Sylvicultural systems.

Being much more intolerant to root competition than jarrah the group selection system seems quite inapplicable. The crowns of large karri may be 80 - 120 feet in diameter, and more or less even aged groups are found extending over an acre or more.

An average of 5 trees to the acre is all we can expect to find and clear felling with seed trees is the obvious system. Whether it will be possible to lessen the thinning trouble by maintaining some trees to suppress a large number of the individuals in the too dense crops of seedlings that will, we hope, result from the present regeneration work remains to be seen. There is not the same objection to clear felling as exists with more tolerant eucalypts for there are few vigorous middle size trees in the virgin forest and these are as a rule smashed by the fall of the big ones.

No size of blank has been laid down by the Department as the smallest worth considering in regeneration work but observations go to show that at least 3 chains are necessary from stem to stem of nearest trees.

7. External Dangers:

Man is the only serious danger and his fire stick is more devastating than his axe. Karri with its annually decortivating bark is more sensitive to fire than a rough persistent barked tree and, while fires do not occur frequently as in the jarrah forests the moist conditions making the bush too wet to burn, the same cause makes for more luxuriant growth so that when a fire goes through it is a big conflagration. I have seen giant karris defoliated to the topmost twig. They cover themselves with greedy branches and often recover but many are killed outright. Stock is too sparse to be a serious trouble. A longicorn borer making an oval or kidney shaped hole in the wood causes some bother as does a pin hole borer.

74. Plants.

Apart from increasing the fire hazard no plants do harm. The retention of karri oak seems desirable and the introduction of a less inflammable understorey and one which would make use of all the food now being utilised by wattles and water bush and bracken would be welcome. Fungi attack dead wood and logs are rapidly consumed.

76. Erosion:

After clearing the accumulated forest soil washes away but the slopes are nowhere steep or long enough to cause apprehension from the standpoint of erosion.

77. Floods: No serious floods occur.

8. Afforestation - Nil.

9. Statistics:

Area dedicated State Forest	152,130 acres	(Decennial report).
Area of virgin karri	238,800 "	(B.E.F.C. statement).
Volume	301,650,000,000 cu.ft.	"
Rate of Milling	4,571,000,000 "	" "
<u>Area regenerated</u>	<u>4.675 acres.</u>	