PAPERS
AND
PUBLICATIONS

for the use of

OFFICERS OF THE
FORESTS DEPARTMENT, W.A.

including
Papers presented
to the

AUSTRALIAN
FORESTRY CONFERENCE
HELD IN W.A., 1949

"FORESTS OF THE DRIER AREAS OF WESTERN AUSTRALIA."

A Paper prepared
for the
AUSTRALIAN FORESTRY
CONFERENCE
1949

by
G. E. BROCKWAY

31485/10/49—1m.

FORESTS OF THE DRIER AREAS OF WESTERN AUSTRALIA

By G. E. BROCKWAY

Western Australia, which occupies almost one-third of the Continent, is in the main a land of low rainfall. Of its total area of 976,000 square miles, only one-eighth (12.6%) receives an annual rainfall of 20 inches or better. Even of this the larger portion (9%) lies within the tropics and carries practically no forest of economic value.

The table hereunder shows approximate areas (in 1,000 square mile units) falling within the various rainfall zones, together with corresponding percentage of the State's total area represented by each:—

	Over 40in.	40in.—30in.	30in.—20in.	20in.—15in.	15in.—10in.	10in.—8in.	Under 8in.
A.	4·9 ·5%	21·5 2·2%	61·5 6·3%	29·3 3·0%	125·9 12·9%	... ...	... ...
B.	9·75 1·0%	9·75 1·0%	15·6 1·6%	26·3 2·7%	97·6 10·0%	325·0* 33·3%	249·0† 25·5%

Total area of State—976,000 square miles.

A Within tropical rainfal belt—summer rainfall system.

B Extra tropical—winter rainfall system.

* Part within A and part within B—rainfall irregular.

† Rainfall irregular. This area forms a buffer between tropical and extra tropical systems.

The better known commercial forests of Jarrah, Karri and associated species are confined to that small fraction (2% of total area) of the State which receives 30 inches of rainfall or better per annum, with Wandoo extending eastward as open forest to areas of 20 inch rainfall.

Beyond the 20-inch isohyet, which lies some 50 miles east of Perth, occurs the inland forest or sclerophyllous woodland.

Although the timber trees of these forests are little known beyond the boundaries of the localities where they grow, they represent a valuable asset and have played a considerable part in the State's development—particularly in respect of the mining industry.

Tropical Zone.

The tropical portion of Western Australia is of very minor importance in timber production, and with the exception of the small, isolated and difficult accessible belts of native pine (Callitris intratropica) which are found in the extreme north of the State, the few species which attain the dimensions and quality of even low grade mill logs are confined to the banks and beds of the rivers. The vivid green of the foliage of these riverine species contrasts sharply with the duller hues of the xeraphytic vegetation a few yards away, beyond the influence of the river moisture.

The more common species found in these river belts are:—

River Gum—Euc. camaldulensis.

Blackheart—Euc. microtheca

Cadjuput—Melaleuca leucadendron.

Leichhardt Pine—Sarcocephalus cordatus.

Chestnut—Terminalia platyphylla.

Figs—Ficus spp.

The limited quantity of these timbers available, coupled with the attenuated pattern of their distribution, quite apart from their poor form and inherent faultiness renders their use in anything but a very small way, impracticable.

Small quantities are sawn, for station use, usually on rough benches driven by low power petrol engines. However, on the less developed stations more primitive methods are used and the outfit may be no more elaborate than a couple of station hands with a blunt crosscut saw.

Low forests of stunted Eucalypts with a grassy ground flora are found in portions of the Kimberley Division. These are Western Australia's only true savannahs. They carry no trees of timber value.

Extra Tropical Zone.

From about the 20-inch to the 9-inch isohyet, in belts of varying extent, distributed through an area of some 120 million acres, occurs the sclerophyllous Eucalypt woodland. These belts are interspersed with non-timber country, viz., cleared areas, salt lakes (and treeless country near them), Mallee, scrub plains and heath.

In view of the great area involved, the inaccessibility of much of it and the lack of detailed assessments, any estimate of its total area must of necessity be an approximation. However, what data is available indicates an area of some 18 million acres, of which approximately one-third has been cut over.

In spite of the comparatively meagre rainfall, some fine trees occur; in fact, trees which must be considered unique in the floras of the arid regions of the world.

This Eucalypt zone can be broadly divided into three, viz.:—

(a) 20-inch to 15-inch Rainfall.—The York Gum (E. foecunda, var. loxophleba), Jam (Ac. acuminata), association with, of course, other species, e.g., the Mallets, Manna Gum (Acacia microbotrya), etc., in minor proportions, although not necessarily of minor importance. The area of this forest has been considerably reduced by clearing for agriculture.

(b) 15-inch to 11-inch Rainfall.—The Salmon Gum, Gimlet, Morrel and Yorrell associations which have also been largely removed in the development of what is now the main wheat growing area of the State.

(c) 11-inch to 9-inch Rainfall.—The eastern portion of the zone, beyond the generally recognised agricultural belt, where no clearing for agriculture has been carried out. The timbers include those in (b), together with a number of additional species, e.g., Euc. Dundasi, Euc. Brockwayi, Euc. Le Soueffi, Euc. Woodwardi, etc. In this subzone in no month does the average precipitation exceed the evaporation. The soil types of the zone fall into four broad groups, viz.:—

(1) The red brown loams with considerable calcium carbonate in the subsoil and in some instances, particularly in the south-easterly portion of the zone, coming right to the surface. These soils carry the main timber trees of sub-zones (b) and (c) above.

It is interesting that at a depth of 6-10 feet an acid subsoil occurs. The presence of the alkaline layer above this has been attributed by some workers to the action of the forest flora, drawing calcium from the lower layers and returning it by the deposition and subsequent decomposition of debris, to the surface of the ground whence it is transported back to the soil as carbonate. The light nature of the precipitation—an average of about 20 points per wet day is not conducive to the transport of this material to any great depth.

(2) The brown and grey sandy and loamy surfaced soils, alkaline but less so than (1). These carry mainly Mallee. (Nos. (1) and (2) above correspond to the "Mallee" soils (of Prescott) of the Eastern States.)

(3) The brown and red brown medium textured soils more or less neutral in reaction, with dark clay subsoils. These occur in the western portion of the zone, i.e., sub-zone (a) where the action of slightly heavier rainfall has resulted in the calcium being replaced by iron and aluminium.

(4) The yellow and grey sandy and gravelly soils—in some areas showing areas of massive laterite—acid in reaction and carrying heath or scrub such as Wodjil (Acacia Beauverdeana, Ac. signata, etc.), Tamma (Casuarina campestris) and some small Mallees (Euc. leptopoda, etc.). These soils represent portions of a very ancient land surface formed under climatic conditions involving heavier rainfall than at present.

On the edges of the scrub plain belts where the laterite has weathered away exposing the less durable underlying rock, small cliffs or breakaways occur. Amongst the weathered material of these breakaways some important species are found, notably the Mallets (Euc. astringens, Euc. Gardneri and Euc. falcata) and Wandoo (Euc. redunca).

Since the heavier and richer soils of the wheat belt carried the timber species, it is not surprising that enormous quantities were destroyed in the process of clearing. This has proved a great handicap to these concerns throughout the area requiring wood fuel (e.g., alunite industry, flour mills, pumping stations, etc.).

The "forests" of the 11-inch to 9-inch rainfall zone have been of considerable importance in that they have supplied the bulk of the fuel and mining timber for several of the main goldfields of the State. Prior to the construction of the railway line to Kalgoorlie, sawn Salmon Gum was used for building purposes. However, when rail transport enabled sawn Jarrah to be placed on the market at about one-quarter the price, its use for this purpose ceased. The toughness of the inland timbers makes them invaluable for mining purposes where great strength and resistance to abrasion are required and while most of the mining timber is used in the round, a steady demand exists for sawn Salmon Gum and Morrel for underground use.

Since the discovery of gold, some 27 million tons of timber has been cut from the inland forests for use as fuel and mining timber.

This has entailed the felling of some 7 million acres of forest. At one time the consumption was in the region of a million tons per year, but it is now about a quarter of that figure. Firewood for the Golden Mile (Kalgoorlie) is at present transported slightly over a hundred miles from the forest on a private (3-ft. 6-inch gauge) railway. The greatest distance hauled to date was about 130 miles. Within 150 miles of Kalgoorlie are ample supplies of timber for at least another half century.

In view of the low value per acre of these forests and the uncertainty of the life of the mining industry, no special steps, such as the planned retention of seed trees or vigorous growing stock, are taken to ensure regeneration or the provision of timber for subsequent cutting. By far the greater proportion of cutover country, however (estimated at 90 per cent.), carries some second growth, seed for the production of which has been provided by the felled crop and by large over-mature trees which have been left by the cutters.

In some parts the regeneration has been prolific; in others sparse, the success depending on a number of factors, viz., the species, the site, the locality, the seasons, the occurrence or absence of fires through the tops after the cutting. Second growth timber is protected from general cutting.

The problem which causes so much concern to the majority of Australian foresters, the uncontrolled fire, is of minor importance in the inland Eucalypt forests.

Bush fires are infrequent and except following clear felling operations or after occasional wet seasons when a heavy growth of grass and ephemeral herbage develops, they are of very small extent. All trees of the interior are extremely fire tender and only the Mallees coppice after a fire. A light fire with flames only a couple of feet high is sufficient to cause the death of thin barked species, such as Gimlet (Euc. salubris).

To the east the Eucalypt belt becomes broken and the trees sparse with Mallee types predominating and eventually it merges into the Nullarbor Plain.

To the north there is a somewhat gradual transition from an Eucalypt to an Acacia association. In this transition region are found extensive areas of "Oak" or "Belah" (Casuarina lepidophloia).

In this Acacia association the commonest species is Mulga (Acacia aneura). Mulga is found over extensive areas of inland Australia and the virtual extermination of this species over considerable areas in the Eastern States has been a matter of grave concern to pastoralists and soil conservationists.

It would appear that under the severe and irregular conditions under which Mulga exists, death from drought, at times on a wholesale scale over many acres, has been a common feature, while grass fires following wet seasons (e.g., 1942) have devastated considerable areas.

In the past the durability of the seed of Mulga and the species associated with it has ensured a replacement in better seasons. With the new set of factors introduced with our entry into the country, the natural sequences have been upset. Grazing animals, both native and introduced, destroy not only many of the young plants, but also

seed. There is evidence that Mulga in this State in its young stages is not relished by stock, but whether this is the case in extreme droughts may be doubted. There is a field here for much further research.

The demand made by the mining industry for fuel and timber have been particularly heavy for many miles round many of the mining towns and even in recent years some 20,000 tons of it has been used per annum on the northern goldfields.

While it is undesirable that a plant with the browsing value of Mulga should be felled for fuel, the economic importance of the mining industry is a factor which cannot be ignored. The greater part of the Mulga used is required for producer units which cannot easily change to other fuel.

To reconcile as far as may fairly be done the conflicting interest of the pastoral and mining industries, certain restrictions have been imposed in connection with the cutting of Mulga. The most important of these are:—

(1) A minimum diameter limit of three inches is imposed for all cutting.

(2) No cutting of green Mulga is permitted on any area not carrying more than seven trees per square chain and on any area cutover at least seven trees over four feet in height must be left per square chain.

(3) The cutting of green Mulga for domestic firewood is prohibited, while industrial plants are required to use a high proportion of dead Mulga as fuel.

While Eucalyptus camaldulensis occurs along the larger water courses throughout the Mulga zone, perhaps the most interesting Eucalypt of this region is the Desert Gum (Euc. eudesmioides). This occurs both in Mallee and tree form and specimens 40 feet or more in height are not uncommon. It is invariably associated with Spinifex (Triodium spp.) on red sands and is found in areas of very low rainfall some two hundred miles north-east of Kalgoorlie. Its timber is brittle and of little value except for firewood, but the drought resistance of this tree should render it worthy of consideration in wind eroded inland areas.

Sandalwood, Santalum spicatum, a small tree of insignificant appearance which has been exported to Asiatic countries for years, has provided the well-known aromatic wood of commerce and also a valuable essential oil.

Originally occuring to within sixty miles of Perth, it is now rare within the agricultural areas. During recent years practically the whole of the supplies have been obtained well to the east of the agricultural areas, even as far afield as 140 miles east of Laverton.

This species is a root parasite and the density of stocking is limited by the ability of the normal vegetation to support it, hence it does not occur in anything but very scattered formation.

Attempts to regenerate it have been frustrated by the introduced rabbit and this tree must ultimately approach extinction.

The Santalum lanceolatum of the northern portion of the State has been used to some extent for oil distillation, but remaining supplies are limited and inaccessible. The oil content of the wood varies considerably in trees from different sites and different localities. While all supplies which reach the market came from northern ports, odd specimens of this tree are found to within 100 miles of Kalgoorlie. These southern trees are almost entirely lacking in oil and are of no economic importance.

Arboricultural.—The raising of dry area species for use by farmers for planting on over cleared farm land has become a function of the Forests Department. Considerable difficulty had always been experienced in raising dry area species in the coastal nursery, so a nursery for these was established at Kalgoorlie. Over 40 species of Eucalypts have been raised, of which about a dozen show promise of being suitable for extensive use.

In the appendix are listed the more important inland species with their major characteristics and requirements set out in tabular form.

In order to test various species under field conditions a number of arboreta were established throughout the wheat belt during 1949. Particular attention is directed to the finding of suitable species for the lighter lands which were originally treeless and to date the most promising for such lands appear to be Euc. camaldulensis, Euc. Woodwardi and, of course, Euc. cladocalyx.

Residents of the eastern agricultural areas are becoming conscious of the need for shade and shelter trees for their various soil types, and it is our aim to supply what they require.

PRINCIPAL TREES OF INLAND W.A.

Species.	Common Name.	Soil Type in which found.	Locality (Habitat).	Average Annual Rainfall.	Purposes for which used.	Special Features, etc.
uc. astringens ...	Brown Mallet ...	Lateritic loamy soils and sandy to medium loams	Narrogin, Wagin, etc. ...	16in.—20in.	Tan bark—timber for tool handles	Ornamental as well as useful tree.
Euc. brachycorys ...	Ribbon Gum ...	Loamy sands in Lake country ...	East of Southern Cross and Norseman District	11in.	Small mining timber, firewood, etc.	Should be useful tree for sand drift country.
**Euc. Brockwayi* ...	Dundas Mahogany ...	Basic rocky hills and also on sandy loams on flats near hills	Norseman District ...	11in.	Mining timber and firewood ; locally for tool handles	A fast growing, ornamental tree producing a tough, useful timber.
Euc. camaldulensis ...	River Gum	Along water courses from Leonora northwards	In all mainland States ...	8in. upwards	In W.A. mainly as fuel and mining timber. Only used where nothing else available	A fast growing tree adaptable as to soils and useful for wheat belt planting.
Euc. campaspe ...	Silver Gimlet ...	On red loams of from light to heavy texture	Eastern Goldfields, etc.	8in.—10in.	Firewood. Usually hollow and unsuitable for timber	A very drought-resistant tree. Suitable for shade.
**Euc. Dundasi* ...	Dundas Blackbutt ...	On loams of various textures. Prefers soils with alkaline reaction	Norseman District and also Mulline	9in.—11in.	Mining timber and firewood ...	About the best of W.A. trees for street planting in inland towns.
Euc. eudesmioides ...	Desert Gum ...	On loamy sands ; in spinifex country	Laverton District ...	8in.	Suitable for firewood but too scattered and inaccessible to be extensively used	Possibly suitable for planting on sand drift country in inland areas.
Euc. falcata	Silver Mallet ...	Lateritic loamy soils and on sandy to medium loams	Narrogin District, Ravensthorpe, etc.	15in.—20in.	Tan bark but inferior to *euc. astringens*	A substitute for *euc. astringens*, to which it is generally inferior.
**Euc. flocktoniae* ...	Merrit	Sandy to medium loams ...	Eastern wheatbelt, Eastern Goldfields, Norseman, etc.	9in.—12in.	Small mining timber, tool handles (locally), firewood	Produces good poles and is quite an ornamental tree.
Euc. foecunda, var. loxophleba	York Gum	Sandy to medium loams ...	Northampton, Northam, etc.	12in.—19in.	Wheelwrights' work	Tree is generally of poor form and untidy appearance.
Euc. gracilis	Yorrel	Sandy to heavy loams near lakes	Southern Cross District, etc.	11in.—12in.	Firewood	Makes a very good shade tree. Fairly salt tolerant.
Euc. Gardneri ...	Blue Mallet ...	Lateritic loamy soils and on sandy to medium loams	East of Great Southern Railway	15in.—19in.	Tan bark but inferior to *euc. astringens*	A substitute for *euc. astringens*, to which it is inferior.
Euc. Le Souefii ...	Goldfields Blackbutt	Laterite ridges and on loams of various textures	Eastern Goldfields, Norseman, etc.	8in.—11in.	Firewood and small mining timber	A drought-resistant tree adaptable as to soils. Not in any way spectacular.
†*Euc. longicornis* ...	Morrel	Sandy loam overlying layer of limestone nodules	Great Southern and Wheat Belt	11in.—18in.	Mining timber, firewood, tool handles, etc.	A tree growing to large dimensions in its natural state.
Euc. occidentalis ...	Flat-topped Yate ...	Sand over clay in poorly drained situations	Near Great Southern Railway and eastward to Esperance and Salmon Gums	12in.—24in.	Firewood	Suitable for planting in low-lying areas.
Euc. redunca (var. elata)	White Gum or Wandoo	Laterite soils and loams on and near breakaways	Generally through the Wheat Belt	11in.—35in.	Inland forms only, firewood and fence posts. In heavier rainfall areas, milling, "Myrtan," etc.	Suitable for the more acid soils of the inland areas.

* Trees suitable for use in the round as mining timber.

† Trees used for milling for mining timber.

PRINCIPAL TREES OF INLAND W.A.—*continued.*

Species.	Common Name.	Soil Type in which found.	Locality (Habitat).	Average Annual Rainfall.	Purpose for which used.	Special Features, etc.
†*Euc. salmonophloia* ...	Salmon Gum ...	Sandy loams to heavy clay loams	Wheat Belt to Goldfields and beyond	8in.—18in.	Mining timber both sawn and in round, firewood, etc.	The largest and best of the inland trees. Requires a good soil. Early growth slow.
**Euc. salubris* ...	Gimlet	Medium to heavy loams ...	Wheat Belt and Goldfields	8in.—16in.	Mining timber and firewood ...	Produces a tough timber but seldom attains large size. At its best on the heavier soils.
Euc. Sargentii ...	Salt River Gum ...	Low lying sandy loams near lakes	East of Cunderdin, etc.	14in.—16in.	No particular use	Suitable for low lying areas near salt lakes. Subject to attack by borers.
Euc. Stricklandi ...	Yellow flowered Blackbutt	On poor laterite hills and on loams near hills	East and south of Kalgoorlie	9in.—11in.	Firewood only	An ornamental tree suitable for inland planting.
Euc. torquata ...	Coral flowered Gum, Coolgardie Gum	On rocky hills, usually basic soil	Coolgardie and Norseman, etc.	9in.—11in.	Firewood	A popular ornamental and shade tree.
**Euc. transcontinentalis*	Boongul	On sandy loams to medium loams	Eastern Wheat Belt, Eastern Goldfields, Trans. Line etc.	9in.—12in.	Firewood, mining timber, and locally for tool handles	A tree of very variable habit of growth. A substitute for Salmon Gum on lighter soils.
Euc. Woodwardi ...	Lemon flowered Gum	Deep loamy sands	About 100 miles east of Kalgoorlie	8in.—9in.	Not used on account of remoteness from industrial areas	A drought-resistant tree suitable for light soils. Popular on account of its striking yellow blossoms.

* Trees suitable for use in the round as mining timber. † Trees used for milling for mining timber.

"GRADING RULES"

A Paper prepared for the
AUSTRALIAN FORESTRY CONFERENCE
1949

by

LOUIS N. WESTON

GRADING RULES.

A Paper prepared for the Australian Forestry Conference, 1949

by

LOUIS N. WESTON

The grading of a great variety of articles of commerce, such as wool, fruit, oils, etc., is a common practice, and these are then sold according to their classification.

In no commodity is such grading more essential than in the case of timber, and probably in no instance is it more difficult to effect.

The primary division of timber by nature into different species is in itself a most important one. The first step by man is then to decide what are the limiting characteristics of a species, so that the timber from each species can be directed into the channel in which it will be of most value.

In older countries, this has usually been decided by trial and error, and field trials will no doubt remain the ultimate criterion in many cases, particularly where the question of durability is involved. Even in the matter of durability, however, considerable guidance can be obtained by laboratory work on the resistance of a species to fungus and termite attack.

Where it is important to gain knowledge quickly of the characteristics of an untested species, including its strength, laboratory tests are of particular importance.

This was exemplified during the war when it was found to be highly desirable to use hitherto untested species amongst the islands to the north of Australia for Army and Navy requirements, and Australian wood technologists were able to help in the matter very considerably.

When sufficient knowledge of a species has been accumulated, so that the purposes for which it is most suitable can be determined, there still remains to be decided the most desirable sizes in which it should be used, and the relation of defects to its serviceability.

In the early days of the timber industry in Western Australia, timber was plentiful and production costs were low.

Grading rules (or specifications) were introduced at an early date, but it is apparent from a perusal of these that they aimed at the protection of the buyer, with little or no thought of the prevention of unnecessary waste of timber nor the economics of production.

Thus perfect or near perfect timber of high grade species was often specified for low grade requirements.

During more recent years, investigation was made into the results of blemishes and defects in the timber after being put into use in various capacities.

Obviously it was undesirable to continue to supply clear timber if the use of timber with minor defects was not a serious deterrent.

After a great deal of investigation, new grading rules for Jarrah and Karri were prepared, and in 1935 were published by W.A. Forests Department in Bulletin 49.

These grading rules represented a cautious approach to the subject, which was essential at that time because industry generally was in the grip of a trade recession, and buyers were insisting on very high grade products. These grading rules were accepted as a step in the right direction, the producer realising that it represented an attempt to avoid waste, and the buyer that it would help to keep costs and prices from rising.

Further investigation resulted in the grading rules being revised and published in Bulletin 51 in 1938, having been adopted by the Standards Association of Australia.

Investigation was still carried on to watch the effects of these modified specifications, and now the effects of the various wood rots were also studied.

Up to that time, rots in Jarrah and Karri were all classed as serious and continuing in their effects.

Close mycological studies showed that the major rots which affected these timbers in the tree, died soon after the timber was milled, and had previously been confused with other rots, a Stemphilium and a Coniophera, both of which attack as secondary rots in certain localities when the timber is in contact with the ground. Many field tests with defective timber were carried out during the course of the investigation.

In 1948 a further revision of the grading rules was published (Bulletin 56) after investigations by officers of W.A. Forests Department and C.S.I.R. officers, and representatives of the major timber firms, and adoption by the Standards Association of Australia.

In this Bulletin, specifications for certain classes of timber which had been included in Bulletin 51 were omitted, because it was found in practice that they were rarely used.

Other specifications were added, including those for Karri sleepers, Wandoo sleepers, Jarrah piles, and Jarrah and Wandoo poles.

These specifications are published under the aegis of the Standards Association of Australia, as is indicated on the covers.

There is, however, a special issue with a cover prepared for the Forests Department of Western Australia and carrying the Bulletin number (56) which is a Forests Department number.

This issue is for the use of W.A. Forestry officers, and for overseas buyers.

The present Bulletin No. 56, contains the following specifications:—

A.S. No. 0.10 Railway Sleepers—
- Part I. Jarrah.
- Part II. Karri.
- Part III. Wandoo.

A.S. No. 0.11 Railway Crossing Timbers—Jarrah.

A.S. No. 0.14 Structural Timber, Select Grade—Jarrah—
- Part I. Sections up to 25 sq. in.
- Part II. Sections over 25 sq. in.

A.S. No. 0.16 Structural Timber, Standard Grade—Jarrah—
- Part I. Sections up to 25 sq. in.
- Part II. Sections over 25 sq. in.

A.S. No. 0.17 Structural Timber, Select Grade—Karri—
- Part I. Sections up to 25 sq. in.
- Part II. Sections over 25 sq. in.

A.S. No. 0.19 Structural Timber, Standard Grade—Karri.

A.S. No. 0.20 Cross Arms.

A.S. No. 0.22 Mine Guides.

A.S. No. 0.24 Flooring, Select Grade—Jarrah—
- Part I. Sawn boards for flooring.
- Part II. Milled strip and T. & G. flooring.

A.S. No. 0.25 Flooring, Standard Grade—Jarrah—
- Part I. Sawn boards for flooring.
- Part II. Milled strip and T. & G. flooring.

A.S. No. 0.34 Lining, Select Grade—Jarrah—
- Part I. Milled, single face.
- Part II. Milled, double face.

A.S. No. 0.32 Flooring, Milled, End Matched—Jarrah.

A.S. No. 0.36 Joinery Stock—Jarrah and Karri.

A.S. No. 0.39 Weatherboards, Green, Standard Grade—Jarrah—
- Part I. Sawn.
- Part II. Milled.

A.S. No. 0.44 Piles—Jarrah.

A.S. No. 0.45 Poles—Jarrah and Wandoo.

Appendix A. Permissible Working Stresses for Jarrah and Karri.

Appendix B. Methods of differentiating Jarrah and Karri.

An inspection service is maintained by W.A. Forests Department, inspection being carried out at the request of either buyer or seller. The applicant must state, when applying for inspection, which of the specifications is to be used.

Because of the severity of the very early grading rules, they were usually ignored in practice, and each timber inspector relied upon his own opinion of timber defects to guide him in his work.

As a result, a great deal of variation was to be found in the work of the inspectors. It was commonly claimed that a really satisfactory timber specification could not be written.

The aim of the grading rules now in use is to state as simply as possible the limiting defects which may be accepted in a piece of timber for a particular purpose.

It is still necessary for an inspector to have a sound knowledge of timber in order to apply the grading rules satisfactorily.

In Western Australia a chief inspector gives guidance in the application of the rules, and an interpretation when required.

Although the human element will always create some little variation in such application, variations between the work of inspectors have been greatly reduced.

It is realised that all parcels of timber for a particular order may not appear to be of the same standard, because timber varies in different districts. The most noticeable difference is that in some districts most trees have gum veins, whilst in other districts gum veins are rare.

Thus much of the timber from the former districts would not be considered suitable for joinery work because of the amount of gum present and would not be accepted for that purpose under the grading rules.

For less exacting requirements the presence of the gum, so long as it did not exceed the limit allowed under the grading rules, would not affect the serviceability of the piece and would be accepted.

The work of inspectors has been much easier to carry out now that the grading rules have been moulded upon a realistic basis, and friction which used formerly to occur periodically between the inspectors and interested parties has been practically eliminated.

31008/10/49—500

"RADIO COMMUNICATION IN WESTERN AUSTRALIAN FORESTS"

A Paper prepared for the
Australian Forestry Conference
1949.

by
C. A. PINKUS.

Radio Communication in Western Australian Forests.

By C. A. PINKUS

Task.

Between Mundaring and Pemberton there are two million acres of Fire Protected Forest. To this must be added a considerable acreage to which fire control must be extended in the near future. The task of radio is to provide communications covering the whole of this area from any one point to another. The Fire Control Organisation demands the quick movement of vehicles for inter-divisional reinforcement, and it is not uncommon for vehicles and equipment to move north and south to aid a district with more fires than it can handle alone. The Radio Organisation must meet these circumstances and provide easy contact to supply Fire Control Personnel with up-to-the-minute information on vehicle movements.

A simple summary of the radio requirements is:—

	Range
(a) Contact between all fixed stations	0—200 miles
(b) Contact between fixed stations and fire vehicles	0—40 miles
(c) Contact between officers' vehicles	0—200 miles
(d) Contact between officers' vehicles and fixed stations	0—200 miles

It is advisable to group stations geographically for the purposes of control. This has been organised in Western Australia on a divisional basis. From north to south control stations are—Mundaring, Dwellingup, Collie and Manjimup.

History.

The first test of radio as a communication medium in this State was made in 1924-1925, between Perth and Mundaring. Later, in 1929, further testing was carried out at Collie. Little exact information can be ascertained of results, but from what is gathered it appears that the findings in both tests were similar, namely, that radio technique and available equipment were insufficiently advanced for practical forest communications.

During July, 1946, further tests were made, this time with success.

The R.A.A.F. and Navy made personnel and equipment available, and a mobile unit conducted tests at many locations in the Jarrah forests, with three fixed stations set up as the mobile party travelled. These tests indicated that two-way contact could be maintained with a mobile truck under very trying winter conditions.

The Department, convinced that radio could now be of practical assistance, immediately set about the task of providing equipment and staff. Progress has been good and the following shows the number of stations installed each year:—

	Fixed	Mobile
1946	3	Nil
1947	8	30
1948	2	25
1949	Nil	5
Total	13	60

31007/10/49—500

Equipment.

Decisions on the best type of equipment to employ were unnecessary as a number of Service "disposals" were available at very attractive prices. Although designed for light duty battery operations to Service specifications, certain sets are readily adaptable for forest requirements. These sets are giving good service and providing valuable information and data on which later to base a specification for our particulars needs.

The capital outlay involved in purchasing "disposals" equipment represents one-sixth to one-half of the cost of purchasing new equipment. Add to this the advantages of four to five years' practical work before deciding on final models best suited to the work, and it may be said that the course taken has been economical and prudent.

Principal types in use are:—

Mobile—

AWA type FS6—5 watts.*
AWA Teleradio 3BZ—10 watts.
Radio Corporation RC8—18 watts.

Fixed—

Teleradio 3B—10w.
Tasma AT14—150w.†

* Extensively modified.
† Installed only at Main Divisional Centres.

ORGANISATION

Maintenance.

All radio maintenance, overhauls, modifications, etc., are done in Perth at the Radio Branch. Each winter to date, sets have been collected, a Division at a time, taken to Perth for overhaul and any necessary repairs, and returned. Fixed station equipment is replaced by service equipment as these stations carry on throughout the winter. Centralised maintenance has many advantages, the chief of which is that the Radio Control Officer gains valuable data on which to base the periodic time for overhauls, effectiveness of mobile mounts, life of cables and components, etc.

Staff.

The staff consists of a Control Officer, one mechanic and an apprentice. Other duties which the staff covers are installation of battery charging facilities, which is closely allied to radio maintenance.

Training.

Fire schools are held annually and radio is prominent on the syllabus, one full day being devoted to set operation and talks on elementary radio theory. In addition, training is carried on in the field by the Radio Control Officer, particularly to gangs not producing the expected results.

Orders.

All facts appertaining to radio are promulgated as "Radio Communication Orders." These orders are divided into parts A, B and C, General, Procedure and Technical. They serve to acquaint field staff with radio methods and provide ready reference for new members.

General.

For the greater part of the year, conditions for radio are good. During the months of January and February mid-day working is not easy owing to heavy ionospheric absorption, but as this period only lasts for little more than an hour, it does not cause serious inconvenience. There are very few, if any, "dead" spots in the forest where signals cannot be read. This is mainly due to the type of aerial and choice of frequency. The ground wave of the frequencies in use is short, and reflected skywaves provide most of the signal energy. The use of high frequencies (4 to 5 Mc/s) sometimes under very difficult conditions, makes it easier to relay through a distant station than work a Base Station direct. For Fixed Stations the common practice of using half-wave horizontal aerials is followed. All mobile vehicles using 12-volt equipment have been fitted with an additional battery and series-parallel switches. This eliminates entirely the need for recharging radio batteries. The switch places the car and the additional radio battery in parallel whilst the vehicle is running and in series when radio is to be used. To make the FS6 set suitable for operation, it has been extensively modified. The receiver has been fitted with a loudspeaker and output valve while the transmitter is plate modulated. Transmitter valve line-up is now 6J5 oscillator, 6V6 modulator, 807 P.A. For some purposes the transmitter power has been increased to 11 watts by the use of a higher output vibrator power supply.

Procedure and Operation.

This fire season it is hoped to introduce Divisional channels. During past seasons only two channels have been available, 5630 Kc/s for the Karri (Kirup and south) and 4880 Kc/s for the Jarrah (north of Kirup). This was adequate until last year when additional stations and a prolonged hot season caused serious jamming. Under the proposed set-up each of the five Divisions will have the sole use of one channel, and it is proposed that 4880 Kc/s will become the channel for inter-Divisional use, to be used exclusively for weather information, calls for assistance from other Divisions, officers travelling between Divisions and limited administrative traffic of an urgent nature. Each Divisional Control Station will listen on its own and the inter-Divisional frequency and will reply using the channel called on. This system will be able to cope with the busiest periods. One night frequency will be available to all Divisions.

All calls are made to schedule, except during high hazard weather, when Fixed Stations and Fire Trucks maintain continuous watch. To keep a schedule a truck (if on the move) stops, erects its aerial and awaits the Fixed Station's "go ahead." If "all clear" the truck takes in the aerial and moves on until the time to make the next schedule. This system has the disadvantage of loss of time, but erecting a long wire aerial ensures good signal strength. Development to the stage where the operator remains seated in the cab and communicates to base while moving or stationary is somewhere in the future; besides it is very costly.

In winter, only Fixed Stations operate on two schedules each working day.

Value.

In last year's Annual Report it was stated, "As an aid to fire control the use of radio is the greatest advance since the introduction of

the power pumper." This statement is true only when serviceability, training and radio discipline is high, coupled with the use of equipment most suited to the task. This combination will make radio an outstanding success but any great departure from these ideals can make it a humbug.

The principal reasons for using radio in fire control work are firstly to make it possible for trucks to get to fires sooner, and secondly, while attending fires, to send information to the base station to ensure organisation of the most efficient use of man-power and equipment.

Radio can be used efficiently for many other purposes, but they are subservient to the main purpose. This must always be kept in mind, otherwise efficiency will be lowered by administrative work overloading the system to the detriment of the operational side.

Future Development.

Technical improvement prompts most of the plans for development. The number of sets in use will not increase greatly as it is considered that most of the needs for radio have been met. It is proposed, however, to carry out tests at fires with pack sets, easily portable by one man. A number of pack sets are on order for this purpose. They are the model ATRP1 developed recently by the Victorian Forestry Commission for this special need.

Other plans are:—

Develop and test a prototype mobile transceiver.

Development of fixed dual channel receivers.

Investigate types of mobile top loaded and solenoid antennas to replace long aerials for close-range work.

Development of aerial reels.

"PINUS PINASTER IN WESTERN AUSTRALIA."

Some Notes on the Geographical Forms of the Tree

A paper prepared for the

AUSTRALIAN FORESTRY CONFERENCE

1949

by

D. H. PERRY

Pinus Pinaster in Western Australia.

SOME NOTES ON THE GEOGRAPHICAL FORMS OF THE TREE

By D. H. PERRY

To any forest service contemplating the establishment of plantations of Pinus pinaster, a sound knowledge and appreciation of the habits of growth of the various geographical forms of the species is vitally important. The South African Forest Service recognised this many years ago and sent C. E. Duff to Europe to investigate the matter. His report (1) is an authoritative and comprehensive treatise on the subject and experience gained in Western Australia during the last 30 years supports his findings.

In a paper contributed to the Australian Forestry Journal some years ago (2) the writer was largely guided by Duff in grouping the various strains to be recognised in Western Australia. At that time and since, however, the terms strain, form, race, type, etc., have been used rather loosely. Since writing in 1940 an attempt has been made to standardise the use of these terms. The following classification is now recognised:—

1. **ATLANTIC RACE.**
   - (a) Landes Strain.
   - (b) Portuguese or Leiria Strain.
   - (c) French Hoek (seed from French Hoek Plantation, South Africa).

2. **MEDITERRANEAN RACE.**
   - (a) Esterel Strain.
   - (b) Corsican Strain.
   - (c) Italian or Lucca Strain.

1. ATLANTIC RACE.

So called because the two strains comprising this race came from the Atlantic coast of France and Portugal and possess common characteristics. This race is a lighter green in colour than the Mediterranean race, has longer needles, faster rate of growth and produces its inflorescences earlier.

(a) Landes Strain.—In Western Australian plantations the needles of this strain are rather a pale green in colour and on occasion, but not consistently are paler than the Leiria strain. Extreme length of needle is about 10 inches and the average six inches to seven inches. Branches are set on at an angle of about 45 degrees with the stem and tend to curve upward at their extremities giving the crown a rather rounded outline. The staminate flowers begin to appear by the beginning of September and are fully mature by the beginning of October. By the end of October the pollen sacs are empty and the inflorescences are beginning to shed.

31486/10/49—500

This strain has been very largely planted in Western Australia in the past, the seed having been procured from seed merchants in France and is described by them as coming from the South of France. It is assumed however, that this seed was collected from the forests of the Landes in Gascony, that is in the South-West of France. This tree is usually of good form and has produced some fine stands. The height growth on the best sites is 55 feet in 22 years.

(b) Portuguese or Leiria Strain.—So called because the stands of this strain have been raised from seed supplied by the Portuguese Forest Service from the Forest of Leiria. This strain appears to be more erect than the Landes in its early years and has a smaller crown spread. The branches form an angle of 20 degrees to 45 degrees with the stem and are fairly straight, giving the tree an erect conical shape. The needles are a slate green, a shade darker usually than in the Landes strain but considerably lighter than any Mediterranean race tree. They reach an extreme length of 10 inches with an average of 6 inches to eight inches. On good sites the crowns are denser than the crowns of the Landes strain. The Leiria strain is faster growing than any other and develops a particularly good form. Approximately 20 per cent. of all trees in a healthy stand will produce forks, a characteristic confined to this strain. In Western Australia this tree has proved to be most adaptable and will produce more timber in a given time on any site than any other strain. The staminate inflorescences begin to appear by the middle of August and the pollen sacs are scattering their contents by the end of the first week in September. By the end of September all pollen has been shed and the flowers are beginning to fall. The major portion of the seed of this strain as mentioned earlier has been supplied by the Portuguese Forest Service, in answer to requests for seed, from the Forests of Leiria. This strain has proved so outstandingly satisfactory under Western Australian conditions that all plantings since 1945 have been exclusively of this tree. The height growth on good sites is 57 feet in 18 years.

(c) French Hoek.—Very little is known about this strain. It has been raised from seed supplied by the Forests Department of South Africa and was collected from trees growing at French Hoek Plantation. Our plantations of this strain are only young yet, but are recognisably different from the Landes and Portuguese strains as we know them. Generally the form is not good although some variation occurs. Trees of this strain are rather slower growing than Landes and an outstanding characteristic is the large quantity of cones which are borne from an early age. The pale green colour and general habit would appear to place this tree in the Atlantic race.

2. MEDITERRANEAN RACE.

So named because the strains comprising this race come from regions facing the Mediterranean Sea. They also have features in common which assist in grouping them. These are chiefly a dark green colour, considerably darker than the Atlantic race, very dense crowns, shorter and stiffer needles, horizontal arrangement of branches, slow rate of growth and later flowering times.

(a) Esterel Strain.—This strain is represented in Western Australia by several small stands. The seed for one of them was obtained from France, in answer to a request for seed of Pinus pinaster, from

the Esterel region. These trees answer very closely Duff's description of the Esterel strain. Another rather extensive stand has been established from seed supplied by a French seed merchant as coming from the Landes region, but which is obviously from the Esterel or from stands originally from that region. The needles are a dark green in colour, very stiff and coarse. Extreme length is six inches and average length about four inches. Staminate inflorescences are produced in profusion, and begin to appear about the middle of September and by the middle of October are fully out. All pollen has been shed and flowers are falling by early November. The tree is rather dome-shaped as a result of the upper branches curving up to nearly the same height as the leading shoot. Very noticeable features of this strain are its dense crown and the large persistent branches which at an early age form very prominent nodes on the main stem. Height growth is slow and general form very poor. This is an undesirable strain except for windbreak and shade purposes. The height growth on good sites is 38 feet in 18 years.

(b) Corsican Strain.—There are a number of small stands of this strain in Western Australian plantations, the trees having been raised from seed obtained from Rafn of Denmark and the French Forest Service, in answer to requests for seed of Pinus pinaster, from Corsica. This strain is very erect and straight and of excellent form and very closely resembles Pinus laricio in general habit at this age (20 years). The needles are fairly short and stiff, a dark green in colour, and carried at an angle of 90 degrees with the stem. This strain is quite distinct in its tendency to produce very few staminate inflorescences up to the age of 20 years and practically no cones. A few staminate flowers appear about the middle of October and are shedding pollen by the end of the month and are themselves falling by the end of November. This strain is a most desirable one and should produce timber of high quality, but unfortunately its slow rate of growth rather causes it to compare unfavourably with the Leirian strain. The rate of growth on average to good sites is 37 feet in 18 years.

(c) Italian or Lucca Strain.—This strain has been established in Western Australia from seed obtained in large quantities from Europe in 1917-1918. It is very slow growing, probably the slowest of all the strains, is a very dark or deep green in colour, carries a very dense crown of short stiff needles, and the form is extremely poor. Altogether a most undesirable tree and to be avoided at all costs. The rate of growth on average to good sites is 30 feet in 30 years.

GENERAL AND SUMMARY.

It should be borne in mind that the foregoing descriptions have all been made on trees of up to 20 years of age. None of the descriptions will fit the mature trees of these strains of Pinus pinaster.

It is important to stress the value of the flowering period as a means of assisting identification. This has proved a great help particularly with stands which are not in healthy condition. A poor site very often has the effect of reducing the various strains to much the same general appearance although the trained and practised observer can usually still differentiate between them.

Some years ago Mlle. V. Fieschi carried out an examination of the needles of several strains of Pinus pinaster. She succeeded in proving to her satisfaction that on the difference in resin duct counts

in the needles she was justified in making separate species of the two races, namely the Atlantic and Mediterranean. The first she named Pinus pinaster and the second Pinus mesogeensis. This work was considered to be worth following up in Western Australia as a possible means of differentiating between the two races of this tree and possibly between the strains of each race. The writer during the past 10 years has examined sections of many hundreds of needles from various strains of this species at different ages. Needles have been procured from Europe from known localities and are in the course of being examined. It is hoped to publish the results of this work at an early date as a further contribution to our knowledge of this tree.

Observations and measurements made of plantations established in Western Australia indicate beyond all doubt that the Leirian strain of Pinus pinaster is the most satisfactory and suitable for our conditions. It has been exclusively planted for some years now and will continue to form the bulk of our planting stock of this species in the future.

The Corsican strain shows promise on account of its splendid form, but loses on rate of growth.

The Esterel and Luccan strains are to be entirely avoided when establishing plantations owing to their poor form and slow rate of growth.

REFERENCE LITERATURE

(1) Duff, C. E., B.A.—"The Varieties and Geographical Forms of Pinus pinaster, Soland, in Europe and South Africa." 1928.

(2) Perry, D. H.—"Pinus pinaster in Western Australia." Australian Forestry, Vol. V, No. 2, December, 1940.

(3) Fieschi, V. (1932).—"Anatomie de la Feuille chez les Pins Maritimes." Le Bulletin de la Societe d'Histoire Naturelle de Toulouse. Vol. XIV.

(4) Rycroft, H. B., M.Sc., B.Sc., For. Wicht., C.L., B.Sc., B.A., Dr. Ing.—"Field Trials of Geographical Races of Pinus pinaster in South Africa."

FIRE CONTROL
in
Western Australia

A Paper prepared for the
AUSTRALIAN FORESTRY CONFERENCE
1949

by
A. I. MILESI

FIRE CONTROL IN WESTERN AUSTRALIA

By A. J. MILESI

Forests are one of Australia's greatest assets and forest fire is the greatest enemy with which the forester in Australia has to contend.

It strikes suddenly and the point and time of attack is unpredictable except within very wide limits. The fight against this destroyer has been waged down the ages and the destruction caused in the past, when nothing like modern methods were available for suppression of fires, has been tremendous.

The terror engendered by bush fires in the past and the seriousness of their implication is demonstrated by the fact that in ancient Lebanon the inhabitants invariably put to death any person who was found, even accidentally, to have been the cause of starting a bush fire.

In the height of summer we foresters sometimes think that there still might be something in the idea. The forester spends his life learning his profession, works hard to build up a properly managed forest, only to see his life's work reduced to a smoking ruin in a matter of a few minutes.

It is from a consideration of these facts that has arisen the modern highly complex fire control organisations. Of fundamental importance to the efficient working of fire suppression organisations are early detection and accurate location of fires; good roads and means of access to all parts of the area, and a well-trained fire-fighting unit provided with suitable equipment and adequate means of transport; the whole held together by a really efficient communication system. Without any of these the remainder becomes only partially efficient, for the secret of success lies in the ability to arrive at the scene of the fires as quickly as possible in order to extinguish the flames and reduce to a minimum the damage that is likely to accrue.

A comprehensive picture of steady progress in building up such an organisation to prevent, detect and suppress fires can be seen in the activities of the Forests Department. The growth can be traced from the early days of horse transport and hand beating, through the speeding up stage of look-out towers and road and firebreak development, to the modern set-up of heavy duty water-equipped motor transport with radio communication.

31523/11/49—500

The true beginning of organised fire control came when the first look-out towers were built in the Mundaring area in 1921. These were linked by a telephone line and the heliograph was used for communication with fire gangs in the forest, but transport was as yet in the primitive stage of horse and buggy. Fire-fighting methods of direct beating with bushes, raking and back-firing were crude and arduous in comparison with methods of today, and the life of the forester in the summer months was a hard one.

The firebreak system and the technique of controlling burning had not yet been developed, and the value of unburnt forest as a factor for increasing timber production was almost unknown to the public of that day.

In our hardwood forests controlled burning will always play a large part in forest protection and to enable this practice to be carried out successfully a main road, feeder road and firebreak system was gradually extended through the forest. In 1927 the system covered 1,093 miles, today its amounts to over 11,000 miles. In parallel with this ran the telephone lines linking divisions, districts and fire towers. Today 1,280 miles are in existence. To complete the practice of controlled burning it was necessary to institute light burning of the bush in advance of areas to be cut by sawmillers and hewers, and to provide for the burning of the resultant debris, advance burning and top disposal.

The stage was now set for the speeding up of the machinery of fire control. The regenerated forests had been provided with means of access in roads, means of communication in telephone lines and means of controlled burning from firebreaks surrounding areas of 500-1,000 acres.

The introduction of motor transport and the pack spray as a fire-fighting unit was the first step towards mobility. It was not, however, until 1934 that the first light duty outfit was used at Dwellingup. A light utility fitted with several pack sprays, 33-gallon tank of water, fire rakes, crosscut saws, axes, water bags and emergency rations, carried a gang of four men; speed and power had been harnessed to lighten the load of the fire-fighter.

With their introduction, however, the fire-fighter had to learn a new technique, so systematic training of fire gangs commenced. About the same time there came a rapid extension of the fire tower network and with it the introduction of modernised equipment for detection, including the use of direction finders, panorams and binoculars. Towers increased in height and in the low, undulating hills of the Karri country, lookout cabins have been constructed in Karri trees up to 200 feet high.

The number of lookouts today is 30 and they cover the forest area from Sawyers Valley to south of Pemberton, with one isolated tower overlooking the Mallet areas at Narrogin; and so speed of detection, communication and suppression, so vitally necessary in fire control, have, to a degree, been obtained.

Later on better roads and better motor vehicles will lead to further improvement.

Another aspect of the bush fire problem has been given attention --the forecasting of fire weather. In the early days of fire control, it not infrequently happened that numerous outbreaks of fires on days of unexpected high temperature and low humidity caused disorganisation with resultant heavy losses. Sometimes, too, controlled burning was undertaken on days which unexpectedly turned out to be of high fire hazard. To overcome these disabilities and provide a forecast of fire weather from day to day during the summer months, a Fire Weather Research Station was established at Dwellingup in 1934. Working in conjunction with the Divisional Meteorologist in Perth, this station sends out daily a fire weather forecast which is relayed by phone to all divisions, districts, towers and outstations and broadcast over the Departmental radio from Dwellingup at 7.45 a.m. each morning.

This forecast provides a valuable guide to foresters in controlled burning operations and in the organisation of men and materials in periods of high hazard.

With the advent of better roads and the transformation of practically all the firelines surrounding the firebreaks into trafficable roads, the day came when the light duty outfit was augmented by a heavy duty unit capable of supplying up to 200 gallons of water per minute. These heavy duty outfits, coupled with special emergency units delivering up to 650 gallons per minute and manned by trained crews, are capable of combating almost any fire.

The technical knowledge necessary for the handling of this heavy mechanical equipment is provided by regular summer schools of instruction attended by senior officers, foresters, assistant foresters and overseers. Lectures and demonstrations are given on such kindred subjects as fire weather, care of vehicles, fire fighting methods and controlled burning technique. The fire-fighter of today is no longer a man who "belted" a fire with a bush, but a highly trained operator using modern equipment.

The latest addition to the modern fire-fighter's array of equipment is the radio. During the summer of 1946-1947, extensive trials on an experimental basis were made of radio equipment acquired from the Services, chiefly the Navy and the R.A.A.F.

Four fixed stations were operated in conjunction with several mobile units on fire trucks and extremely good results were obtained, the degree of coverage being highly satisfactory. This summer, radio transceivers are standard equipment on all fire trucks, gang trucks, and officers' vehicles, as well as at all Departmental stations.

Communication has been speeded up a step further and direct contact established with the actual fire-fighting personnel.

This is probably the biggest advance in fire control in Western Australia since the introduction of water and power—a spectacular advance from the days of the heliograph and the horse.

So much for the development of the system—This is how it works.

Probably the most important part of the forester's fire control job is fire prevention: that is the all-the-year-round efforts to ensure that during the danger period no fires will start. Our efforts in this direction are directed along two channels—risk reduction and hazard reduction.

Risk reduction, the more difficult, is the attempt to reduce the probability of a fire being started. Little, if anything, can be done about reducing the non-human risk, but by public lectures to bush fire brigades, tourist clubs, schools, the University, local governing bodies and local progress associations every effort is made throughout the year, and particularly just before the commencement of the summer, to make the travelling public thoroughly fire conscious and as anxious as we are to see that they do not start any fires.

Articles in the Press, propaganda films and the annual Fire Prevention Week are also weapons in the fight against the carelessly, man-caused fires. The way is long and hard, but there are encouraging signs that the public is being slowly educated towards the ideal of no uncontrolled fires in the forest.

A further measure of fire suppression practised in this State is the fitting of spark arresters to all steam locomotives and tractors at the beginning of the fire season.

Hazard reduction, the removal of the fuel, if it were practicable and desirable would, of course, be the ideal method of fire control.

However, it is impracticable over large areas of forest, and except in certain circumstances, definitely undesirable. In practice we find that only certain areas of the forest are liable to bush fires, such areas as those adjoining private property, railway lines, main roads and picnic spots. These produce a crop of fires each year, and to minimise the incidence of these fires and to confine those that do start to the smallest possible area, breaks are burnt through, round or along all such danger spots as frequently as they will burn, usually at least once in every three years.

A certain amount of break burning within compartments, subject to high risk, takes place each year and burning to protect mill villages, forest settlements and isolated schools is also carried out.

Presuppression measures, the activities that are necessary to ensure that when a fire does start, the whole organisation is ready to go into action are naturally a routine duty of the field staff.

As soon as the spring controlled burning season commences the towers begin to be manned and when the fire season proper starts, all towers are manned from early morning till after dark and the full radio routine of periodic calls comes into operation.

The lookouts are so dispersed that the whole of the 2,000,000 acres of protected forest is under observation of at least one, usually two, and frequently three towers.

The equipment in use at the present time for the detection and location of fires consists of:—

(1) A plan of the area on a scale of 80 chains to an inch, properly mounted and fitted with a direction finder.

(2) A set of panorams.

(3) A pair of binoculars.

(4) A telephone.

(5) A log book.

The plan is mounted on galvanised iron, varnished as a protection against the weather, and fixed to a soft wood board which is clamped to the top of a cupboard in which the telephone it fitted. The plan is fixed in a perfectly horizontal position and correctly orientated.

A protractor, centred on the position of the tower, is printed on the plan and the centre of the protractor is pierced vertically to receive the rustless steel bar which carries the direction finder.

The direction finder, mounted on this bar, consists of a sighting vane at the top of the bar, at approximately eye level, and a graduated brass arm which rests on the surface of the plan; these two are fixed in the same vertical plane and the arm indicates on the protractor the bearing on which the vane is sighted.

Our ideal being early detection and speedy attack, as soon as a towerman sights the faintest wisp of smoke, a bearing is taken, entered in the log book and communicated to the district office. Cross bearings are obtained from other towers and plotted on the co-ordinating plan at the control centre. The intersection of these cross-bearings fixes the position of the fire, and if it is within protected forest the nearest gang is contacted by telephone or radio and despatched to the fire.

These gangs usually consist of three or more permanent employees under the direction of an overseer. They are regular forest workmen, trained in fire-fighting technique and equipped with a light utility carrying a water tank up to 100 gallons, several pack sprays, a low-down force pump, fire rakes and shovels and fitted with a mobile radio set.

Their job is to extinguish the fire, or if this is not possible, to hold it in check at all costs until help arrives.

Usually while the gang is getting their equipment out of the truck, the overseer makes a quick reconnaisance of the fire, directs the gang to where they are to start and how to go about bringing the fire under control. He then radios a fairly detailed report back to headquarters, establishing the fact that the gang has arrived, and giving such details as exact location of the fire, its size, the type of fuel bed and terrain, and an estimate as to whether the gang can or cannot cope with the outbreak.

The fire is usually attacked with pack sprays and rakes, although if the truck can get close enough, the low-down pump replaces the pack sprays. Usually the gang can bring the fire under control before it has burnt more than a fraction of an acre.

If conditions are very severe, the controlling officer may order a heavy duty outfit to stand by or even proceed to the fire even if the first overseer considered that his gang could handle the situation.

If the fire has gained such proportions when the first gang reached it that they were unable to suppress it or if it eventually got out of hand, a radio call is immediately put through to headquarters, when one or more heavy units, and if necessary other gangs are sent as

reinforcements. No risks are taken in letting a fire gain large proportions. It is found that if a fire is kept small it is comparatively easy to handle, but when it becomes very large, the effort and time taken in suppression is out of all proportion to the increase in the area of the fire.

These heavy duty outfits consist of a 4-5 ton truck, usually with 4-wheel drive, carrying a specially constructed slip-on unit consisting of 600-gallon tank and power pumper.

The power pumpers range in size from small, high speed rotary pumps delivering 15-30 gallons per minute, to larger sizes capable of delivering better than 200 gallons per minute through anything up to eight hose lines. These outfits can utilise the water in the tanks or can pump water from dams or wells and through long lines of hose up to two miles in length.

Equipment such as this, with adequate water supply, is capable of handling almost any forest fire.

It frequently happens that a fire surges up to the forest boundary on a very wide face from private property contiguous to the forest boundary and is already of such magnitude that one heavy duty outfit cannot cover the whole face of the fire. In such an eventuality special emergency outfits, consisting of high powered fire engines, capable of handling hugh quantities of water are brought out and stationed on an adequate water supply. These engines pump water at the rate of up to 600 gallons per minute through up to three miles of hose, and are capable of feeding the units at the face of the fire.

Alternatively, they carry their own supply of 800 gallons.

Every fire is "knocked down" by one means or another and a cleared break constructed round the whole of the periphery. This break is a raked strip in the case of the small fire, but if the fire threatens to assume large proportions, a small bulldozer, on special transport, is despatched to the fire and takes part in the "knocking down" and "mopping up" of the outbreak. These bulldozers have been used for several years now and time and again have proved their worth, especially in the heavy undergrowth found in the lower South-West, where it is a physical impossibility for men to push their way through the more dense areas.

After the fire is "knocked down" the arduous job of putting it out and "mopping up" commences.

Every tree or spar that is alight within five chains of the edge of the fire is either put out or felled, and every log and stump burning close to the raked break must be extinguished with water, completely covered with earth or cut off and rolled in on to the burnt country. It is found that thorough "mopping up" and patrol pay big dividends.

When the fire is considered safe, a patrol is left on the area and the gangs and equipment return to headquarters for overhaul, refuelling and generally refitting. The patrol, equipped with a light unit and radio remain until the fire is completely safe, even up to several days, and a flying patrol is usually made some considerable time after the fire if particularly dangerous conditions develop.

It is felt that it is better to spend several man-days on patrol than very many man-days on re-extinguishing an escape.

Such is a brief outline of the Western Australian fire control set-up; it is not perfect. No fire control organisation is or ever will be. When a fire control organisation ceases to adopt new and improved methods it ceases to function as a worthwhile system. However, the results obtained to date are encouraging and it is our hope that they will continue to be so and our successes in the future will justify our continued expansion.

"THE KARRI FOREST"

(In Relation to Site)

A paper prepared for the
Australian Forestry Conference
1949

by

D. W. R. STEWART

THE KARRI FOREST (in relation to Site)

By D. W. R. STEWART

1. **Karri** (Euc. diversicolor) as a forest, is unique in the plant formations of Western Australia. It occupies a limited area of high rainfall in the extreme south-west and is the nearest approach in this State to temperate rain forest.

With its larger trees, denser mesophytic ground flora, and greater development of understorey trees its stands in marked contrast to the northern Jarrah forest.

Range and Distribution.—Although the Karri region would embrace more than a million acres, the main belt of Karri covers some 700,000 acres, being a long narrow belt almost parallel with the coast, and tapering from some 25 miles in width at its N.W. extremity to 10 miles or so at the Frankland River, and there after continuing eastwards past Denmark with decreasing width, to a point some 10 miles west of Albany. It is bounded on the west by the fault line of the Darling Scarp, extending southwards from Nannup; on the S.W. by the coastal plain which varies in width from five to 15 miles; and on the N.E. by a N.W.-S.E. line through Manjimup, and parallel to the coast. Two small outliers, each of a few thousand acres, occur, viz.—

(a) on a narrow coastal strip between Karridale and Margaret River on the western side of the "trough fault," and

(b) on the Porongorup Range some 25 miles north of Albany.

Within this belt, Karri does not occur as a large area of pure forest. Rather is it a series of patches, ranging in area from a few hundred to several thousand acres. Near its inland limits, it is practically confined to narrow strips along the gullies. These increase in width downstream eventually spreading well up the slopes. Usually Marri predominates on the ridges, with sometimes an admixture of Jarrah. To the south and south-east, the Karri occurs on the hills and with wide poorly timbered flats between.

2. **Physiography.**—The Karri belt occurs at the southern extremity of the laterite capped plateau, and is drained by short streams to the south coast, nearly all of which are permanent.

The Karri occurs on the true soils of the underlying rocks following the denudation and removal of the laterite capping. The underlying rock is a gneissic granite of sedimentary origin.

The topography is generally undulating, with steep falls to the main streams. The higher ridges some 25-30 miles inland, e.g., Manjimup, are rarely over 1,000 feet above sea level, decreasing to 550 feet in the vicinity of Pemberton, within 10 to 15 miles of the coast.

It would appear that the original plateau has been deeply dissected by the main watercourses, and the original laterite denuded except on the upper slopes and on the crests of ridges, more remote from the coast.

3. **Climate and Rainfall.**—The region enjoys a mild climate and an assured rainfall, the mean ranging from 43 inches inland to 60 inches nearer the coast. The inland limit of Karri, practically follows the 43 inch isohyet. The rainfall during the six driest months

usually exceeds eight inches. Heavy rains occur in the four wettest months of May, June, July and August, the average ranging from 26 inches to 32 inches.

Temperatures are mild. Winter frosts are occasional only, and summer maximum temperatures rarely exceed 95 degrees.

4. **Soils and Forest Types.**—The soils of the Karri forests are derived in situ from the underlying gneissic rocks, which, according to geologists, are of sedimentary origin. These soils generally determine its distribution. Towards the inland limit of its distribution, they occur in narrowing strips along the lower slopes and watercourse, and Karri is replaced by Jarrah on the ridges and upper slopes on soils of lateritic origin.

On the hill slopes, there is usually an intermediate zone where Marri predominates, with an admixture of Jarrah towards the higher ground and Karri towards the lower. It is very rarely that Karri and Jarrah intermingle directly. Occasionally Marri may form pure stands over small areas. Marri is apparently a more tolerant tree as regards both soil and climate, occurring over a wide range of soil types, and in areas of rainfall down to 17 inches. On typically Karri soils, it is ousted by the faster growing Karri. It competes with Jarrah in all but some of the poorest of sands and laterites where Jarrah may form pure stands.

Variation in the edaphic factor gives rise to the following major forest types which are readily recognisable in the Karri zone.

1. **Karri** in pure stands.
2. **Karri-Marri** in mixture, the former usually towering above the Marri.
3. **Marri**—with varying amounts of Karri or Jarrah.
4. **Jarrah-Marri** mixture with Jarrah predominant.
5. Swamp types along the main watercourses.
6. Open non-timber area, or "plain" country.

1. Pure Karri forest in the virgin state is an imposing sight. The stand height is usually over 200 feet, reaching to 250 feet at its best development, with occasional individuals over 280 feet. Although reputed to be an open stand with a light undergrowth, and some grasses of grazing value in the early days, repeated firing by the white man has led to degradation of the crowns, and the development of a dense woody undergrowth of leguminous shrubs such as various Acacias, Bossia, Albizzia and the mesophytic Chorilaenas, Trymalium, Hovea, etc. On some areas, bracken up to eight feet or more in height, is the principal ground cover. Other patches may be predominantly Netic (Bossia Aquifolia), Wattle, "Hazel" (Trymalium or Chorilaena). On more restricted areas, Karri, Sheoak (Casuarina decussata) may occur as a scattered tree, or in close formation, growing up to 60 feet in height. The height and density of the shrubby undergrowth depends largely on the effect of past fires or trade cutting in reducing crown cover. The extreme is seen where the virgin stand has been fire-killed and dense thickets of Wattle up to 30 feet in height have taken full possession of the site. In a good seed year, dense thickets of Karri regrowth take possession after fire and eventually suppress the competing shrub species.

2. **Karri-Marri forest** carries a similar understorey to the Karri forest, but the stand height is usually somewhat less.

3. **Marri with scattered Karri,** usually has lower undergrowth and less of the soft leaved species. Height growth of Karri is from 150 feet to 200 feet.

4. **Jarrah-Marri forest,** approaches in type the Jarrah forest of the main Jarrah belt, except that the proportion of Marri in the stand is higher (30 per cent. to 50 per cent.) and both species attain large dimensions. The undergrowth is higher and denser than that occurring further north. Podocarpus drouyniana, and Agonis parviceps are very common, as well as a number of Acacias. Soils are sands and sandy loams with varying amounts of ironstone or lateritic gravel.

5. **Swamp types** may occur along the main watercourses, which spread over flats five, six or seven chains in width. In winter, these flats are inundated, but the stream is confined to a narrow winding bed in summer. It supports an extremely dense growth of shrubs, sedges and trees of which Warren River Cedar (Agonis juniperina) is perhaps the commonest. More rarely River Banksia (B. verticillata) occurs.

6. **Non-timbered areas** occur on deep poor white sands. The ground vegetation is an extremely dense growth of shrubs, including Ti-tree (Agonis parviceps) Emu Bush (Podocarpus drouyniana), Blackboys and numerous members of the Myrtaceae family.

These areas may range from a few acres to several hundred acres in the main belt between Nannup, Manjimup and Pemberton. Further east around Northcliffe and thence south-east to the Frankland River, quite large areas of this "plain" country occur. Outcropping from this sandy plain which is water logged in winter, are hills bearing stands of Karri, on the typical Karri soils.

Development.—Early exploitation of the Karri forests occurred during the latter part of last century, viz., by Millars Timber and Trading Co., at Torbay and Denmark, at the eastern extremity and at Karridale on the western outlier.

About 1912, four large mills were established in the main Karri belt, viz., one at Jardee (Millars), two State mills at Pemberton and one State mill four miles west of Manjimup.

Following World War I, all lands cut over by these mills were alienated for soldier and migrant settlement under the "Group" scheme, together with large areas of virgin forest. Prior to this there had been practically no agricultural settlement in Karri country although a few old families were established as graziers with cattle and horses on the Warren River. Further alienations occurred in the Walpole district in 1931.

Of an estimated 700,000 acres of land in the main Karri belt, approximately 200,000 have been alienated, with the resultant destruction of a great quantity of timber. Of the 500,000 acres remaining, the greater part is now dedicated State Forest and it is estimated that Karri predominates over some 250,000 to 300,000 acres. The remainder would be occupied by Jarrah, Marri and other non-Karri types.

Agricultural settlement, principally for dairying, has been a most costly venture, with quite inadequate returns for the vast amount of expenditure incurred. After nearly 30 years' effort, it is doubtful if 20 per cent. of the alienated land is cleared and developed, and many holdings lay abandoned for long periods. Soil deficiencies were evident and nutritional troubles encountered with stock and crops. Cobalt, copper and zinc have all yielded remarkable responses on certain limited areas, in correcting certain specific ailments.

Not until 1925 was any appreciable area of Karri dedicated as State Forest. Reforestation measures were undertaken following trade cutting at Big Brook (N.W. of Pemberton) and the oldest stand of regrowth from Departmental operations dates from 1929. Its health, vigour, and fast growth rate leave little doubt in the minds of those who see these regeneration areas, that no crop is better adapted to the site or likely to contribute more to the national welfare than that which nature so generously provides, namely, Karri.

31009/10/49—500

"Some Notes on Coastal Sand Drift Fixation in Western Australia"

A Paper prepared for the
AUSTRALIAN FORESTRY
CONFERENCE
1949

by
D. H. PERRY & L. N. WESTON

SOME NOTES ON COASTAL SAND DRIFT FIXATION IN WESTERN AUSTRALIA

By D. H. PERRY and L. N. WESTON

This work has so far been confined to the south-west coastal regions where the rainfall is not less than 30 inches per annum and where Marram Grass (Ammophila arenaria) thrives. This coastal strip consists essentially of a sandy belt of country stretching from the Moore River in the north to Albany in the south and varying in width from three to 20 miles. It has been recognised generally as belonging to the Cainozoic formation which fringes the western boundary of the continent, although that section referred to herein is more aptly described as forming part of the Tertiary Calcareous Sandstones and associated sand drifts.

Owing to its sandy nature, this region, following the destruction of the indigenous ground cover by over grazing, repeated severe burning or other causes, is particularly liable to erosion by wind. It contains at present many large areas of shifting sand, the major portions of which occur in uninhabited country of little economic value. There are exceptions, however, and dunes at Swanbourne, near Perth, Boranup at Augusta, and several areas in the vicinity of the mouths of the Margaret and Warren Rivers have been, or are in the course of being fixed. The dunes at Swanbourne were encroaching on valuable suburban property, those at Boranup on roads, railways, farmlands, and that at the mouth of the Warren River gave indications of serious obstruction to stream flow. Satisfactory fixation of the dunes was effected by the systematic planting of Marram Grass (Ammophila arenaria). This grass is admirably suited to the purpose as it thrives on white beach sand in close proximity to the sea where the mean annual rainfall is not less than 25 inches. It possesses the ability to grow rapidly through the accumulating sand and after the short period of one year is responsible for the formation of a hummock from six to eight feet in height. This rapid growth, however, is arrested once the sand movement ceases and stable or fixed dunes are characterised by tussocks of dormant dead or dying grass. By this time much of the indigenous flora has become sufficiently re-established to prevent any serious erosion by prevailing winds.

Another grass which is giving encouraging results on some of the dune areas in the vicinity of the Margaret River is Ehrharta villosa or Pyp Grass. At Gnarabup, between the Margaret River and the Leeuwin, Pyp Grass has been established within 30 yards of high water mark and at time of writing is thriving. This result is supported by South African experience where this grass apparently thrives on a rainfall of 15 inches to 18 inches per annum.

The first area of serious sand drift reported along the coast occurred at Boranup, about 14 miles north of Cape Leeuwin. This was first noted about 1876. Moving inland on a front of about two miles, it engulfed the main Augusta-Busselton track about two miles from the sea. During the following years, it was necessary to shift the track on three occasions, until it was three miles from the sea.

In the early 1890's, the owners of the Karridale Mills (M. C. Davis and Sons) whose plant and mill site were threatened with obliteration obtained Marram Grass from South Africa, and employed school children to plant it on the sand drift.

Although the drifting dunes, about 200 feet high, with a very steep advancing face had already covered an area of tall Karri forest, their further progress was arrested immediately.

Now some 50 years later this dune is quite stable although small wandering dunes occasionally occur at some spots, generally after a fire. These usually become fixed naturally by the Marram before assuming dangerous proportions. It is interesting to note that on this dune the natural vegetation has failed to penetrate very far from the outer perimeter, a distance of about 10 chains appearing to be the maximum and five chains the average. The only vegetation on the central part of this huge dune is Marram Grass. On the other hand after the passage of 20 years, the small dune of about 100 acres at Swanbourne is entirely fixed and the indigenous vegetation has re-established itself over the whole area.

Drift sands that have been dealt with in this State fall naturally into two classes:—

(1) Those commencing immediately from high water mark and spreading inland.

(2) Areas of drifting sands separated from the coast by a belt of country on which the indigenous flora remains unharmed.

(1) In dealing with dunes of the former type the main difficulty is associated with the establishment of the Marram Grass close to the high water mark. This position is usually so exposed that in many cases the grass is blown out before it can become rooted. Fortunately in Western Australia we have an indigenous plant, Spinifex hirsutus, which will thrive just out of reach of high tide and this plant is admirably suited for raising a littoral dune to protect the first plantings of Marram Grass. Immediately behind the low dune thus formed the Marram is planted in rows parallel to the sea. The greater the degree of exposure the closer the planting distance and rows from three feet to six feet apart, and the sets of Marram from two feet to three feet in the rows have been found satisfactory for even the most exposed sites. Where there is an excavating movement going on the Marram should be planted deeply, at least 75 per cent of the cutting being buried.

It has not been found necessary in any of our work to date to erect palisades to build up a protective littoral dune and it is not proposed to discuss this phase of the work. Constant attention for several years will be necessary to establish Marram on the windward side of the littoral dune as it is often blown out before it can become rooted and must be replanted.

(2) Dunes which are separated from the coast by a strip of country on which the indigenous flora is still intact are comparatively easy to fix as they are usually not so exposed. The dune may be planted up with Marram Grass, the rows being at right angles to the direction of the prevailing or most damaging winds. The espacement may vary from 12 feet between the rows and four feet between the sets to 60 feet between the rows and five feet between the sets, depending on various factors which will be discussed later.

The establishment of Marram Grass from seed may be effected only in protected areas or where artificial protection has been provided in the form of a thick covering of branches over the sand. As the cost of this method would be prohibitive in most localities planting is the most economical and satisfactory method of establishment.

Cuttings may best be obtained by opening up a trench 12 inches deep immediately in front of a clump of Marram Grass and severing the roots by a horizontal cut with a spade at the bottom of the trench. The grass cuttings are heaped in bundles of convenient size and topped to leave them approximately 24 inches long with three or four nodes in the bottom 12 inches. Each of these nodes is capable of producing roots which appear about 10 to 12 days after planting out. The cuttings when prepared are tied up in bundles and covered up or heeled in. They should not be exposed to the air longer than is absolutely necessary to trim them and tie them up.

The transport of the grass to the planting site is always a serious problem. Modern four-wheel drive vehicles with the tyres run at about 14 to 16 lb. pressure will traverse a good deal of the dune surface, but there are many areas where the sand is too loose for this type of vehicle. Where it has been impossible to get a truck or a horse-drawn vehicle on to the job as at the Warren River, two men distributed the grass on an improvised stretcher. Probably the most successful method of distributing the grass is to utilise a specially constructed cart. It need only be a platform and shafts on an old car front axle springs and wheels. This type of vehicle has a very light draught as the pneumatic tyres do not sink in the sand if run in a semi-deflated condition.

Pack horses are useful in isolated localities.

Of the various planting methods available, that of pit planting has been found most satisfactory. This is almost as cheap as notching or spearing in soft sand and ensures the sets of grass being planted deeply enough. Spearing may be done only where the surface is wet and firm as otherwise the sand runs in when the spade is removed. A simple V-shaped pit should be opened up with a spade or planting hoe, the set consisting of two cuttings, inserted, and the sides stamped in. The digger should place the excavated sand on the lip of the hole to facilitate planting and should not be permitted to open up more than a dozen holes ahead of the planter as the sand quickly dries and runs in. One digger to one planter has been found a very satisfactory unit.

The factors that influence espacement are many; the more important of these include money available, degree of exposure of the site to be planted, the amount of grass available and the time in which it is necessary to fix the area. Since the cost of the work is governed directly by the espacement it becomes necessary at the outset to evaluate properly all the factors concerned in order that the most economical planting distances may be utilised. When there are large areas of moving sand to be fixed and the degree of exposure or sand movement is not great, a maximum espacement of 60 feet between the rows and five feet within the rows may be allowed. Each row of grass will form a low hummock or ridge and in time the Marram will regenerate itself from seed in the intervening hollows. It is absolutely essential that the grass be planted closely in all exposed positions and particularly where the sand is being excavated. Rows should be from three feet to six feet apart and the sets two feet to three feet in the rows according to the degree of exposure.

In Western Australia the transport question is a very difficult one as most of the areas of shifting sand are in very isolated and inaccessible country. Supplies of grass on such areas could best be made available by the establishment of small nurseries close to the planting site. These nurseries should be about two or three acres in extent, from which sufficient supplies of grass for the planting of approximately one square mile of dune might be obtained. The sets of Marram should be planted three feet x three feet in the nursery and left for two or three years to develop. Once established such a nursery may be worked over for cuttings each year as the grass quickly shoots again. The most suitable site for a nursery is a fairly sheltered position where sand is being built up or deposited and is to be found generally on the lee side of a gently sloping dune.

If the maximum benefits are to be derived from any planting programme, sheep and goats should be totally excluded and the grazing of horses and cattle strictly regulated.

A number of factors govern the cost of these operations, but the following figures may be regarded as an indication of expenditure to be incurred on average sites. (Basic wage, £6 10s. 6d. per 40-hour week):—

Espacement 3 ft. x 3 ft.—Total cost £11 16s. per acre.
Espacement 6 ft. x 6 ft.—Total cost £5 per acre.
Espacement 30 ft. x 5 ft.—Total cost 15s. per acre.

The methods of sand dune fixation outlined above have produced such satisfactory results that little difficulty should be anticipated in the undertaking of similar works under conditions pertaining in Western Australia.

REFERENCE.

"Drift Sand Reclamation and Coast Stablisation in the South-Western Districts of the Cape Province." C. R. Gohl.

"Some Notes on Coastal Sand Drift Fixation in Western Australia." D. H. Perry. Aust. Forestry. Vol. I., No. 2, 1936.

31487/10/49—500

"FOREST FIRE WEATHER"

A Paper prepared for the

Australian Forestry Conference

1949

by

W. R. WALLACE

FOREST FIRE WEATHER

By W. R. WALLACE

The commercial forests of Western Australia are confined almost entirely to the south-west corner of the State. This region experiences a wet winter and a long dry summer. The average annual rainfall is 40-50 inches of which about 70 per cent. falls in the months of May to August, and less than 1½ inches total for the three months, December to February, during which period the mean maximum temperatures are 80 degrees, 82.5 degrees and 84.8 degrees, respectively. Fires commence to run in the forests from mid September and in a dry year controlled burning may be still carried on as late as mid July of the following year.

A fire hazard exists on more than 90 per cent. of the days from the first of November until the commencement of the winter rains (usually in late April). During this long period fire hazards persist right through the nights and even minor relief occasioned by favourable weather changes is welcomed by the forester.

In an endeavour to arrive at a better understanding of the factors influencing the start and spread of bush fires in Western Australia, a Meteorological Station was set up at Dwellingup, in the heart of the Jarrah forest in 1934. The particular objects of the investigation were:—

1. To find a measure of current fire danger.
2. To consider the possibility of forecasting forest fires weather.

The Dwellingup unit has been maintained as a full weather reporting station, and during the fire season, further weather information is supplied from stations at Pemberton (Karri forest) and Ludlow (coastal), while daily reading of temperature, humidity and wind are made from all divisional headquarters.

The original work proceeded along the lines of American investigations and results were confirmed in general for Western Australian conditions. In particular it was established that no single weather element could be used as a criterion of current fire danger.

Working from first principles, on the assumption that the moisture content of fuel had a major effect on its burning qualities, investigations were carried out on the moisture content of small pieces of wood. Half-inch, one inch and two inch cylinders of locally grown Pine (p. radiata), Jarrah and Cedar were tried, together with 12 in. x 1 in. x ⅛ in. lathes, and 6 in. x 4 in. x ¼ in. end sections of the same species.

These determinations were made at two hourly intervals during the day in conjunction with the ordinary weather observations.

In order to gain some idea of the then immeasurable "fire danger" all field officers (11) operating in the Division at the time were asked to give an estimate of the maximum degree of fire danger for each day on an empirical scale of 0-10, being a day when a fire would not run and 10 being a day of maximum fire danger.

The estimates given were consistently close and it was decided that a mean of these personal estimates would give a reasonable indication of the maximum degree of fire danger for any day.

In this connection where occasional personal estimates varied from the mean by more than one, they were discarded for the daily average.

All weather readings, moisture contents and mean estimates were plotted daily and in the first season the close relationship between the variations in the mean estimate graph and that of the half-inch cylinder was readily apparent. Further extensive checking in the following season allowed the moisture content of the half-inch pine cylinder to be adopted as a measure of current fire danger in this State.

Late investigations at Pemberton indicated that the same standards could be applied in the Karri forest region and continued observations have supported this opinion.

While the original determinations were made on individual wood cylinders this was obviously cumbersome and the present method is to establish 3-stick units of 50gms. oven dry weight. Increase in weight in this case is then doubled to arrive at moisture content.

When this method was introduced in 1936 certain peculiarities in behaviour of the cylinders towards the end of the fire season became more obvious and it was found after investigation that there is a loss of oven weight which commences immediately after exposure and which continues throughout the life of the cylinder.

The effect of this weathering was to indicate lowered moisture contents than was actually the case. When the trend of loss of weight was determined, compensation was allowed on the moisture content Fire Hazard Graph, by lowering the graph periodically during the season and still using 50 grams as the apparent oven dry weight. Similar experiences have since been reported from America and Canada with other species.

For general purposes it was found desirable to have some descriptive scale of fire danger and the following Fire Hazard Scale was adopted:—

General	Empirical		Moisture Content
N.1		1	over 17%
Low	1.	4	17%— 13%
Moderate	4.	6	13%—7.8%
Average Summer	6.	7	7.8%—6.5%
High Summer	7.	8	6.5%—5.3%
Severe Summer	8.	9	5.3%—4.2%
Dangerous	9.	10	4.2%—3.2%

In two cases only in the past 15 years has the true moisture content been below 3.2 per cent. These were 3 per cent. and 2.9 per cent., both occurring after prolonged periods of dangerous weather.

The question of forecasting was found to be much more complicated and required an assured supply of general synoptic charts covering this State. These were available only from the Weather Bureau in Perth, and were usually 30 hours old on arrival at Dwellingup. Despite this disadvantage, forecasting was commenced from Dwellingup daily throughout the summer in 1936, and broadcast from National Stations for the benefit of forest officers and the general public.

After two years, during which close co-operation was maintained with the Divisional Meteorologist, this officer was asked, in view of the greater scope of his weather information, to take over the fire hazards forecasts. Further co-operation with local meteorological officers and the sending of the officer in charge at Dwellingup to a Meteorological school in 1939 considerably improved the technique of fire weather forecasting which soon reached a high standard of accuracy.

The present routine incorporates both national and departmental dissimination of weather information and forecasts. The Dwellingup and Pemberton stations report daily to the Meteorological Bureau at 9 a.m. and 3 p.m. and to the afternoon telegram add the current fire hazard. The Bureau having its own three hourly synoptic charts and 3 p.m. readings from all over the State, compiles the forecasts for the following day and transmits them by telephone to Dwellingup before 1615 hours. This office, which maintains departmental radio control in the South-West, checks the forecasts and transmits them at 1615 hours to all forest stations.

The forecast normally takes the form of a brief weather message giving in particular, wind direction and strength, together with the maximum hazard expected for the following day, e.g.:—

> The fire weather forecasts for the following Jarrah Forest Area is:—Slightly higher temperatures, lower humidities and light to moderate E.N.E. winds backing N.W. in the late afternoon. Fire Hazard—High summer.
>
> Karri Forest Region.—Moderate E. winds veering S.W. in the afternoon. Fire Hazard—Average summer.

By this means all officers are given an indication of weather trends well in advance. On the following morning, weather reports and moisture contents are received by radio at Dwellingup from Pemberton and Ludlow. A check is made on the overnight forecast, which is amended if considered desirable and transmitted to all stations at 0745 hours, i.e., before the men have left their headquarters for the day's work.

Here again great assistance is given by the Meteorological Bureau, whose officers send warnings or amended forecasts of any sudden and unforeseen change in weather which may occur after the 1615 hours forecast. Arrangements have been made for a check with the bureau at 0730 hours daily in the approaching fire season.

The reliability of these forecasts over the past decade and the knowledge that a special forecast can be obtained at any time of the day or night from Dwellingup has imbued the field staff with confidence in this service, which forms the basis of the Forests Department's organisation during the summer months.

Apart from departmental officers, the general public which hears the forecasts repeated at intervals during the day, has shown marked interest in recent years and particular attention is now being paid by farmers to these forecasts on bush fire weather. Perhaps one reason of the greater public interest in recent years and particular attention, is that these forecasts are broadcast every day of the summer at the same times, whether the hazard is dangerous or nil.

31005/10/49—500

"STOCKTAKING IN THE JARRAH FOREST"

A Paper prepared for the
AUSTRALIAN FORESTRY CONFERENCE
1949.

by
P. H. BARRETT.

Stocktaking in the Jarrah Forest

By P. H. BARRETT

Introduction.

Every forester would like to know what the stocking of the forest is at the present time and what it is likely to be in a given period of time. The object of major forest assessments therefore, is to gain satisfactory information of the available timber at that time and by judicious selection of growing stock and subsequent remeasurement gain a reasonable idea of what is likely to be available in future years.

Upon figures so obtained is based the calculation of cut for many years ahead. Apart from present stocking, rate of growth in given girth classes becomes of paramount importance. Only a thorough assessment and regular measurement of growth rates will give us any idea of the present and future crop.

Forest Area.

The dedicated forest area is some 3.34 million acres, of which some three million acres carry Jarrah forest. This area is not one compact belt of timber of even growth and density. Closer examination reveals that three broad types occur, viz.:—

1. The prime Jarrah forest of the laterite hills.
2. The Jarrah forest bordering on and intermixed with the Karri forest.
3. The coastal plain Jarrah forest.

1. **The Prime Jarrah Forest Belt.**—This belt, some 20-30 miles wide, extends from approximately Mundaring in the north to Bridgetown in the south. Although fine Jarrah is common south of the Blackwood River, the quantity of laterite gravel is reduced and the percentage of Marri in the forest as a whole increases, while belts of Karri occur as one proceeds south and south-east.

It is this belt of prime Jarrah upon which most of the present day assessment is concentrated and to which the methods used apply more closely.

2. **The Jarrah forest bordering on and intermixed with the Karri forest** is more complex both in soil types and forest types associated with them. Almost pure stands of Jarrah, Marri, Karri and Blackbutt may occur and mixed stands of two or more species are often met with. Allowance is made for such stands in the assessment instructions.

31006/10/49—500

3. **The Coastal Plain Jarrah Forest.**—Only a small portion of the coastal plain is held as State Forest and as it carries a relatively low volume of merchantable timber no stocktaking is being carried out on this belt at present.

History of Stocktaking.

Prior to the passing of the Forests Act in 1918 estimates of the volume of merchantable timber were hazy and over optimistic.

Just prior to and about the time of the passing of the Act measurement plots were laid down in isolated areas, mostly in virgin forest.

From 1919 onwards for a few years, the first effort was made to get out of the guessing stage. A rapid if crude classification of the forest was made and gave very approximate values of the merchantable timber available according to the standards of sawmilling at that time.

In the 1930's considerable work was done on heights and site qualities. Although the forest crop itself is the best measure of site or quality co-dominant height is usually accepted as the most reliable index of site. In an endeavour to tie in soil type with site quality a girth-height index was used. Co-dominant trees were girthed, their total heights measured and from a table the heights were adjusted to read the height they attained or would attain at 94 inches G.B.H. The resultant figure was called index height. Five acre sample plots were laid down on the major soil types and detailed measurements of present stocking plus the record of timber removed, were taken. However, considerable variation in total volume for the same soil type occurred and the work lapsed during the early war years. It was not until 1942 that the basic method for the present day type of assessment was laid down.

The Present Method.

This consists essentially of gridding the forest with assessment strips two chains wide at one mile intervals, the strips being run across the contours of the country and allowance being made along base lines for a closer assessment if required. Strips at one mile intervals give a two and a half per cent. assessment.

The base lines are started by compass and pegged or poled through, offsets being laid down at every 20 chains. A 6 in. x 6 in. peg is placed at these 20-chain marks, the chainage stamped on them and direction trenches dug. Tie-in points are recorded wherever possible.

The strip lines are run in a similar manner, but 4 in. x 4in. pegs are set at five-chain intervals and the strip number and chainage stamped on them. Direction trenches are dug at each peg.

In the actual assessment a five-chain band is laid along the strip from peg to peg and trees positioned by reference to the chainage and offset distance either side of the chain.

The following measurements are recorded:—

Removed Volume—R1 logs with butt girth 90 in. U.B. or over.
R2 logs with butt girth < 90 in. U.B.

Where more than one trade cutting operation has taken place a certain percentage of the strips include all removed timber, the earlier removal being shown in the booking with a circle around the letter, e.g. (R1)

Standing Merchantable Volume.

90 in. + G.B.H. o.b.	A_1 Retained as growing stock.
	A_2 Merchantable volume that should have gone to the sawmill.
	A_3 Doubtful.
72 in. — 90 in. G.B.H. o.b.	B_1 Growing stock.
	B_2 Poor.
60 in. — 72 in. G.B.H. o.b.	C_1 Growing stock.
	C_2 Poor.

Piles and Poles—D. Recorded at such—minimum size for pole is 20 ft. length 6 in. top diam. u.b.

Girths and log lengths are recorded and also estimated volumes where measurement is impossible.

Remeasurement.—The A_1, B_1 C_1 and D trees are painted for subsequent remeasurement, the paint mark facing the centre of the strip and the top of the mark representing the point of measurement.

Other Species, with the exception of Karri, are recorded as for Jarrah. Karri has higher girth limits, viz.:—

A—120 in. G.B.H. o.b.

B—90 in.—120 in. G.B.H. o.b. Minimum size pole 35 ft. 9 in. top diam.

C—65 in.—90 in. G.B.H. o.b.

The Time Factor.

Until recently an assessment gang of three men carried out most of the work, but arrangements are now being made for the general Divisional staff to do most of this work. This not only speeds up the job but enables the tree marker to keep a check on his own work and the staff are able to learn first hand just what is (and has been) in the forest which they control.

Conclusion.

It is hoped than in 10 years' time the whole of the cut-over forest of the prime Jarrah belt will be assessed, giving us a reasonable knowledge of the growing stock above 60 in. G.B.H. o.b. plus a more accurate idea of what piles and poles are available, while the foundation for rate of growth information will be well laid. More detailed information involving smaller sizes can be obtained at any time.