UNUTILISED FOREST RESOURCES IN WESTERN AUSTRALIA: their location and magnitude

Submission to the Senate Standing Committee Inquiry into Forestry and Forest Products Industries, April 1979.

by J. S. Beard, D.Phil (Oxon)
Forestry Consultant.

SUMMARY.

It is shown that about 850,000 tonnes annually of waste wood would be currently available for utilisation in the forests of the southwest of W.A. In addition there is an area of 6,370,000 hectares of woodlands on the eastern goldfields which formerly supplied mining timber and firewood to the gold mines. The full potential outturn is unknown but is estimated at not less than 3 million tonnes per annum. All of this is material below sawlog size and is suitable for fuel in some form or for chipping and pulping.

These constitute important national resources of which note should be taken.

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INTRODUCTION.

The forests of Western Australia are confined to a portion of the south-west of the State extending along the Darling Range southwards from the vicinity of Perth to the south coast. Most of the commercial forest is within State Forests and is worked under the control of the Forests Department. It is here that the State's production of sawn timber and pulpwood is located.

A much larger area of more open eucalypt woodland formerly extended eastwards from the forest belt as far as the Nullarbor Plain, a distance of some 700 km. The western portion of this belt, extending for 300 km. has been cleared for farming but the eastern portion remains. Tree height, form and density as well as timber quality are inferior in these woodlands so that they have never constituted a sawlog resource. When the mines of the eastern goldfields were in full production, however these woodlands were extensively cut for mining timber and firewood. They are little worked now and constitute an important potential resource.

RESOURCES OF THE STATE FORESTS.

The State Forests of the south-west are composed of three principal species:

Eucalyptus marginata	(jarrah)
Eucalyptus calophylla	(marri or red gum)
Eucalyptus diversicolor	(karri)

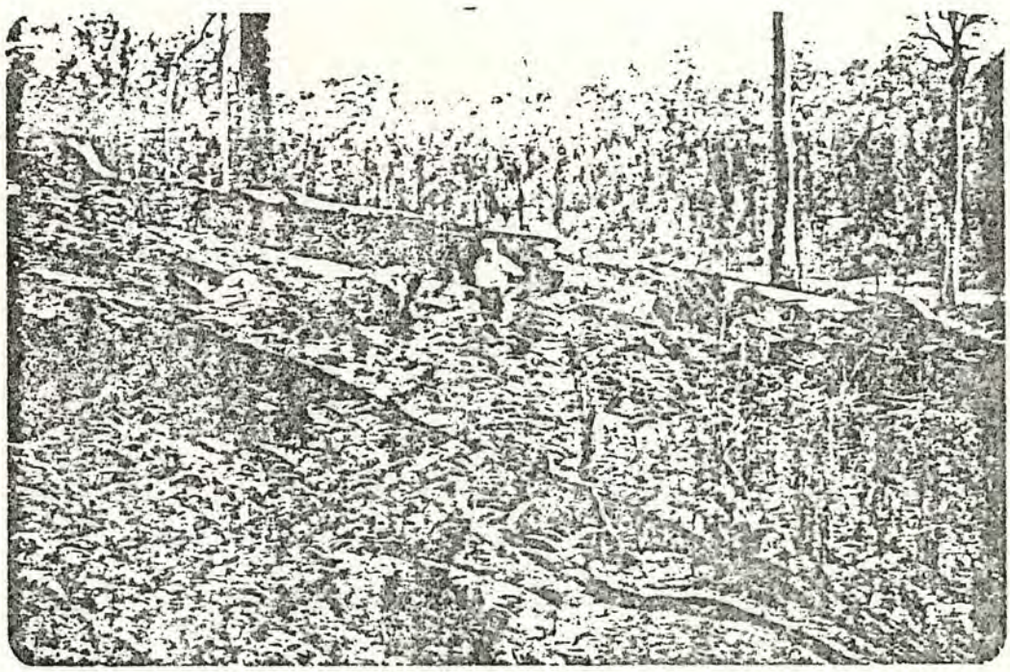
The northern part of the forest, north of Manjimup, is composed of jarrah mixed with some marri and this forest-type extends also into the south on the poorer soils. Karri comprises a large part of the southern forests on the better soils. It is normally mixed with some marri. Pure stands of marri are unusual.

Forest exploitation has increased over the years with expanding demand until today all State Forests, unless reserved for any special purpose, are covered by management plans providing for logging and regeneration.

Jarrah and karri are commercial species for milling. Marri, unfortunately is not. Owing to the prevalence of ring shakes only a few selected logs will yield usuable timber. There is one mill at Manjimup which accepts selected marri logs. If, when logging jarrah and karri, marri were to be left standing it would seed freely and lead to a preponderance of marri in the next rotation. Marri in logged areas therefore had to be felled and burned but this situation has now been remedied by the development of the woodchip industry which utilises marri. All marri logs except those so damaged by forest fires as to be encrusted with charcoal can now be profitably removed from logged areas. This development has transformed the economics of forestry in the lower south-west and has made it possible to work economically mixed karri-marri stands.

Further, karri is also acceptable for woodchipping. All millable karri logs are strictly reserved for that purpose owing to the overall shortage of sawn timber but unmillable karri, and in particular mill waste, is directed to the chip mill. All major southwestern sawmills have now installed their own chippers and the production this year will reach 100,000 tonnes or one-sixth of total chipwood production.

Karri regeneration area with all sawlogs and chipwood removed, waste material awaiting burning.



Karri regeneration after burning, showing residue.

Market conditions have not yet permitted the chipwood industry to attain its target production of 720,000 tonnes annually. The outturn this year is likely to reach 600,000 tonnes. There is thus a shortfall in production for which a market needs to be found.

A market is also needed for waste material which still remains in the forest. As the existing equipment at the woodchip mill cannot handle log lengths less than 11 feet, any shorter pieces are wasted. Waste also comprises crooked logs and branches, and marri logs contaminated with charcoal. The amount of such material which is burned on regeneration of each coupe is still very large. It is difficult to estimate but at a conservative figure is likely to be at least 30 tonnes per hectare, giving an annual potential of 150,000 tonnes in the woodchip licence area. Only a proportion, perhaps one-third of this could be utilised as chipwood and the remainder must be regarded as a potential resource usable as fuel in some form or for industrial purposes.

The second unutilised resource is jarrah waste. Owing to its high colour and extractives content jarrah is not at present acceptable as chipwood so that mill waste still has to be burned. The extraction of milled lumber from jarrah logs is not likely to exceed 37% so that with kerf (sawdust) at 13% and bark at perhaps 5%, the remainder of 45% of logs removed from the forest is waste not at present usable. The quantity is formidable and merits a major effort to promote its utilisation. The high wastage is due to the inherent qualities of eucalyptus timbers and not to the "scandalous inefficiency of the timber mills" alleged by amateur conservationists. Based on the proportion of jarrah to karri milled in the southwestern forests, the quantity of jarrah waste amounts to over 150,000 tonnes annually from this area alone, without counting production from the northern jarrah forest. Again, just as in the karri forest, there is a large amount of tops, branches, broken and crooked logs which is at present left lying in the forest. The quantity per hactare would not be as great as in the karri forest but could add 50,000 tonnes a year to the total.

Thirddly, there is the marri growing in the northern jarrah

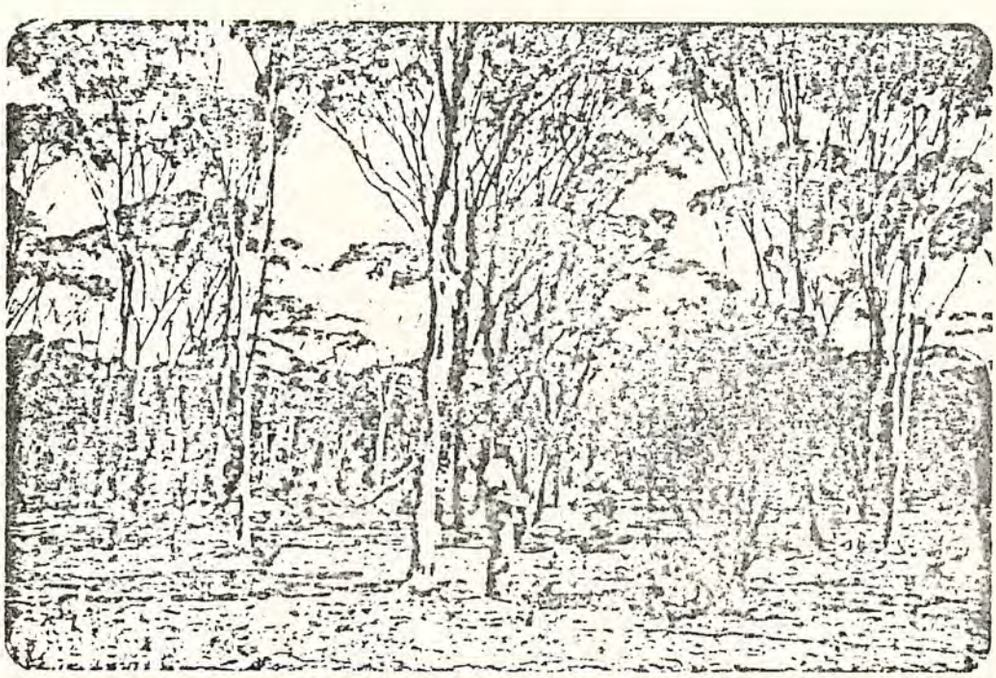
forests which is at present unusable. Given bigger markets for woodchips, mills could be installed to handle this material. No estimate of the quantity available has been made, but with consideration to the fact that the woodchip licence area comprises 30% of the State Forests and has a potential consumption of some 500,000 tonnes of marri per annum (excluding the karri which is chipped), also that the quantity of marri available in the northern forests would be less, a figure of at least another 500,000 tonnes per annum would appear reasonable.

Fourthly a potential resource which will become available in the future is small-size timber from karri thinnings. In 20 years' time young stands of karri regenerated by the present clear-felling methods will become capable of yielding large quantities of poles and small saw logs which could profitably be removed by thinning if markets existed. Some thinning of stands regenerated in the previous half-century could begin now if it was marketable and could produce 30,000 tonnes per annum.

It will therefore be seen that the forests of Western Australia are at present being under-utilised to the extent of nearly one million tonnes of wood annually. On the other hand it is frequently alleged that the forests are being overcut. In terms of saw logs, this has been and still is the case, and is inevitable in the early stages of working virgin forests with their great accumulation of overmature timber. In terms of the whole potential outturn there is scope for a vastly increased output.

Typical stand of Salmon Gum (Eucalyptus salmonophloia).
Virgin state. North of Beacon.

Dundas blackbutt (Eucalyptus dundasii).
Virgin stand. Near Norseman.



Mixed woodland of E. transcontinentalis & E. flocktoniae.
This may be a young stand, see young pole crop in rear.
Near Jeffcott Rock

RESOURCES OF THE GOLDFIELDS WOODLANDS

The precise extent and composition of these woodlands has only recently been documented, through the vegetation mapping published by the present writer. The map accompanying this report is composed of portions of Sheets 3 and 5 of the Vegetation Survey of Western Australia, 1:1,000,000 Series (Beard 1975, 1976) and a portion of the unpublished Sheet 7 (Beard, in preparation) which has been hand-coloured. The woodlands are coloured green and have the basic formula eMi, standing for Eucalypt, Medium-height trees 10-30 m. tall, Incomplete canopy. Dominant species are indicated by small numbers following the "e". The mapped woodlands have a total area of 6,370,000 hectares determined by planimeter and excluding mixed areas of woodland and mallee, open woodland with saltbush and bluebush on saline and alkaline soils, and low woodlands where trees are less than 10 m. in height.

This woodland area is enormously large, being over three times the area of State Forests of the south-west (1,853,876 ha.) and constitutes an important potential resource. The woodlands stretch from Lake Moore to Balladonia, a distance of 600 km., in a belt up to 250 km. broad which constitutes a unique region known to botanists and plant geographers as the Southwestern Interzone (Burbidge, 1960). The country has no agricultural potential owing to the low rainfall (300 to 175 mm. per annum west to east), very little pastoral potential owing to lack of potable stock water, and is therefore likely to continue under its natural plant cover.

On the Eastern Goldfields there are 781 ha. of State Forests and 32,243 ha. of Forests Act Timber Reserves but the vast bulk of the woodlands are not regarded as part of the forest estate. They are treated as vacant Crown Land on which the Forests Dept. is responsible for the control and management of forest produce and have never been managed under a forestry Working Plan, though there are some general remarks about them in the General Working Plan No. 86 of 1977.

When the gold mines were in the heyday of their production the woodlands were utilised to provide supplies of mining timber and firewood, transported on movable light railways. One line at one

time ran south-east from Kalgoorlie round the eastern end of Lakes Lefroy and Cowan, and nearly reached the Eyre Highway, a distance of 150 km. All usable timber was felled and carted in drays to the "wood-line", the light railway. Cutting was supervised by the Forests Dept. and records kept of the yield, but the cut was determined by demand and there appear to be no figures for the yield per hectare, nor for the growth-rate potential of the woodlands. Working plan No. 86 of 1977 states that

"Gold-mining has resulted in the annual consumption of about 350,000 tonnes of wood for mining timbers and firewood, and some 3.4 million ha. of woodlands in the semi-arid Kalgoorlie region have been cut over a 70 year period."

The area concerned is that within reasonable reach of Kalgoorlie and Norseman. More outlying localities were never touched and there are 1½ million hectares between the Goldfields and the wheat belt and another 1½ million east of the Fraser Range still in their virgin state. The figures given in the Working Plan must not be taken too literally. All of the 3.4 million ha. was never clear cut; this is merely the area within which fellings were taking place, and the actual area cut is probably unknown. Production of 350,000 tonnes of wood annually from that area over 70 years gives a yield of only 7 tonnes per ha., which is certainly far too low, and a more likely estimate from felling areas would be 50 tonnes.

No active steps were taken after felling to ensure regeneration and nature was left to take its course which it did with conspicuous success except in some of the salmon gum stands which have come back rather thinly. Salmon gum has a very minute seed but it is probable that measures such as slash burning or scarifying the surface would secure adequate regeneration. Otherwise the woodlands have grown back extremely well, showing that they could safely be worked in the future without fear of denuding the country.

A detailed technical description of the structure and composition of the woodlands is added as an appendix to this report and is taken from Beard (1969).

DISCUSSION

For some time past the State's sawlog resources have been fully committed and the outturn is not equal to demand. On the other hand markets for unmillable species and for other waste such as mill offcuts, damaged and crooked timber and branches have been slow to develop. The first positive large-scale outlet to be established was the wood-chip operation in the south-west which is currently taking off 600,000 tonnes per annum. It has been shown that another 850,000 tonnes per annum of waste material could still be tapped in the southwest, while there is a vast potential resource in over 6 million hectares of woodlands on the goldfields. The latter would all be in small unmillable material and the potential yield is at present anybody's guess in the absence of figures, but it could not be less than 3 million tonnes per annum.

The purpose of this submission is to draw attention to the existence of these potential resources so that due account may be taken of them in planning at the Government level. Concern is being expressed at diminishing energy resources and industrial raw materials are another dminishing resource, e.g. petrochemicals which compete with liquid fuel for petroleum supplies. Wood is a renewable resource and is of special interest for this reason. It is not suggested that the unutilised forest resources of Western Australia could command immediate markets, rather that as existing sources of energy and raw materials run out, their place will be filled by developing new sources of which wood will be one. The potential uses are many, for example:

Energy production

a) Power generation. There is an immediate case for the construction of a regional power station in the Manjimup - Pemberton area fuelled by forest waste. Consumption in this area of electricity generated by burning Collie coal is environmentally indefensible.
b) Manufacture of charcoal.
c) Manufacture of alcohol as a liquid fuel.

Industrial use

a) Increased production of chipwood for overseas markets.
b) Local paper manufacture.
c) Chipboard and hardboard.
d) Charcoal byproducts (see b) above).
e) Industrial processes based on cellulose, e.g. rayon manufacture.

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Appendix.

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5. Sclerophyll Woodland

Like the mallee, the sclerophyll woodland is eucalypt-dominated, there are several different floristic associations and structural types. In general, growth consists of a tall but open stand of trees with extremely sparse undergrowth with the result that the woodland is subject to burning to only a minor extent. Where fire passes, the trees are killed and do not coppice but regenerate from seed, an even-aged stand resulting. Study is required of the extent to which existing stands are even-aged, and of the regeneration of the various species. If it should prove that fire, even at

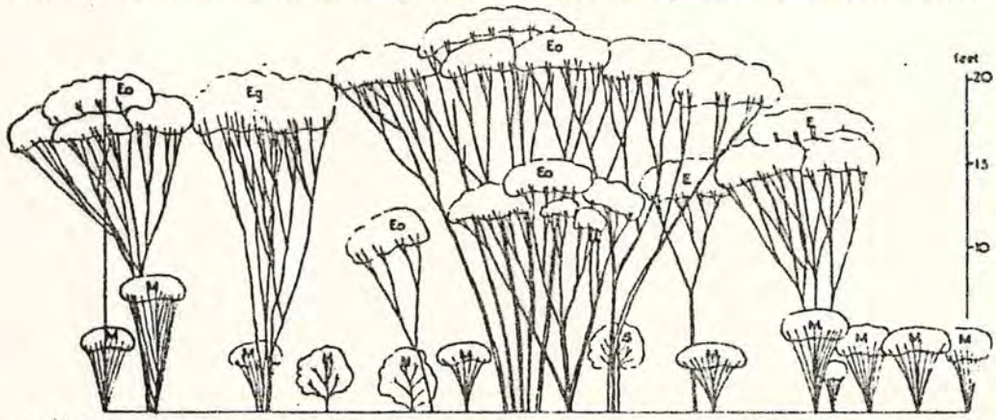

Fig. 6. Profile diagram of tall Mallee near 260 mile peg, Hyden – Norseman Road. For key to species see p. 257.

very long intervals, is the agent responsible for regeneration of these woodlands, then as with the other formations height and density are a function of age, and structure is not altogether meaningful. There is in general a correlation between height and density in that the lowest woodlands tend to be the densest, and the tallest the most open. There is every gradation from the low dense mallee to the very tall stands of over 80 ft in height where the trees are extremely scattered. However, one may distinguish two broad classes, the mixed woodlands of 40–60 ft in height on residual soils, and the Salmon Gum (*Eucalyptus salmonophloia*) woodlands of alluvial flats, which exceed 60 ft. In the former type trees are irregularly scattered so that in part their crowns touch and in part there are large open spaces. Diameters of the dominants are 9–12 in. The trunk forks into a number of ascending branches at about a third of tree height and the rather flat crown is thin and casts little shade as the leaves hang downwards. Except at times in gaps the only tree layer is that of the dominants forming the canopy, but there are two highly sparse layers of shrubs, the one 6–12 ft high and mainly of "broom-bush" habit, the other of low shrubs under 2 ft. Locally the latter may be saltbush. On soil derived from granite the trees in this formation are smooth-barked, but on basic rocks the majority of the species have persistent rough bark on the lower trunk or on the trunk and lower limbs. The significance of this is not understood. Fig. 7 illustrates a measured profile in an example of this mixed woodland in which *Eucalyptus*

transcontinentalis is dominant. One outstanding tree reaches 75 ft in height, but most of the dominants attain between 40 and 60 ft. There is an understory of eucalypts in mallee form. Low shrub and herb layers are virtually absent. The profile demonstrates the irregularity of the woodland and the openness of the canopy. There are wide gaps between groups of dominants which

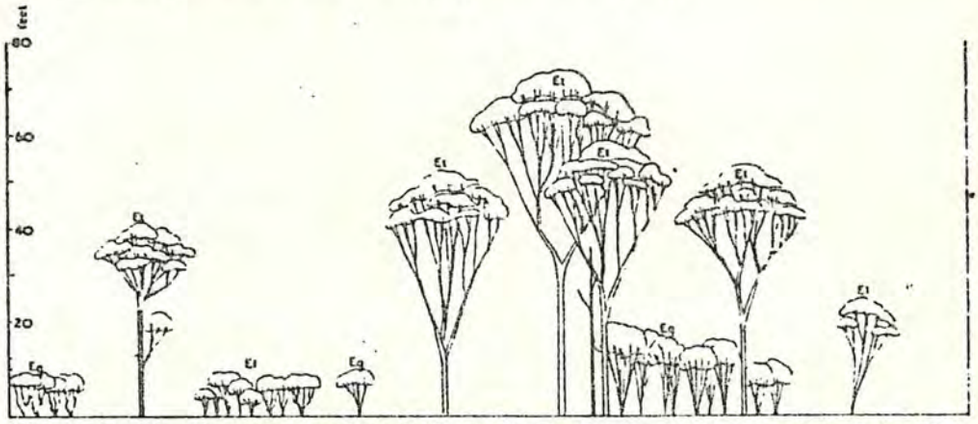

Fig. 7. Profile diagram of sclerophyll woodland – *Eucalyptus transcontinentalis*. For key to species see p. 257.

tend to occur in clusters, the result no doubt of group regeneration. Much more work could usefully be done on the structure and stability of these woodlands.

The taller woodland of *Eucalyptus salmonophloia* and its associates is generally over 60 ft tall, with a maximum of about 90 ft, very open with the trees as much as 200 ft apart. There is a very strong trunk, in most cases up to 3 ft in diameter and extending to half the height of the tree. The shrub layers are as in the mixed woodland, a saltbush understory being common in the vicinity of salt lakes and on alluvia derived from basic rocks. Both smooth and rough-barked trees are present but, as before, the rough bark appears to indicate a higher base status in the soil.

Fig. 8 shows a profile measured in pure salmon gum woodland, an example which is probably of a denser stand than normal (compare

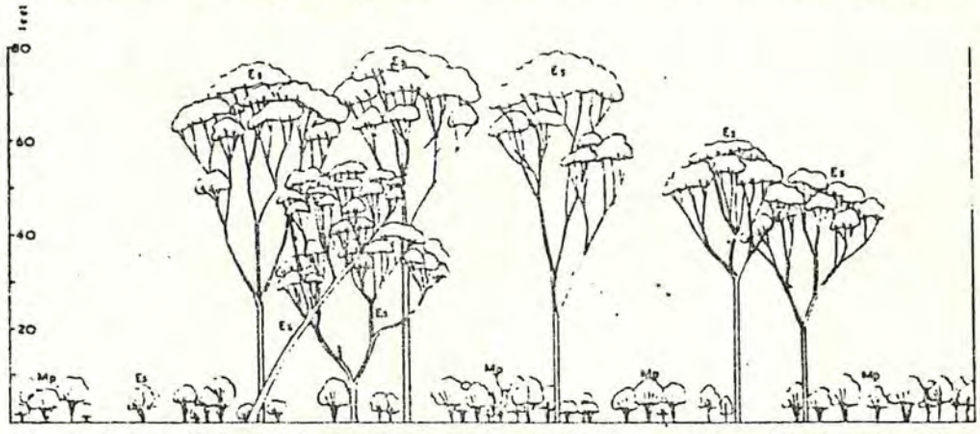

Fig. 8. Profile diagram of sclerophyll woodland – *Eucalyptus salmonophloia* association measured 26 miles south of Hyden on Hyden—Newdegate Road. For key to species see p. 257.

photograph). Density is frequently irregular and clustered as with the *Eucalyptus transcontinentalis* woodland, and a typical group occurs in the centre of the measured profile. Height of the dominants is generally greater than that of *Eucalyptus transcontinentalis* and its associates. Seedlings, saplings and young pole-sized *Eucalyptus salmonophloia* are a rarity, but there is very frequently a tall shrub layer of the *Melaleuca* species known as "Boree".

In all the eucalypt types including mallee, the adult leaves are evergreen, simple, mesophyll in Raunkiaer size, falcate and pendant, hanging vertically. There is a complete absence of lianes and epiphytes, and of any such special plant forms as palms, cycads and bamboos, even grass trees.

6. Halophytes

The most extreme communities of halophytes are the small (< 12 in.) succulent chenopodiaceous shrubs which occupy raised beds on the floors of the larger salt lakes. Rather rarely here, one may find a *Frankenia* zone of small ericoid shrubs round the lake margin. Alluvial flats bordering lakes tend to have a saltbush understory in woodland and in some places on the north-east side of a lake the tree cover may be very sparse or virtually absent, leaving a pure saltbush community. Sandhills to the south-east of lakes tend to carry a woodland of special floristic composition which is described in the appropriate place, but has not been mapped. Halophyte communities have otherwise been mapped where they occur.

Classification, Terminology and Notation

The broad principles of classification adopted are those stated by the author in previous work (Beard, 1944, 1955). To recapitulate briefly, the basic unit is the plant association which is a floristic grouping, being the largest possible group with consistent dominants, either of the same or closely allied species. Associations may be divided into minor floristic groups, to which it was proposed to apply the Clementsian terminology. Also they may be termed consociations if they are single-dominant communities. The associations may be grouped together according to their physiognomy (structure and life-form) into formations. The formation is thus a physiognomic group and can be treated without reference to floristics. A higher grouping of formations into formation-series was proposed by Beard for tropical America (*ibid.*) and the applicability of this concept to Australia is discussed below.

Coming down from principles to practical considerations, there is a need for some consistent and logical system of classification, some consistent terminology and a mapping notation, for use in the description of vegetation and in the cartography. On the other hand it is not possible to predict accurately in advance of a survey what vegetation units are going to be found in Western Australia, and how they need to be treated. In a general way, of course, the vegetation types of the State are known, but it would be unwise to adopt a rigid classification and terminology in advance. It would be better to consider this towards the end of a general survey and to adopt in the meantime a flexible system. It is therefore proposed to distinguish plant formations by local names, e.g., jarrah forest, mallee, mulga and pindan, and to relate these in each paper as they occur to recognized classification systems.

At the highest level of classification we have the system put forward by Küchler (1949) and elaborated by Dansereau (1951) which was designed to be of universal application on a world scale and to facilitate valid

Mallee communities noted on the traverses were as follows:

Lake King-Norseman Road, at S.W. corner of Lake Johnston sheet—*Eucalyptus eremophila, Eucalyptus flocktoniae, Eucalyptus foecunda, Eucalyptus oleosa* var., *Eucalyptus* sp. unidentified (J.S.B.3740).

Ditto, vicinity of the 100-Mile Tank—*Eucalyptus eremophila, Eucalyptus flocktoniae, Eucalyptus pileata, Eucalyptus* sp. unidentified, with white fruits.

100-Mile Tank to Lake Hope—*Eucalyptus eremophila, Eucalyptus foecunda.* Young thickets of *Eucalyptus salubris* and *Eucalyptus gracilis* representing sclerophyll woodland in process of regeneration.

Norseman-Hyden Road, 315-300 Mile Pegs—*Eucalyptus eremophila, Eucalyptus gracilis, Eucalyptus foecunda, Eucalyptus redunca.*

South of Woolgangie—*Eucalyptus eremophila, Eucalyptus loxophleba, Eucalyptus oleosa* var.

Woolgangie to Bullabulling — *Eucalyptus eremophila, Eucalyptus foecunda, Eucalyptus incrassata.*

No mallee has been observed in this area on greenstone.

5. Sclerophyll Woodland

In this formation there are a number of different associations which may be readily recognized.

(*a*) *Eucalyptus transcontinentalis**-*Eucalyptus flocktoniae* association on the "granite eluvium" of the geological survey, i.e. red loam developed *in situ* on granite. Associated trees are *Eucalyptus gracilis* (o), *Eucalyptus corrugata* (f), *Eucalyptus salubris* (l.a.), *Eucalyptus melanoxylon* (l.f.). Undergrowth may be almost entirely lacking, but the few scattered shrubs seen include: *Alyxia buxifolia, Comesperma spinosum, Daviesia anthoclona, Dodonaea stenozyga, Eremophila dempsteri, Eremophila saligna, Eremophila* sp. inedit. J.S.B.3825, *Grevillea huegelii, Grevillea oncogyne, Melaleuca pauperiflora, .Melaleuca .pubescens, . Melaleuca . sheathiana, . Santalum acuminatum, Scaevola spinescens, Westringia rigida.*

In places, mainly south of the Johnston Lakes, a low woodland may be encountered intermediate in structure between mallee and sclerophyll woodland proper, and composed of *Eucalyptus flocktoniae* and *Eucalyptus eremophila*, mostly with a dense understory of *Melaleuca pungens.*

(*b*) *Eucalyptus* aff. *striaticalyx-Eucalyptus leptophylla* association on sand ridges. These tend to occur to the south-east of salt lakes, in curved lines, conforming to the present lake margin. The ridges are low, well vegetated, and too limited in extent to be mapped. There are good examples between the 380 and 370 mile pegs on the Norseman–Hyden Road. The dominant species is a tree suggesting *Eucalyptus striaticalyx*, up to 40 ft tall, with persistent stringy bark on the lower trunk, together with a few salmon gum, *Eucalyptus salmonophloia*, and the sand salmon gum *Eucalyptus leptophylla.* The latter is only a small tree, but may form pure stands locally. Undergrowth consists of a fairly dense ground layer (2 ft) of spinifex *Triodia scariosa*, and the cyperaceous reed *Lepidosperma viscidum.*

(*c*) *Eucalyptus torquata-Eucalyptus le socufii* association on rocky greenstone ridges. This association occurs only in the Coolgardie system and is of limited extent in this area. *Eucalyptus torquata* and *Eucalyptus*

* For convenience, since these are important ecotypes readily recognizable in the field, it is preferred to use the forms *Eucalyptus transcontinentalis* Maiden and *Eucalyptus longicornis* F. Muell. rather than *Eucalyptus oleosa* F. Muell. var. *glauca* Maiden and var. *longicornis*. F. Muell.

le soeufii are co-dominant, abundant and characteristic. Associated trees are *Eucalyptus corrugata, Eucalyptus clelandii, Eucalyptus campaspe* and *Casuarina cristata*. There is an open shrub understory, largely of *Eremophila* spp. up to 6 ft tall and of "broom-bush" habit, notably *Eremophila scoparia, Eremophila glabra, Eremophila oldfieldii,* also *Dodonaea, Cassia* and *Acacia* species, interspersed with glaucous 4 ft shrubs of the "Old Man Saltbush", *Atriplex nummularia*. Forbs include *Ptilotus exaltatus*.

(*d*) *Eucalyptus le soeufii-Eucalyptus oleosa* association on deep soils developed on the greenstones and included granites. This also is confined to the Coolgardie system and is of limited extent within the Boorabbin map sheet. Composition is related both to that of the *Eucalyptus transcontinentalis-Eucalyptus flocktoniae* and *Eucalyptus torquata-Eucalyptus le soeufii* associations, all eucalypt components of both being present except for *Eucalyptus torquata* which is entirely absent, being confined to rocky ridges. A newcomer is *Eucalyptus oleosa* var. *obtusa*. Thus we have: *Eucalyptus le soeufii*, v.a.; *Eucalyptus oleosa* var. *obtusa*, l.a.; *Eucalyptus transcontinentalis* (*Eucalyptus oleosa* var. *glauca*), a.; *Eucalyptus clelandii, f.*; *Eucalyptus corrugata, f.*; *Eucalyptus campaspe*, l.f.; *Eucalyptus flocktoniae, f.*; *Eucalyptus gracilis*, o.

The understory does not differ significantly from that in the *Eucalyptus transcontinentalis-Eucalyptus flocktoniae* association.

(*e*) *Eucalyptus dundasii-Eucalyptus longicornis* association on deep soil over greenstone in the Bremer Range. The woodland shows a co-dominance of *Eucalyptus dundasii* and *Eucalyptus longicornis* (*Eucalyptus oleosa* var. *longicornis*), sometimes in mixture, sometimes in pure patches. The former of these is characteristic of greenstone soils further east, around and to the south of Norseman, and the latter of greenstone soils further west around Forrestania and in other localities. This woodland appears to be rather readily destroyed or damaged by fire and in many places there are young saplings and pole-sized stands consisting largely of *Eucalyptus corrugata* in addition to the above two species. Since *Eucalyptus corrugata* was nowhere observed in mature stands it may be that it is a relatively short-lived pioneer species: this merits further investigation. In the transition to *Casuarina* scrub on Mt Day there is a narrow band of *Eucalyptus celastroides* and *Eucalyptus* sp. (unidentified). Undershrubs are extremely sparse, but the following were noted: *Eremophila* sp. inedit., J.S.B.3825; *Eremophila densifolia; Dodonaea stenozyga; Acacia* spp. On the low ground a saltbush *Cratystylis conocephala* is common.

(*f*) *Eucalyptus salmonophloia* consociation on alluvial soils, derived from both granite and greenstone. The composition of this association is very simple. Very commonly and most typically the tree layer consists of nothing but *Eucalyptus salmonophloia* and this seems to be associated with a light loam soil. Changes in soil tend to bring in some admixture, *Eucalyptus longicornis* on clay-loam, *Eucalyptus salubris* on stiff clay. *Eucalyptus melanoxylon* appears to indicate high base status, usually the presence of Kunkar. Under ecotonal conditions appropriate mixtures can be seen, e.g., with *Eucalyptus transcontinentalis, Eucalyptus flocktoniae* and their associates or with *Eucalyptus flocktoniae* and *Eucalyptus eremophila* (in marlock form) where the boundary is with mallee. In these cases, *Eucalyptus salmonophloia* being of superior stature, a layered woodland is formed. There is commonly a tall shrub layer of *Melaleuca* spp., e.g., *Melaleuca pauperiflora, Melaleuca pubescens,* and/or *Melaleuca sheathiana*. Shrubs are extremely sparse, but include many species of *Eremophila* and *Acacia, Daviesia*

nematophylla and *Daviesia anthoclona*. Where the soil is somewhat saline, there is a ground layer solely of saltbush, 18 inches high.

6. Halophytes. The vegetation of saline areas may be divided into two types, saltbush and samphire. The former may be found on alluvial soils in the vicinity of salt lakes, while the latter occurs in the lakes themselves, usually on raised beds forming a marked pattern in the lake. Not all lakes have these beds. The saltbush type begins as a ground layer under *Eucalyptus salmonophloia, Eucalyptus melanoxylon* or *Eucalyptus flocktoniae,* which become more and more scattered as salinity increases. On the east side of some lakes the trees may thin out completely to leave pure saltbush and grass as at Lake Hope, where the saltbushes *Atriplex paludosa* and *Frankenia interioris* and grasses *Danthonia setacea, Stipa elegantissima* were recorded. Occasionally at lake margins trees of *Eucalyptus kondininensis* are found, but this tree does not seem to be common in the area.

Samphires have not been studied and are assumed to be *Arthrocnemum* spp.

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