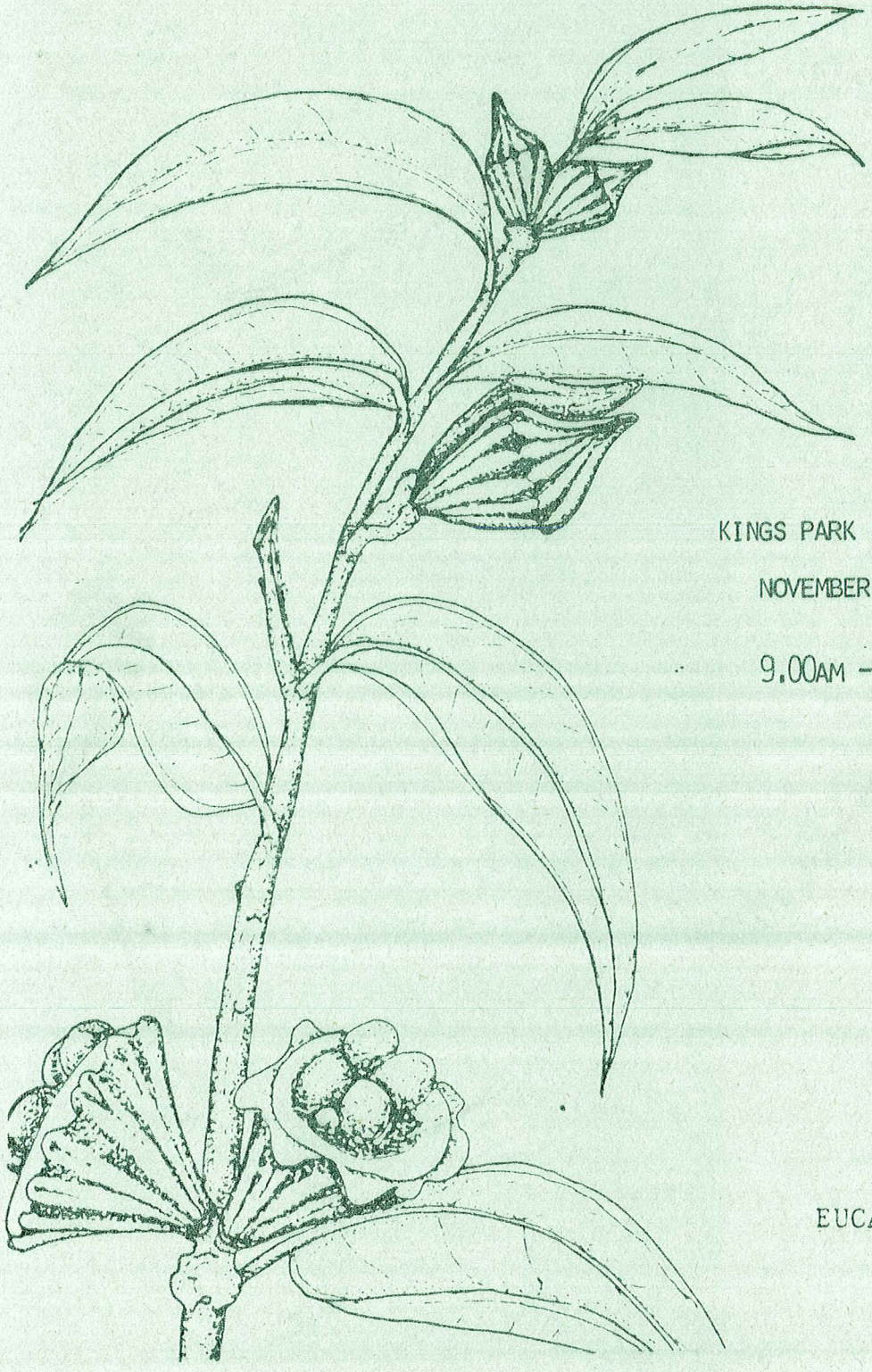
Australian Systematic Botany Society

CONFERENCE

ON THE

BIOLOGY OF EUCALYPTUS



KINGS PARK SEMINAR ROOM

NOVEMBER 16 1981

9.00AM - 4.00PM.

EUCALYPTUS CORONATA

Patterns of Water Utilization in Selected Species of *Eucalyptus* used in Rehabilitation of the Northern Jarrah Forest.

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Abstract

Patterns of water utilization over a six month period of several eucalypts employed in rehabilitation programmes of the high rainfall jarrah forest are compared using measurements of xylem pressure potential and stomatal resistance. The species included the natural dominant species (*Eucalyptus marginata* Donn. ex Sm.), two other indigenous species (*E. calophylla* R.Br. ex Lindl. and *E. wandoo* Blakely) and four eastern Australian species (*E. globulus* Labill., *E. maculata* Hook., *E. resinifera* Sm. and *E. saligna* Sm.).

A number of daily and seasonal patterns of tree water use during summer are identified, *E. marginata* was found to have a different water use pattern compared to the other species examined, with minimal stomatal control allowing maximum tree water loss. All other species showed some degree of stomatal control. It is suggested that annual water use capabilities of communities, however, must be determined before recommendations for species to replace *E. marginata* can be made.

Anatomical Features Related to Water Utilization in Selected Species of Eucalyptus used in Rehabilitation of the Northern Jarrah Forest

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Abstract

The anatomical attributes of the water conducting system and leaves of three indigenous species (*Eucalyptus marginata* Donn. ex Sm., *E. calophylla* R. Br. ex Lindl. and *E. wandoo* Blakely) and four eastern Australian species (*E. globulus* Labill., *E. maculata* Hook., *E. resinifera* Sm. and *E. saligna* Sm.) are described with reference to their physiological behaviour.

Important features in stem and wood anatomy included vessel distribution, reaction wood and starch distribution, and these generally correlated with the species taxonomic affinities. *E. marginata* (Sub-genus Monocalyptus) was distinctive, amongst the Symphyomyrtus (*E. globulus, E. resinifera, E. saligna, E. wandoo) E. wandoo* showed differences. Overall, the wood anatomical groups had little in common with groupings based on field transpiration behaviour.

Using leaf anatomy a third grouping of species was possible, principally based on stomatal occurrence. *E. globulus, E. maculata* and *E. wandoo* are amphistomatous whereas *E. calophylla, E. resinifera, E. saligna* and *E. marginata* are hypostomatous, and of the latter group, *E. marginata* can be readily separated using other leaf structural criteria. The major structural feature associated with water utilization appears related to differences in the stomatal antechamber pore and the potential for unobstructed water vapour exchange.

The anatomical structures described here, together with the physiological behaviour, confirm the unique way in which *E. marginata* responds to environmental factors and, thus, the special problems to be faced in its replacement in salt-prone areas partially cleared by current forest management practices.

Growth and Anatomical Characteristics Affected by Water Deficit in Selected Species of *Eucalyptus* used in Rehabilitation of the Northern Jarrah Forest

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Abstract

Revegetation of degraded land in the Darling Range of Western Australia requires species with the potential to transpire large quantities of deep soil profile water to maintain salt equilibrium levels.

Juvenile plants of the native dominant species, *E. marginata* Donn. ex Sm. and six potential replacement species, *E. calophylla* R. Br. ex Lindl., *E. wandoo* Blakely, *E. saligna* Sm., *E. resinifera* Sm., *E. maculata* Hook. and *E. globulus* Labill., were tested under well-watered and water stress conditions in a greenhouse.

All species showed growth rate, morphological and anatomical responses to the water deficit conditions. In general *E. marginata* was most affected by drought conditions. All others developed xeromorphic characteristics felt to be undesirable in light of the need of replacement species to utilize large amounts of soil water. Droughted plants showed a marked reduction in the percentage of reaction wood. Other changes included variations in starch deposition, cambial activity, increased frequency and narrowing of vessels, reduction of leaf vein fibres, and increased stomatal frequency. Transpiration by *E. marginata* seedlings was greater than all other tested species. The responses of the seedlings appeared similar to mature, field-tested individuals. Comparisons of seedlings grown in elongated tubes with those in pot containers indicated that quite different stem:root ratios can be achieved if roots are allowed to grow freely.

The use of certain anatomical features, genetically or environmentally induced, that could be helpful in distinguishing between potentially desirable and undesirable jarrah forest rehabilitation species is briefly discussed.

Understorey suppression by *Eucalyptus wandoo*

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Abstract

The average width of canopy of isolated patches of *Eucalyptus wandoo* at Wongamine Reserve is 6.7 m. A well-defined suppression zone, with 33x less understorey biomass per unit area than the surrounding scrub, extends beyond the tree canopy by an average of 1.6 m. Forty-seven environmental and 5 vegetation attributes were measured along a transect running from the centre of a patch into the scrub. Soils under the canopy were coarser, contained more nutrients and secondary compounds but less water than those in the scrub. Germination and subsequent growth of *Hakea trifurcata*, *Gastrolobium spinosum* and wandoo in potted soils from the transect showed a slight reduction in the wandoo canopy soils. The enigma were sites in the suppression zone but outside the wandoo canopy - on vegetation grounds their affinities were with the wandoo understorey, on soil and greenhouse-response grounds their affinities were with the scrub. The most satisfactory explanation is that roots of mature wandoo extend beyond the canopy and outcompete those of the shallower-rooted scrub species for water in the sub-soil during the summer drought. Death of mature shrubs accounts for enlargement of the suppression zone, while failure of seedling establishment, largely due to low surface water availability, accounts for maintenance of this zone.

PROPAGATION OF EUCALYPTS USING TISSUE CULTURE

Ian Bennett
Environmental and Life Sciences
Murdoch University, W.A. 6150

Vegetative propagation of mature eucalypts is very difficult using conventional means of asexual propagation. Cuttings fail to root due to the presence of rooting inhibitors (G factors), grafts show high incompatibility and other methods are either unsuccessful or very slow.

More recently attempts have been made to clone eucalypts using tissue culture methods. Generally, material which is taken from juvenile plants (i.e. seedlings) responds well in culture; shoots can be multiplied and rooted, and buds can be induced on callus cultures. When mature material is used it is difficult to obtain contaminant-free material, shoots show poor rooting ability and callus cultures will not undergo organogenesis.

We have been able to establish shoots in culture from *E. marginata*, *E. diversicolor*, *E. calophylla*, *E. wandoo*, *E. sieberi* and *E. citriodora*. Most of these have come from seedling material but mature explants have been used to initiate shoot cultures from *E. marginata* and *E. diversicolor*. Rooted plants have been obtained from all species except *E. wandoo* (which has not yet been tested).

The regeneration of shoots from eucalypt callus has previously been reported from seedling material of *E. citriodora* and *E. alba*. We have achieved this from seedling callus of *E. marginata* and *E. diversicolor* and in addition from callus of *E. marginata* originating from stamens from mature trees.

APPLICATION OF TISSUE CULTURE TO EUCALYPT IMPROVEMENT

Jen McComb
Environmental and Life Sciences
Murdoch University, W.A. 6150

The possibility of cloning eucalypts using tissue culture methods leads to the following possible applications:

1. Flower colour
   Some of the earliest organ cultures of eucalypts done in Australia were set up by R. de Fossard in an attempt to produce clones of *E. ficifolia* with uniform flower colour.

2. Frost tolerance
   In France, tissue culture propagation has been used to multiply from frost tolerant *E. gunnii*, *E. dalrympleana*, *E. pauciflora*, and *E. delegatensis*.

3. Fast growth rate for plantation trees
   In countries where eucalypts are grown as exotics in plantations for timber or charcoal the fast growth rate of selected lines can be maintained through clonal propagation.

4. Oil content
   Interest in alternative oil sources has led to renewed investigations into eucalypt oil. Species with high levels of oil production include *E. polybractea* and attempts are being made to bulk up clonal material of individual plants with high oil contents. A species of interest for W.A. is *E. oleosa*.

5. Salt tolerance
   The occasional trees that persist on salt scours could be cloned and tested to determine whether they are tolerant of salt or have in some way escaped exposure to salt.

6. Disease and pest resistance
   Trees that survive in areas where others are killed from a disease, or which show little damage from insect pests can be cloned for tests on their resistance, and to provide material for replanting.

7. Rare species and hybrids
   Valuable hybrids must be propagated vegetatively if the hybrid genome is to be retained, and tissue cultures provide a means of doing this. It is possible (but doubtful) that tissue culture could provide a means for increasing the numbers of individuals in rare species.

The condition of an area of Salmon Gum woodland providing nest sites for cockatoos.

Dr. D.A. Saunders

CSIRO, Division of Wildlife Research, Clayton Road, Helena Valley, Western Australia, 6056.

CSIRO, Division of Wildlife Research has been involved in long term studies on the ecology of several species of cockatoos in the south-west of Western Australia, all of which use hollows in trees as nest sites. In view of the importance of trees as providers of nest sites for the birds, we conducted a survey on a 15 hectare plot of woodland on private property in the Shire of Three Springs. In this woodland we examined every hollow for its potential as a nest site for any hole nesting bird of the size of a galah or larger. There were 241 such hollows in 173 trees (95% of them in Salmon Gum). Forty-seven percent of these were used as nest sites by eight species (6 species of cockatoo, 1 species of duck and 1 species of raptor). In addition one species of owl roosted in the hollows but did not nest during the survey.

Individual trees in the woodland were measured in several different ways in May 1978 and rated according to it's form and condition (dead, staghorned, broken trunk or healthy). In July 1981, the condition of each tree was checked and compared with it's condition 3 years' earlier. There had been a very rapid deterioration in the health of the woodland with 23% of the sample classed as healthy in 1978 and only 5% so classed in 1981. Nineteen percent of the trees were dead in 1978 while 40% were dead in 1981. In addition there was no regeneration to replace these rapidly dying trees. The implication for the woodland in the agricultural area is discussed in relation to the future of hole nesting species in the area.

GROWTH RATE OF JARRAH

I. Abbott and O.W. Loneragan
Institute of Forest Research & Protection,
Hayman Road, Como, W.A., 6152.

Four topics will be discussed:

1. What size (diameter at breast height) does Jarrah grow to, and how long does it take to reach this size?

2. What is the growth rate of Jarrah in relation to Havel vegetation type?

3. What effect does thinning have on growth rate of Jarrah?

4. What effect does fire have on growth rate of Jarrah?

ROOT SYSTEMS OF JARRAH FOREST EUCALYPTS

B. Dell
School of Environmental and Life Sciences,
Murdoch University, Murdoch, W.A. 6150.

The root systems of the main jarrah forest eucalypts are compared and jarrah is selected for more detailed observations. The surface roots of jarrah are often densely aggregated into mats. The fine roots in these mats can be divided into three groups: (a) long roots which have indeterminate growth and develop secondary thickening, (b) roots with determinate growth and secondary thickening, and (c) short roots with determinate growth and lacking secondary growth. The short roots may be mycorrhizal (ecto- and endo-) and are probably the main nutrient absorbing roots.

Periodicity of new surface jarrah root growth is discussed. Major factors controlling root growth are temperature and moisture.

Some data on root growth in the pallid zone is presented. Penetration of the pallid zone is dependent on size and abundance of existing root channels as well as soil structure. Acidity is probably not a problem for root growth provided the tree can obtain nutrients from other layers in the soil profile.

Studies on the penetration of roots into the pallid zone requires accurate identification of root pieces. The development of a key to assist root identification is described.

BREEDING SYSTEMS OF *EUCALYPTUS*

by G. J. KEIGHERY
KINGS PARK AND BOTANIC GARDEN
WEST PERTH 6005

The genus *Eucalyptus* (Myrtaceae) is one of the largest genera of flowering plants with 540 species and infra specific taxa. Two hundred and thirty four taxa occur in Western Australia and one hundred and sixty are endemic to the state, chiefly the lower southern heathland regions.

All taxa are long lived woody perennials, which rarely (except in some tropical species) exhibit vegetative reproduction. Reproduction is almost invariably from seed, produced sexually as there is no evidence of apomixis. All Eucalypt flowers are basically similar in morphology, but vary in size, shape and colour depending to a degree on the pollinators involved. Apparently bird pollination is basic to the genus, but often many pollinators are involved (insects (flies, beetles, bees, wasps), birds and mammals).

No species of *Eucalyptus* could be stated to be inbreeding though most are self fertile to some degree. However, lower seed set is often recorded after selfing and inbreeding depression is known to occur in selfed progeny.

POSTER ABSTRACT

The relationship between *Eucalyptus forrestiana*, its subspecies *forrestiana* and *dolichorhyncha*, and *Eucalyptus stoatei*.

C J Robinson, Kings Park and Botanic Garden, West Perth, 6005.

Population samples were collected across the ranges of *E. forrestiana* and *E. stoatei* to investigate the relationship between these two very similar species. The variation in operculum length, height of hypanthium wings and number of interwing ridges were examined and found to vary gradually across the continuous range of the two species. Morphometric analysis is currently being conducted. It is suspected that *E. stoatei* will ultimately be shown to be a geographically determined subspecies of *E. forrestiana* as are subspecies *forrestiana* and *dolichorhyncha*. There is no variation in either cotyledon shape or adult habit across the range.

Fire Scar Formation in Jarrah *(Eucalyptus marginata* Sm.)

BURROWS, N.D. Forests Department of Western Australia,
Manjimup Research Station.

ABSTRACT

Fire scar formation or drysiding occurs when there is only partial death of the tree bole as a result of a heat flux penetrating through to the cambial zone and exceeding its threshold for survival.

Drysiding in jarrah *(Eucalyptus marginata* Sm.) measured 1 and 2 years after experimental fires under summer conditions was found to be a function of fire behaviour, fuel type and loading, previous fire damage, stem diameter and bark thickness. Drysiding was fully visually discernable two years after burning but healing processes and the implications of drysiding on timber quality and productivity requires further study.