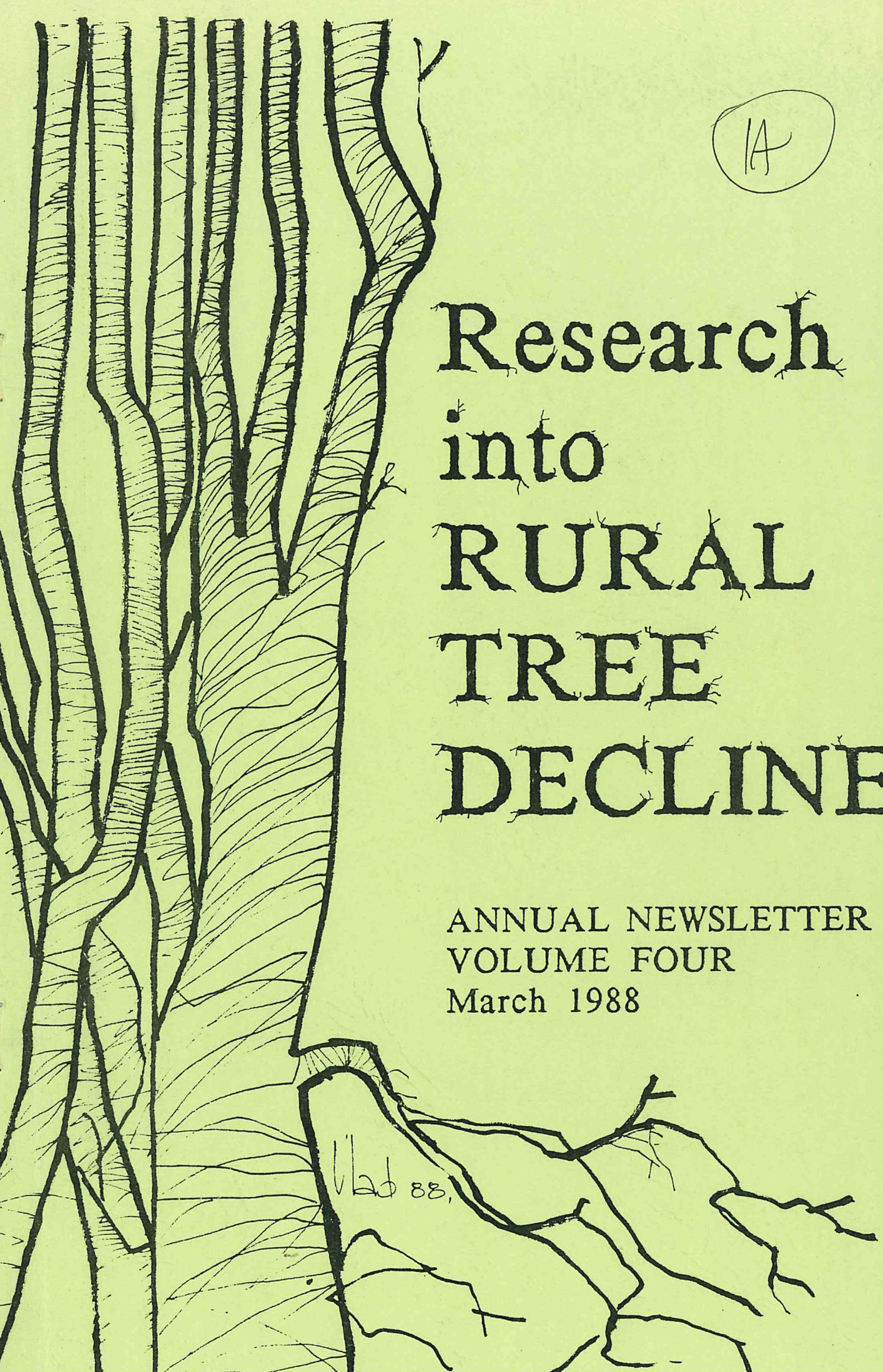

Research into RURAL TREE DECLINE

ANNUAL NEWSLETTER
VOLUME FOUR
March 1988

Volume 4 of the research into rural tree decline newsletter is bigger than ever, with articles from over 40 contributors and a circulation list of more than 200 researchers and institutions. While I hesitate to suggest that this volume is any better than its predecessors, the quality of contributions is certainly up to its usual high standard. I trust that a lively feedback between contributors and other readers will ensure that the effectiveness of the newsletter keeps abreast of its increasing size and range.

I am grateful to the CSIRO Division of Forestry and Forest Products in Canberra, for its support of this volume; I would particularly like to thank Eva Morrow for her capable word processing and Vlad Mosmondor, who designed the cover and arranged the printing.

Editing the newsletter has been interesting, challenging and rewarding - thank you to all correspondents for making it so. It has also, unfortunately been rather time consuming. Does anyone else want to be editor next year? I can guarantee that, on balance, you'll enjoy the experience.

Jill Landsberg

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March, 1988

Research into Rural Tree Decline
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Draft proposal for an Australian tree research fund

Research Working Group
National Tree Program Co-ordination Committee
C/- National Tree Program Secretariat
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The draft proposal was prepared in association with the non-government organisation Greening Australia.

Background:

Research in Australia on trees and shrubs of value in agricultural land management has been limited, and most tree related research has been confined to trees of commercial value such as forestry species. Yet the rural areas of Australia are the priority areas for re-vegetation as trees can have a major role in land management for sustained productivity.

The draft proposal:

It is proposed that an Australian Tree Research Fund be established to play a major role in defining applied research projects and disseminating research results on the role and use of trees in Australia.

It is proposed that the Fund be established jointly by the National Tree Program and Greening Australia. The Fund would support applied research in a number of areas including:

- role and significance of trees in land management and restoration
- agroforestry
- fuelwood
- effluent disposal
- tree establishment methods including direct seeding
- tree management
- genetics
- tree phenology
- community and land-owner attitudes to trees
- economic costs and benefits of trees, and
- the extent of tree cover in Australia

Monies for establishment of the fund would be sought from the private and public sector.

Response to the draft proposal

Early in 1987, the draft proposal was circulated widely for comment. A range of responses were received and nearly all were supportive. The National Co-ordination Committee of the National Tree Program is now considering the proposal in the light of comments received, and has requested a detailed prospectus from Greening Australia Ltd on how that organisation could administer such a fund. A final recommendation is expected to be forwarded to the Commonwealth Minister early in 1988.

Additional information

Additional information including copies of the draft proposal are available from Greening Australia in each state and territory, or from the Director, National Tree Program at the above address.

Native tree dieback in southern Queensland: Its occurrence, severity and aetiology.

Abstract of a PhD thesis awarded in 1986 by the Department of Botany, University of Queensland, St Lucia, to F.R. Wylie.

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A questionnaire survey and associated field studies were conducted in rural areas of southern Queensland over the period 1981 to 1983 to obtain information on the extent, severity and possible causes of native tree dieback in the region, the range of tree species affected, and community attitudes to the problem. The survey entailed interviews with 171 landowners, and field inspections, in a total of 70 Shires in Queensland and, for purposes of comparison, four Shires in northern New South Wales.

Dieback was recorded in all Shires surveyed but, in Queensland, was particularly severe in a total of 20 Shires in the Fitzroy, Wide Bay-Burnett, Moreton and Brisbane regions, and on parts of the Darling Downs. It was generally more severe for properties in the coastal strip east of the Great Dividing Range than for properties to the west (i.e. in areas of population concentration and intensive land management). Dieback was first noticed by most landowners only within the last decade, and the rate of decline seems to have accelerated in recent years. Dieback was recorded in a total of 62 tree species in Queensland, and affected all ages of trees. Eucalyptus crebra, E. drepanophylla, E. melanophloia and E. tereticornis were the "indicator" species of dieback in this area.

Dieback tended to be more severe on small properties which, generally, were more intensively managed, had a greater percentage of their total area cleared, and had smaller blocks of remnant vegetation than large properties. Older-established properties usually exhibited the most dieback. Properties with the largest percentage of their area devoted to improved pasture, and where fertilizer had been used on crops and pasture, had the highest dieback ratings. Some salinity in soil and/or water supplies was recorded in every survey district, from a total of 38 Shires, and on 46% of survey properties. Eleven of the Shires with salting were also areas of widespread and severe dieback. Dieback was most severe on flat lands. Survey data were suggestive of a link between climatic water stress of trees, insect grazing and severity of tree dieback.

The results of pattern analysis of the data were consistent with the hypothesis that a multiplicity of factors contribute to dieback severity, and the effects of any individual factor, or combination of factors, vary with locality. There was a high level of awareness and concern about dieback among survey respondents, but a general lack of knowledge of the ecological processes involved in tree decline and land degradation. The findings of the attitudinal assessment highlighted aspects requiring more research and extension emphasis.

A detailed investigation of a serious dieback problem identified in the survey (viz. dieback of Casuarina cunninghamiana, and other tree species, along many streams in the Mary River catchment of south-east Queensland) was conducted over the period 1982 to 1984. Studies were carried out at a total of 220 stream sites in the catchment to determine the extent and severity of tree dieback and to identify the cause(s) of the problem. Of the 142 sites with Casuarina ssp., dieback of these trees was evident at 136 sites and was severe to very severe at 54 sites (38%). Dieback of Eucalyptus spp. was evident at 212 sites but was generally less severe than that recorded for Casuarina.

The major factor contributing directly to the dieback and death of trees at these sites (particularly Casuarina spp.) was severe and repeated defoliation by the leaf-eating chrysomelid beetle Rhyparida limbatipennis Jacoby. However, a link was demonstrated between the extent of tree clearing/land use in different parts of the catchment, levels of streamwater salinity, and the severity of insect-related dieback of trees along streams. Generally, streamwater quality was poorest and tree dieback most severe in areas which had been the most extensively cleared/intensively managed. These relationships are illustrated in a proposed model of dieback aetiology for catchment trees, and options for remedial action are outlined.

A model of the initiation and development of dieback of rural trees in southern Queensland is presented and discussed with reference to the study results and to the literature, and research needs are highlighted. It is concluded that the extent of tree clearing since first settlement, and the inadequacy of tree replacement, may have contributed most to the problems of tree decline and degradation of rural lands. If tree clearing is the pivotal factor, as suggested, then the present impetus towards re-establishing tree cover in critical areas is well directed and offers hope of a solution.

Decline of river red gum (Eucalyptus camaldulensis) on grazing land in Western Victoria

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Decline of river red gum was studied on grazing land near Buangor in west-central Victoria. The species is found here in large, relatively pure stands stiuated on or near the northern edge of the Western Victorian basalt plains.

The study consisted of three main elements, (i) an assessment of the rate of tree loss in the Buangor area; (ii) a survey of the site selected for detailed study to attempt to identify management, soil or other factors that might be implicated in tree decline; (iii) a detailed field study of some of the tree crown and soil conditions associated with river red gum decline. The main findings of the study are briefly outlined below.

Rate of tree loss

Aerial photographs were used to determine the historical rate of tree loss in the Buangor area. Photographs were obtained for the years 1947 and 1980. During that period, the average (compounding) rate of tree loss was 1.1% p.a., slightly less than the average for other Victorian studies. Rates of tree loss in stands of river red gum (0.8% p.a.) were substantially less than in the box-stringybark stands (1.9% p.a.) which generally occupy more elevated sites across the study area.

Site survey

The site survey did not identify any association between management, soil or stand factors and tree health.

An attempt was also made to estimate tree age using radiocarbon dating to determine whether dieback could be related to natural senescence. The one tree that was sampled was found to be between 360 and 580 years old. This is the oldest (published) definitive dating for river red gum. The size and crown condition of the sampled tree did not suggest that it was one of the older trees in its stand. Sampling difficulties meant that the age of only one tree could be determined. Thus it was still not possible to make any firm conclusions about the contribution of senescence to rural tree loss.

Detailed field survey

The study had two components, one examining crown conditions and the other examining soil conditions associated with a sample of dieback-affected and healthy river red gums.

Crown characteristics

a) Crown morphology and dynamics - A method of assessing the severity of dieback in tree crowns was developed. "Healthy" trees had dense crowns that were well distributed around the tree trunk and contained few dead branches or epicormic shoots. "Unhealthy" trees had degenerate crowns with thin clumps of mostly epicormic foliage. A group of trees ("average" health category) with crown characteristics intermediate between these two extremes was also identified.

The crowns of "healthy" trees were significantly larger than those of "unhealthy" trees. This observation reflects the effect of dieback processes working in the now unhealthy trees. There was a general trend across the whole tree population for crowns to be larger to the south and east of the trunk than to the north and west. This is probably a consequence of greater insect herbivory on the warmer, more sunlit aspects of the crown. Greater exposure of these parts of the crowns to the summer sun and desiccating northerly and north-westerly winds also may have slowed the growth of these parts of the crown.

Crown dynamics of "healthy" and "unhealthy" trees differed little throughout the year. The one exception to this was the timing of new foliage production in spring. Healthy trees initiated new foliage vigorously in November, whereas new foliage production in unhealthy trees was delayed somewhat. The new foliage of unhealthy trees also had a lower specific leaf area (i.e. had more mass per unit area) than comparable foliage from healthy trees.

b) Crown water relations - gas exchange - This study showed that there were differences in crown water relations and gas exchange between tree health categories. The study provided evidence of reduced stomatal control of water loss by dieback-affected trees during summer and autumn when vapour pressure and soil water deficits were high. Transpiration measurements (per unit leaf area) partly confirmed this response, although "average" trees generally had greater transpiration rates than either "healthy" or "unhealthy" trees.

Rates of photosynthesis (per unit leaf area) in "healthy" and "unhealthy" trees were similar. Rates of photosynthesis and transpiration per tree would be expected to differ between health categories because of the smaller leaf area of dieback affected trees. Water use efficiency did not vary between tree health categories.

Leaf water potential values showed that trees were under moderate stress during summer. However there were no differences in leaf water potential between health categories.

c) Foliar chemistry - the study of foliar chemistry showed that there were quite significant differences in concentrations of some macronutrient elements between old and young foliage and between the foliage of "healthy" and "unhealthy" trees. The most important differences were observed in very young foliage. Concentrations of nitrogen, phosphorus, potassium and magnesium were greater in such foliage collected from "healthy" trees than in foliage from "unhealthy" trees sampled at the same time.

Soil conditions

a) Soil water - During the period of sampling there was a consistent trend for the amount of water stored in soil (to 170 cm) to increase with distance from the trees. Similarly there was a consistent difference in water storage between soil under open pasture and "unhealthy" trees on one hand and "average" and "healthy" trees on the other. Depletion of soil water by trees declined (and hence the potential for groundwater recharge) with their crown health and approached that of open pasture for tree crowns that were in very poor condition.

The rate of evaporation was estimated using a simple water balance equation. These calculations showed that evaporation rates did not differ between

"healthy" and "unhealthy" trees or between trees and pasture during the period of study. Evaporation rates were in the vicinity of 600 mm p.a.

b) Soil strength and compaction - Bulk density and soil strength were sampled to determine the extent of radial and directional variation and whether there were differences in soil conditions between "healthy" and "unhealthy" trees. Samples were taken in June and November. Soils at the very surface were wetter in June than in November. At greater depths, soils were wetter in November than in June.

Bulk density of soils increased with distance from tree trunks. Soils were probably less compacted under trees than away from them because of the ameliorative effects of organic matter in the surface soil. There appeared to be less organic matter under open pasture than under trees. Bulk density did not differ significantly between tree health categories or between northern and southern radii.

Assessments of soil strength showed that soil conditions under open pasture were less favourable than under tree crowns. Soils under open pasture tended to harden near the surface when dry. No such trend was evident under tree crowns. There was little difference in average soil strength (to 75 cm) under or away from the trees in November. In June the strength of surface soil under open pasture was much less than the soil strength under trees, indicating a greater propensity for deformation and puddling by stock hooves.

Coastal vegetation damage and airborne surfactant deposition near Barwon Heads, Victoria

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Coastal tea-tree (Leptospermum laevigatum) and associated species on foreshore dunes near Barwon Heads, southwest of Geelong, have displayed dieback symptoms for several years. The severity of the effect ranges from browning of newly emerged foliage to death of whole plants, and the affected area extends for at least 7 km along the coast and up to 750 m inland. The affected ara includes a major sewage outfall for industrial and domestic waste from the city of Geelong; work is currently in progress to extend this outfall to 1.2 km offshore.

It has been suggested that the vegetation damage is caused by foliar salt uptake facilitated by excessive concentrations of surfactants in coastal spray; observation of elevated chloride concentrations (5 - 20 mg kg^{-1} dry weight) in foliar samples from affected plants in a preliminary survey lends some support to this hypothesis. If this is the cause, the extended outfall may reduce airborne surfactant deposition sufficiently to overcome the problem.

A monitoring program has been commenced as a cooperative project of the Department of Conservation, Forests & Lands, the Environment Protection Authority and the Geelong and District Water Board, to record surfactant deposition and foliar chloride levels in relation to weather conditions before and after commissioning of the new outfall. Collection of the "before" data was carried out between August and December 1987. Significant features of the data are a correlation between foliar chloride content and recent (<1 week) surfactant deposition, and a large variation in surfactant deposition with temperature, rainfall and sampling location.

The second data set is expected to be collected in spring of 1988. A glasshouse study is also to be carried out this year, to confirm that surfactants can enhance foliar chloride uptake by tea-tree seedlings at concentrations similar to those observed in the field.

Weather, Eucalyptus dieback in New England, and a general hypothesis of the cause of dieback.

A summary of a paper by T.C.R. White, published in Pacific Science Vol. 40, pp. 69-89 (1986).

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On the New England Tablelands between 1950 and 1980 very many eucalypts declined and died. This dieback was strongly correlated with a change in the pattern of rainfall. Starting from 1945 trees were more frequently exposed during the growing season to excess of soil moisture followed immediately by a shortage of water. Several species of Eucalyptus were affected but those species which normally grow on poorly-drained sites died first and continued, even on better sites, to be the species worst and most frequently affected. Declining trees were heavily and repeatedly attacked by defoliating insects. The same species had declined and died in the same localities approximately 100 years earlier. This century declines and diebacks in other parts of Australia and overseas showed many similarities to that of eucalypts in New England, and to each other. In particular, they have been associated with departure of rainfall from the norm, and with insects and fungi attacking mostly old trees and species growing on harsh sites.

It is proposed that the primary cuase of diebacks and declines is a change in the pattern of rainfall which physiologically stresses trees via changes in the availability of water to their roots. Senescing and suppressed trees and those growing on sites most prone to be flooded and dried out will be first and worst affected. Defoliating and cambium-feeding insects and root-killing fungi are secondary, successfully attacking only stressed trees. They may hasten the decline and eventual death of badly stressed trees. Predators are more successful on stressed trees because more of their young survive when they feed on tissues made more nutritious by the release of nutrients during senescence induced by water stress. The extent to which they can successfully attack depends on the frequency and amplitude of stress the trees experience. So, declines and diebacks are but one extreme of a continuum of response of trees to physiological stress; small, short-lived increases of predators on one or a few trees, the other. Outbreaks of insects and fungi of varying duration and severity fall between those two extremes.

An Investigation into some Economic and Spatial Relationships of Eucalypt Dieback on Farms in Southern New England, N.S.W.

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The project

Eucalypt dieback is widespread throughout Eastern Australia and seems particularly acute in the New England Region of New South Wales. Much eucalypt woodland occurs on grazing land and so the relationships of dieback to primary production seem worthy of examination. This project examines the interaction between eucalypt dieback and factors of land use, land type, farm income, and land value on a systematic sample of grazing properties in parts of Dumaresq, Uralla and Walcha Shires.

The data were collected at the property level, for all 19 sample properties, and at the paddock level for 192 paddocks on these properties. They were collected from aerial photographs, field observation and interviews with the farm owners or managers. The data were first analysed through computer maps to examine the distribution of dieback. The percentage of woodland suffering from dieback decreased steadily from the north-west to the south-east of the study area. Other maps indicated a negative correlation with percentage woodland. These visual correlations were later supported by the statistical analysis.

The results indicate the condition of the woodland and the extent of its deterioriation over the last decade. In 1973, 43 per cent of the woodland was suffering from some dieback - as an average across all the paddocks. In 1980, 55 per cent of woodland existing at that time was suffering from some dieback. In 1980, all the trees were dead or dying in 37 of the 192 paddocks and over 50 per cent of the trees were dead or dying in 87 of the paddocks.

Variations in gross margin, or net farm income, per hectare were highly correlated with variations in animal stocking rate (75 per cent correlation), with variations in percentage of woodland suffering from dieback in 1973 (54 per cent) and with variations in percentage of the farm in woodland (-50 per cent). Increases in stocking rate, increases in percentage dieback in 1973 and decreases in percentage of the property in woodland are each highly correlated with increases in 1980 gross margin per hectare.

The 192 paddocks were grouped into five classes by the quantity of live tree cover per hectare. In the two classes with the highest quantity of live cover per hectare, decreases in live cover were significantly related to increases in stocking rate and land value. But in the three classes with least live tree cover per hectare (the sparse live woodland), decreases in cover were not related to changes in stocking rate or land value.

These latter results suggest the following relationships: (a) Decreases in live tree cover (and increases in dieback in 1973) are statistically associated with increases in the 1980 stocking rate (of sheep and cattle) in the densely-wooded paddocks. (b) No statistical relationship could be found between live tree cover and stocking rate in the sparsely-wooded paddocks. (c) Similarly, increases in the percentage dieback 1973 are statistically associated with increases in land value 1980 in the

densely-wooded paddocks. In the sparsely-wooded paddocks, no consistent statistical relationship with land value could be found.

The implications of these results seem to be as follows. In some situations (paddocks with sparse, live woodland) there appear no obvious financial incentives to clear woodland further. In these situations, increases in dieback do not seem to statistically associated with increases in stocking rate. However, in other situations (densely-wooded paddocks), there does appear to be financial incentive to clear woodland and to "accept" dieback. In these particular situations, economic conditions encourage the grazier to reduce the amount of live tree cover and to avoid dieback control.

2. Publications so far from the project

a) Relationships between eucalypt dieback, and farm income, stocking rate and land value in southern New England, New South Wales, J.A. Sinden, A.D. Jones and P.J. Fleming, University of New England Monograph - now out of stock.

b) Relationships between eucalypt dieback and farm income in southern New England, New South Wales, J.A. Sinden and A.D. Jones, Paper presented to Annual Conference of Australian Agricultural Economics Society, Brisbane, 1983.

c) Eucalypt dieback and stocking rates in southern New England, New South Wales, J.A. SInden and A.D. Jones, Australian Journal of Agricultural Economics, V29(2) pp. 149-156.

d) Facing the Eucalypt dieback problem: a New England Case Study, J.A. Sinden and A.D. Jones in Facing Forestry's Future, Proceedings of the 10th Triennial Conference of the Institute of Foresters of Australia, 1983, 127-129.

Control and distribution of *Phytophthora* species

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The Road Verges Conservation Committee (WA) has funded our project to test three methods of eradicating *Phytophthora cinnamomi* from small infection centres. Soil fumigation (formaldehyde), fungicide application (Ridomil) and vegetation removal are the treatments being tried in an area of "dieback". Soil fumigation is apparently the most effective and rapid way of reducing the *P. cinnamomi* "population". Assessment of treatments is continuing.

The importance of *Phytophthora* species other than *P. cinnamomi* is also being considered, particularly *P. citricola* and *P. megasperma*. There are now many recorded isolations of *P. citricola* from different regions of the S.W. of W.A. Shearer *et al.* (Australian Journal of Botany 1987, **35**, 103-10) have published data on relative susceptibilities of two hosts to 7 *Phytophthora* species. Further work is required on the distribution of these species and the disease hazards they present, particularly in relation to flora conservation.

Conductivity of large Jarrah roots

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When an area of jarrah forest is infested with the soil-borne pathogenic fungus Phytophthora cinnamomi, many of the understorey and midstorey plant species are killed. Jarrah (Eucalyptus marginata) dies on the wetter sites following exceptionally heavy winter or summer rainfall. P. cinnamomi can infect jarrah roots, but, because it reduces the vegetation density, it will also change the water balance of the site. Growth measurements of trees on a relatively well drained site have shown that jarrah grows faster where P. cinnamomi occurs, compared with the growth of similar diameter trees in adjacent uninfested forest, this is presumably because of reduced competition. On a wetter site, however, jarrah does not show this growth response, even though the area where P. cinnamomi occurs, is more open than the adjacent uninfested area (Davison & Tay, 1988).

Glasshouse experiments have shown that reduced drainage will increase the number of P. cinnamomi lesions on seedling roots (Davison & Tay, 1987) but will also reduce the number of functional xylem vessels in secondarily thickened roots (Davison & Tay, 1985).

Before trying to determine whether trees on the wetter site have more lesions or less efficient root xylem than trees on the drier site, it is necessary to determine the length of xylem vessels and how flow through roots is related to the number and size of functional vessels.

Paint infiltration and gas flow methods have shown that about 15% of vessels in both stem and root are about 1 m long, the reminader are about 40 to 50 cm long.

Gas flow through a standard cross section area, at standard pressure, has been measured through the sapwood of 20 cm long root segments. Because a low pressure was used (20kPa) gas would only flow through vessels which are open at both ends. Measurements through horizontal and sinker roots from trees from several different areas of forest have shown that flow rate decreases towards the bole of the tree (Fig 1). Anatomical examination has shown that this is due to narrower vessels, (Fig 2) not reduced numbers of vessels (Fig 3) or reduced number of functional vessels (Fig 4). As the flow rate is porportional to the fourth power of the capillary radius, gas flow through wide vessels will be much faster than flow through narrow ones. Damage or dysfunction of vessles at the proximal end of a root will therefore have a greater effect on conductivity than damage further from the bole.

Davison, E.M. & Tay, F.C.S. 1985. New Phytol. **101**, 743-753.
Davison, E.M. & Tay, F.C.S. 1987. New Phytol. **105**, 585-594.
Davison, E.M. & Tay, F.C.S. 1988. Aust. J. Bot. **36**, in press.

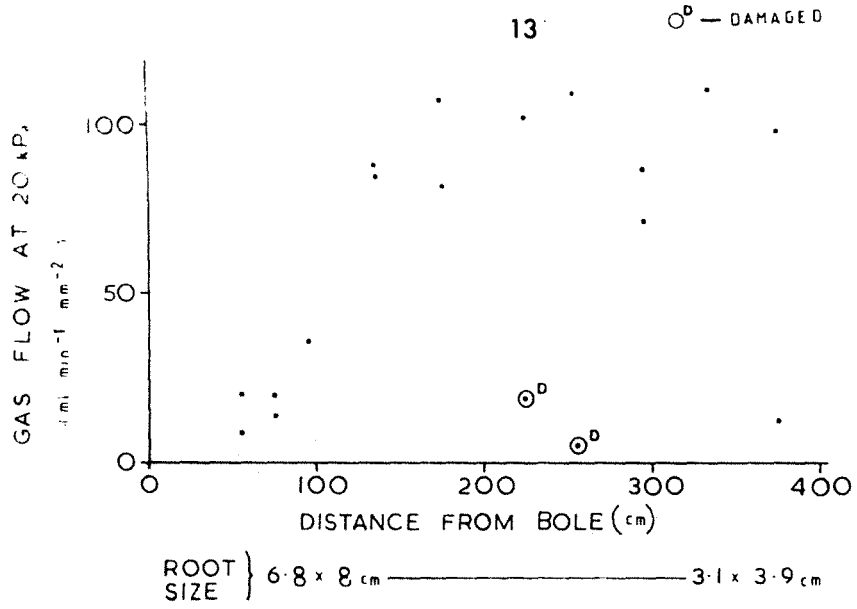

Figure 1.

Flow rate through 20 cm segments along a root

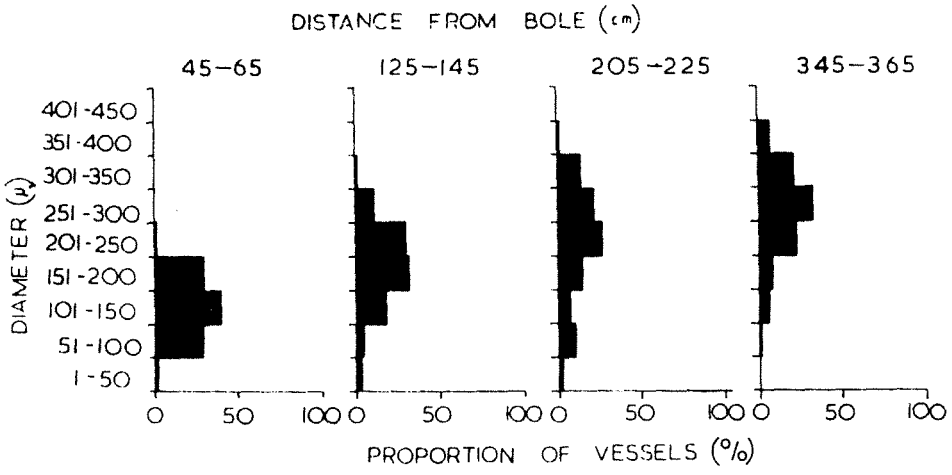

Figure 2.

Distribution of vessel diameters along the same root

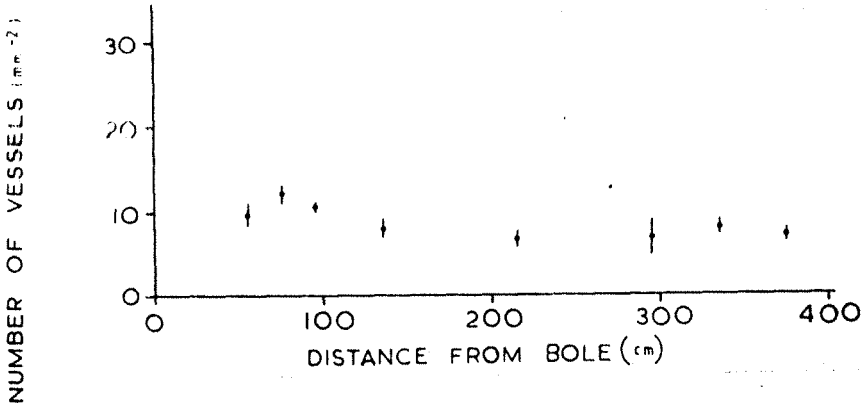

Figure 3.

Number of vessels per unit area along the same root

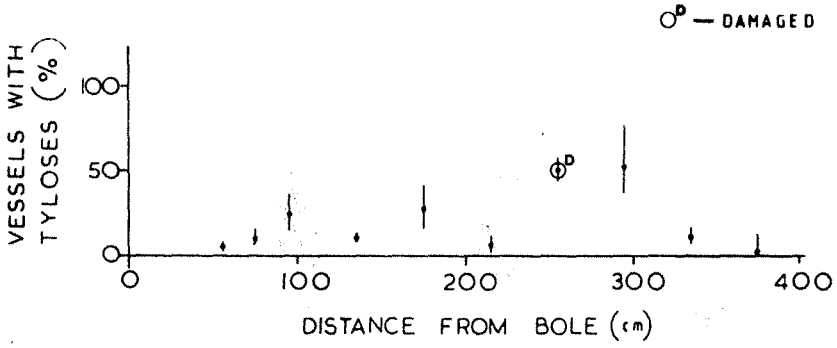

Figure 4.

Proportion of Non-functional vessels along the same root

Impact of insects on the growth and survival of Eucalypts planted in the Southern Tablelands of N.S.W.

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Continuing Project (Commenced 1983)

Insect feeding, particularly by Christmas beetles, is implicated in the decline and death of mature eucalypts in south-east Australia. Mature trees have proved difficult to study, not only because of the obvious technical problems involved, but also because little is known of the past health, or of other stress causing factors. The Division of Entomology initiated a study on the impact of insects on the establishment of eucalypts in farmland in the southern tablelands in 1983. A range of species of eucalypt native to the tablelands and adjacent ranges is being planted out in replicated blocks over an eight-year period, and colonisation by phytophagous insects investigated as the trees grow. The feeding damage of the various insect groups is being assessed by differential grass production and by the extent of defoliation, and the annual biomass production of trees exposed to insect attack is being compared with those protected by chemical treatment. The factors regulating the numbers of phytophagous insects are also being investigated. An outline of the methodology and a summary of some interim findings is given in:

Farrow, R.A. and Edwards, P.B. (1987). A new approach to the study of rural dieback of eucalypts; a report on the initiative by CSIRO Division of Entomology. In 'The role of invertebrates in conservation and biological survey'. (Ed. J.D. Majer). pp 115-118. Western Australian Department of Conservation and Land Management Report. (Reprints available on request).

Rural dieback in isolated remnants of native woodland : stand structure and insect defoliation

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As outlined in volume 3 of the newsletter, we are investigating whether the structure of stands of native trees in pastoral regions influences the health of the trees, and the extent to which they are defoliated by insects. Logistic constraints and demonic intrusions (an apt statistical term for the sorts of disasters which plague field experiments) have led to some modifications of our original proposal. We have now confined our study to the Southern Tablelands of New South Wales, within a 150 km radius of Canberra. The sites we have chosen are all relatively small (2 to 30 ha) stands of woodland trees (species include Eucalyptus blakelyi, E. melliodora, E. polyanthemos, E. bridgesiana, E. goniocalyx, E. macrorhyncha, E. mannifera, E. rosii, E. rubida and E. cinerea). The stands are relatively isolated from others stands or forest patches - for the most part they are 'islands' of trees surrounded by 'seas' of pasture. In our experience such island stands are more at risk from rural dieback than are larger or less isolated stands.

Our 16 sites are in pairs with contrasting stand structure. The 'shrubby stands' have been little altered for pastoralism. Few trees have been cleared and grazing by livestock is light or infrequent. The understorey consists mainly of native shrubs and herbs. Although few trees have been cleared from the 'pasture stands', grazing by livestock is common; thus their understorey consists mainly of native and introduced pasture grasses. We located the shrubby stands first (we could find only 8 that fitted our structural and logistic criteria). We then matched each shrubby stand with the nearest (closer than 10 km) comparably sized stand of pasture trees that contained a similar mix of tree species growing on a similar rock type, and in a similar position in the landscape.

Within these paired stands of trees we are measuring: floristic diversity (some shrubby stands contain more than 35 species of shrubs), tree health (the shrubby stands generally appear healthier), diversity of bird species, especially insectivorous ones (the shrubby stands generally appear to be richer), and soil acidity and nutrient content (no results yet).

E. blakelyi (Blakelyi's red gum) is common to all sites, often has dieback, and is often heavily damaged by insects. Thus we have confined our insect work to this species. Experiments have been running since January, and will continue into early April this year. (Demonic intrusions interfered with earlier experiments). Our test animal is a species of chrysomelid beetle, Paropsis atomaria Ol., the adults and larvae of which commonly feed from mid spring to early winter on many of the species of woodland eucalypts in south eastern Australia.

Starting with eggs laid by beetles reared in insectories, we allow larvae to establish on leaves of our study trees. Some larvae are protected by sleeve cages from predation and parasitism, and we measure the weight to which they grow and the nutrient content of the foliage on which they feed. We also measure the survival of other, unprotected, eggs and larvae placed on different branches of the same trees. In this way we will be able to assess the relative contributions of food quality and predation to the growth and survival of these insects.

In addition to these experiments we are also measuring the relative abundance of other insects at the site, by fogging with insecticide and by using 'barrier traps' (mesh trays with stiff, slippery sides, attached near the ends of branches).

Spring and summer of 1987-8 have been very favourable for defoliating insects. Sawfly larvae (Perga sp.) were followed by cup moth larvae, (Doratifera sp.) which overlapped with larvae of the eucalypt weevil (Gonipterus scutellatus) and the first chrysomelid beetles (Paropsis spp, Chrysoptharta spp., Trachymela spp., and Paropsisterna spp.) and their larvae. Mid December saw the emergence of hordes of Christmas beetles (Anoplognathus spp.), which remained active well into February and caused severe, although patchy, defoliation. Chrysomelids, lerps (Glycaspis sp. and Cardiaspina sp.) tree hoppers (Eurymelidae), and shoot-sucking bugs have continued to be active throughout summer and into autumn. The most heavily damaged trees at our sites lost all of their spring growth flush to the early feeders, and a large proportion of their mature foliage to the Christmas beetles. Much of their late summer growth flush has also been damaged. This pattern appears to be most common amongst trees at several of the pasture sites. E. blakelyi trees usually produce major leaf flushes only in alternate years, unless more frequent flushing is stimulated by repeated defoliations. Most of the E. blakelyi trees at several of our shrubby sites produced only very minor leaf flushes during the 87/8 growing season, and these trees appeared to suffer very little insect damage.

Measuring these apparent differences in defoliation, however, is not straightforward, because of the marked differences in average age of individual trees' leaves, and because heavily damaged leaves are often shed. Continuous monitoring of tagged leaves would have overcome some of these problems, but we did not have the resources to maintain the intensity of measurement this technique requires. Instead, we concentrated on assessing defoliation rates only during the period of our detailed insect work. Early in January, before the emergence of the late summer growth flush, we covered some branches with mesh bags to protect them from insects. We also marked, but did not cover, adjacent branches of similar size. In autumn, when insect defoliators become less active, we will remove both the bagged branches and their unprotected neighbours. We think the differences in leaf area between bagged and unbagged branches will give us a reasonable indication of relative herbivory over a known, although limited, period. Already we can see dramatic constrasts among sites in the relative differences between protected and unprotected branches.

Obviously we still have a great deal of work to do. Even now, however, one fact is very clear. Little-disturbed remnants of the box-gum woodlands that once dominated large tracts of south eastern Australia are a species-rich, seldom appreciated, poorly understood and rapidly disappearing resource.

Defoliating insects in the southern Jarrah forest of Western Australia

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1. In September 1987 I completed a "Review of past and current research into insect problems in the jarrah forest, with recommendations about the future direction of research". This was submitted to the Policy Directorate of CALM. The recommendations are currently being prioritized by a subcommittee of this Directorate.

2. It is now clear that detailed measurement of insect damage to jarrah leaves need only be done during the first 12 months. After that damage is negligible. However most tagged leaves are still alive then (at 36 months about one third of leaves remain alive).

3. A comparative study of damage to leaves of the eight eucalypt species occurring within a 50 km radius of Manjimup showed that E. rudis experienced the most (58% of leaf area) and E. wandoo the least (11%).

4. Studies on inventory plots suggest that Jarrah leafminer causes a loss of about 120 000 m^3 in wood increment each year. The comparable figure for Gumleaf Skeletonizer is estimated to be 50 000 m^3.

5. Infestations of GLS could not be correlated with stand basal area, time since logging or time since the most recent fire. Caterpillars were most dense in jarrah stands in the higher rainfall zone.

6. Studies commenced of jarrah leafminer in October 1987 in jarrah forest near Collie, where this species has been in outbreak for 5 years. Leafminer infestation in this District is now severe, with most stands having brown crowns. The occurrence of parasitized mines was mapped north to Dwellingup.

7. There has been an outbreak of lerp Cardiaspina ? brunnea on Eucalyptus occidentalis in the lower Great Southern for the last 5 years. Many inquiries from farmers about brown crowns and dying trees were received in June 1987.

8. Early in 1988 CALM will be doubling its research effort into forest entomology. A second entomologist and two support staff will be based at the Manjimup Research Centre. They will examine whether parasitoids offer any hope in controlling Gumleaf Skeletonizer infestations in the southern jarrah forest. They will also initiate an ecological study of Cardiaspina infestations on Flat-topped Yate. My own efforts will concentrate more on control of jarrah leafminer, co-ordination of research, and writing.

The biology and ecological impact of bag shelter moths in the Western Australian wheatbelt

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The background to this project was described in volume three of this newsletter.

Briefly, the bag-shelter moth is common in the W.A. Wheatbelt and its abundance is rapidly increasing according to some local shires. The caterpillars of this species feed mainly on Acacia acuminata, or Jam-Wattle, and often defoliate entire trees. A. acuminata is one of the major plant species in the W.A. Wheatbelt. Dense stands are common in remnants of native vegetation, often associated with Eucalyptus species, and also along road verges where it could comprise an important part of the vegetation with respect to usage by fauna. It also contributes a certain value from the cosmetic point of view, since the W.A. Wheatbelt is very monotypic in the sense of vegetation diversity. It is therefore important to conserve A. acuminata and investigate attack on it by the bag-shelter moth.

Early investigations in and around Durokoppin Nature Reserve indicated that the prime target trees were those located on road verges, especially the ones surrounding agricultural land. Single isolated trees were often infested by caterpillars which resulted in defoliation of the entire tree. Otherwise, stands of several trees were attacked and this also resulted in the defoliation of some of the trees. Stands in reserved areas did not seem to be affected by the moth.

Experiments are being conducted to investigate the relationship between infestation by caterpillars and the nutrient status of the trees, and to determine the amount of foliage consumed by the caterpillars at various levels of instars.

The experiments are due for completion in June 1988, at the end of the caterpillars' feeding period.

Seasonality and abundance of arboreal invertebrates in western and eastern Australian forests and their relationship to avifauna

Jonathan Majer[1] and Harry Recher[2]

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2 Department of Ecosystem Management, University of New England ARMIDALE N.S.W. 2351

The background to, and aims of, this continuing project were outlined in the previous Rural Tree Decline Annual Newsletter. Recapitulating briefly, the evidence gathered to date indicates that the abundance of invertebrates in tree crowns has a profound influence on the usage of such trees by birds. The principal objective of this project is to quantify the abundance and seasonality of invertebrates in the canopies of different tree species within Western Australia and N.S.W. temperate eucalypt forests. The results obtained will be integrated with data on the abundance and seasonality of foliage gleaning birds and will provide information which should enable forests to be managed in a way which caters for the conservation of invertebrate-feeding birds.

Papers in press or in preparation.

Majer, J.D. and H.F. Recher. (in press). Invertebrate communities on Western Australian eucalypts: a comparison of branch clipping and chemical knockdown procedures. Australian Journal of Ecology.

Majer, J.D., H.F. Recher and N. Achuthan. (in prep.). Spatial variation of invertebrate abundance within the canopies of Australian eucalypt forests. In ed. M.L. Morrison, C.J. Ralph and J. Verner. Food Exploitation by Terrestrial Birds.

The use of ants as indicators of road verge environmental quality in the Western Australian wheatbelt

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With the widespread destruction of many of Western Australia's ecosystems, road verges are often the only examples which remain of such communities. State Government authorities who are concerned with conservation issues have come to realise this and there is now a committee in existence which is investigating the conservation value of road verges throughout Western Australia.

Maintenance of a road verge does not necessarily ensure the conservation of the plants and animals which occur in the region. For instance, the verge may be affected by excessive burning, weed invasion, pollutants, dust, rubbish disposal or off-road vehicles.

In view of their extreme diversity and abundance, and because of their position near to top of food chains, ants are often good bio-indicators of the environmental quality of an area. They have already been used as indicators of the success of minesite rehabilitation and of the conservation status of nature reserves. The aim of this project is to look at their possible value as indicators of the environmental quality of road verges. The work will be performed along the Wubin-Perenjori Road where the road verges have already been studied in some detail, thus providing some baseline data on which to consider the ant data.

The project involves visiting the area during the summer of 1987/88; subjectively selecting road verges on the basis of their width, degree of weed invasion, plant species diversity, etc.; sampling 100 m lengths of verge by hand and by pitfall trapping; sorting and identifying ants in the laboratory and relating the ant community parameters which are obtained back to the nature of the road verges which were studied.

Relevant references.

Majer, J.D. (1983). Ants: bioindicators of minesite rehabilitation, land-use and land conservation. Environmental Management 7, 375-383.

Arnold, G.W., D. Algar, R.J. Hobbs and L. Atkins. (1987). A survey of vegetation and its relationship to vertebrate fauna present in winter on road verges in the Kellerberrin District, W.A. W.A. Department of Conservation and Land Management Technical Report No. 18.

Roadside Vegetation Conservation Committee (RVCC)

Penny Hussey
Executive Officer
P.O. Box 104
COMO W.A. 6152

The RVCC was set up in November 1985 to co-ordinate and promote the conservation and effective management of rail and roadside vegetation for the benefit of the environment and the people of Western Australia. Its funds, provided by the State Governfment, include $20 000 for research in the financial year 1987/88.

Maintenance of existing vegetation does fall within the ambit of the RVCC, therefore projects involving tree decline along rail and roadside would be eligible for RVCC funding. Intending researchers should apply to the Executive Officer at the above address.

Projects funded during 1987/88 include:

1. Regeneration of Banksia cuneata. Use of fire to rejuvenate a senescent stand of a rare Banksia. Dr Byron Lamont: Curtin University WA.

2. Investigation of a method for eradication of spot infection of Phytophthora cinnamomi. Dieback is often spread along roads. If caught early enough, perhaps it can economically be destroyed. Dr Joanna Tippett, Department of Conservation and Land Management, Perth.

3. Effects of fire on roadside in kwongan vegetation. An attempt to develop management guidelines for fire on roadsides. Mr Ted Griffin, 47 Macmillan St., Victoria Park WA 6151.

4. Effects of herbicide, used for roadside weed control, on native vegetation. An attempt to quantify whether herbicides applied by corridor managers are contributing to tree decline. Mr Simon Whitehouse, Murdoch University, WA.

Conservation requirements of the gazetted rare species, Banksia cuneata A.S. George along the Quairading - Bruce Rock Road, Western Australia.

Byron Lamont, Stephen Bergl, Stephen Connell.
School of Biology
Curtin University of Technology
G.P.O. Box U1987
PERTH W.A. 6001

This project has been funded by the Department of Main Roads through the Roadside Vegetation Conservation Committee for a two year period which commenced in February 1987.

Background

Banksia cuneata, the Matchstick Banksia, is one of the rarest species of banksias. It is confined to remnant vegetation in the wheatbelt area of Western Australia; occurring within a 50 km radium of the town of Quairading. Four populations are currently known; three occur on roadside verges and one is located in a small nature reserve. Fewer than 300 plants exist in the wild.

Project Aim and Constraints

The aim of this study is to explore ways of maintaining present populations and establishing new populations by manipulation of the environment. The project is constrained by:

1) the need to ensure that suitable methods require limited effort and maintenance; and

2) that the surrounding native vegetation be considered in evaluating the success and utility of such methods.

Project Status

Banksia cuneata is serotinous (retaining its seeds in woody follicles on the plant) and is killed by fire. It relies upon post-fire seedling establishment for population regeneration. The size and nature of the seed crop on plants of known ages was assessed in 1987.

In late Autumn 1987, a controlled fire was placed over a portion of one population. Seed release and seedling establishment in control and experimental plots within the burnt and unburnt areas is currently being examined. Experimental plots have been designed to examine the effects of microtopography, weed control, rabbit and insect exclusion, direct hand sowing and seedling tranplanting on the success of seedling survivorship and growth.

Studies in 1988

Glasshouse investigations of the growth of B. cuneata seedlings on different soil types from the wheatbelt area will commence. Field monitoring will continue and a comprehensive census of all known populations will be undertaken. The census will determine population sizes, age structures, the nature of the surrounding native and weed vegetation, substrate relationships and possible threats.

Publications

Connell, S.W., Lamont, B.B., and Bergl, S.M. 1988. Matchstick Banksia. Australian Natural History Magazine (in press).

Lamont, B.B., Connell, S.W. and Bergl, S.M. Seed bank dynamics of Banksia cuneata (in preparation).

National Afforestation Program. General features 1987/88

Enquiries should be directed to:

Assistant Secretary
Forestry and Land Resources Branch
Natural Resource Management Division
Department of Primary Industries and Energy
G.P.O. Box 858
CANBERRA A.C.T. 2601

Aim

The aim of the National Afforestation Program (NAP) is to stimulate a sustained increase in the level of investment by State and local Governments, companies, community groups and individual landholders in the establishment of hardwood plantations and land rehabilitation and degradation control through afforestation. It is intended that the NAP provide funds to afforestation projects in a way which leads to an increase in forest planting activity above that which would otherwise have occurred.

The NAP has three components:

- Broadacre Plantations
- Land Rehabilitation and Degradation Control
- Research and Demonstration

Broadacre Plantations
Eligible Applicants

Submissions for assistance from this component will be accepted from State Government agencies and companies undertaking broadacre forestry. These applicants may be acting in their own right (for plantation establishment on Crown or company land) or on behalf of local Government bodies, community groups or individuals. Local Government and private projects may be eligible for NAP assistance, providing:

- the projects qualify for acceptance into NAP-accredited afforestation schemes administered by State Government agencies or companies; and

- the agency or company is prepared to assume the role of the applicant and

  - develop, on behalf of the persons undertaking the projects (third parties), submissions seeking NAP assistance

  - accept NAP grants on behalf of the persons undertaking the projects and take responsibility for ensuring compliance with conditions attaching to the grants.

Eligible Projects

Commercial plantation projects and large scale agroforestry projects which the Commonwealth considers are additional to afforestation activity carried out in the normal course of business by the applicant may be eligible.

As the aim of the NAP is to act as a catalyst or stimulant to further activity, the Commonwealth will also take into account the extent to which funding of afforestation activity under the NAP would be expected to result in a sustained increase in levels of investment in plantations and agroforestry.

Land Rehabilitation and Degradation Control

Eligible Applicants

Submissions will be accepted from State and local Government agencies, companies undertaking broadacre forestry, and larger community groups. These applicants may be acting in their own right (for projects on land they control) or on behalf of small community groups and individuals. Projects to be undertaken by groups or persons within the latter category may be eligible for NAP assistance, providing:

- the projects qualify for acceptance into NAP-accredited land rehabilitation and degration control schemes administered by State and local Government agencies, companies or larger community groups; and

- the agency, company or community group administering the scheme is prepared to assume the role of the applicant and

  - develop, on behalf of the persons undertakin ghe projects (third parties), submissions seeking NAP assistance

  - accept NAP grants on behalf of the persons undertaking the projects and take responsibility for ensuring compliance with conditions attaching to the grants.

Eligible Projects

Projects where afforestation is an integral element of successful land rehabilitation or degradation control may be eligible.

As the aim of the NAP is to act as a catalyst or stimular to further activity, the Commonwealth will also take into account the extent to which funding of afforestation activity under the NAP would be expected to result in a sustained increase in levels of investment in land rehabilitation and degradation control through afforestation.

Research and Demonstration

Eligible Projects

Research projects should seek to improve the availability of knowledge concerning establishment, management and processing of broadacre plantations, or develop new techniques and strategies for land rehabilitation and degradation control through afforestation.

Demonstration projects should show possible applications of new knowledge gained from research, or increase community awareness of benefits to be gained from broadacre plantations and land rehabilitation and degradation control through afforestation.

Basis of Expenditure

NAP funding will be on a grants basis.

There is no predetermined level of funding between the States and the private sector. Each submission will be examined on its merits, and those which provide for a significant contribution from the grantee or sources other than the NAP, while meeting all of the project selection criteria, can be expected to receive the most favourable consideration.

Project Approval

Decisions as to the allocation of funds from the Program will be taken by the responsible Minister. Notification of approval, conditions attaching to grants, and arrangements for disbursement of funds will be made to successful applicants.

Unsuccessful applicants will be advised of the Minister's decision.

The NAP is administered by the Forestry and Land Resources Branch of the Natural Resource Management Division, Department of Primary Industries and Energy.

Reporting

Progress reports and final reports for each project will need to be prepared by the grantee in accordance with conditions attaching to grants, and forwarded to the Department of Primary Industries and Energy.

TREDAT (Module 5, the Projects Module)

Director
National Tree Program
G.P.O. Box 787
CANBERRA A.C.T. 2601

What is TREDAT? TREDAT is a computerised system for gathering information on tree projects and the performance of tree species in a wide range of situations. TREDAT was developed by the CSIRO Division of Forest Research, the Queensland Forestry Department and the Department of the Arts, Sport, the Environment, tourism and Territories, Canberra. It has five modules:

- Botanical identity,
- Site,
- Management,
- Results, and
- Projects.

The first four modules allow detailed information on species and their performance to be gathered from an extensive range of projects. The Projects module is designed to serve as a record of tree projects, to provide some statistical information, and to provide a reference point for tree-growers and researchers.

Who administers TREDAT?

Information in the first four modules is stored on Queensland Department of Forestry and CSIRO computers. Information on tree plantings throughout Queensland is stored by the Queensland Department of Forestry, while the CSIRO is storing information on the performance of Australian species in overseas countries. Once the system has been fully developed, it is hoped that other states will adopt TREDAT to provide a national TREDAT network.

The Project component will be stored on computer in the Department of the Arts, Sport, the Environment, Tourism and Territories which administers the National Tree Program.

What benefits will TREDAT provide?

Collecting and sharing information about tree-growing will allow more accurate advice to be provided on species selection and establishment techniques, and will lead to improved management decisions in tree-growing. The time, energy and money spent by tree-growers will therefore be used more effectively.

Statistical information will be used in developing and reviewing the effectiveness of government policies and programs.

Who can use TREDAT?

Project (Module 5) information covering the whole of Australia will be accessible to organisations and individuals through published reports and computer facilities. However, detailed tree performance information will be available for Queensland conditions only.

The information will be provided free of charge to people involved in developing and managing tree projects - including farmers, community groups, researchers and government agencies.

What sorts of tree projects?

All kinds of tree projects are of interest whether they involve conservation or management of existing trees, natural regeneration, planting, direct seeding, or transplanting naturally sown seedlings. Projects may be aimed, for example, at reducing soil erosion, providing shelter, controlling salinity, providing logs or fence posts, improving wildlife habitat, or restoring or improving the natural beauty of urban or rural landscapes. All may provide information which may assist other tree growers.

Can information be provided on a confidential basis?

Yes. In general, TREDAT information stored by Commonwealth Government agencies will be made available to any interested party as under the Freedom of Information Act the Commonwealth is generally required to make information available on request. However, persons who provide TREDAT information may request the Commonwealth not to pass on certain information - for example, information affecting their personal privacy, business affairs or trade secrets - as under the Act, the Commonwealth may not be required to release such information. If desired, all information which would enable a TREDAT user to identify your project can be witheld from users. Information held by the Queensland Department of Forestry is not accessible through the Freedom of Information Act.

How is information provided for Module 5?

Project information is provided by answering 14 simple questions on a green TREDAT questionnaire which can be obtained from Greening Australia or the National Tree Program secretariat.

Economic evaluation of trees on farms

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This study is being undertaken under the dual asupices of the Victorian Department of Agriculture and Rural Affairs and Department of Conservation, Forests and Lands, with a grant from the Australian Special Rural Research Fund. It is supervised by the Agroforestry Joint Management Committee of the two departments. The grant is currently for one year, beginning January 1988.

The objective is to evaluate in economic terms, as far as possible, the private and social costs and benefits of saving, planting or regenerating trees on farms in south-eastern Australia.

The economics of heavy clearing regimes as against more limited clearing with retention of trees in strategic areas will be investigated. However, more emphasis will be placed on the economics of planting and regenerating trees on existing cleared land, compared with conventional agriculture or forestry. A range of land types will be considered, along with a range of management options including agroforestry (spaced and pruned), woodlots and shelter belts, with native or exotic tree species.

The study was motivated by the observation that whilst many scientists and governments are convinced of the need to restore trees to farmlands in the broad long-term public interest, actual clearing and planting decisions are in the hands of private landholders. Landholders' efforts are governed by their own perceptions of the private costs and returns, and whilst many individuals are taking up tree planting, the current extent of revegetation seems to be small relative to the magnitude of the accumulated problem of land degradation.

An important part of the study will therefore be to evaluate separately two broad categories of costs and benefits:

(i) those pertaining to the private landholder, including the costs of clearing or establishing trees, effects on agricultural production, timber and tree products, etc.

and

(ii) off-farm or broader community effects, such as on salinity, flood and sediment damage, water yield and quality, tourism and conservation.

The results on private returns could provide a basis for extension efforts among farmers about tree planting, while the data on external economies could indicate to governments the extent of subsidisation for tree planting that is warranted.

The study will not involve any new physical experiments but will mainly bring together in a common framework data from past or current research and experiments. Tree planting trials and projects of the Victorian government and Potter Farmland Plan should be an important source of data, as should case studies of long established shelter belts and remnant native vegetation.

A bibliography on Trees and Rural Productivity has been recently compiled by Ed Adamson with a grant from the Australian Environment Council through the Victorian Ministry for Planning and Environment. This is providing an essential basis of references for the economic study. Further information will also be sought from farmers, scientists and industry. Data are still expected to be patchy, so that a fair amount of interpolation and extrapolation will be needed.

Much of the scientific research measures physical effects (e.g. on wind speeds, moisture, predators) that are automatically captured, along with many other influences, in measures of agricultural productivity. For economic purposes, the main concern is the net result of the various effects of trees on agricultural productivity, but it nevertheless would be of interest to estimate the contribution of the various component effects.

Farmers' attitudes towards treegrowing

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The Land Protection Division and the Potter Foundation commissioned a study to provide baseline information about farmers' attitudes towards a number of issues associated with land degradation. One aspect investigated in detail was farmers' attitudes to treegrowing. Included were perceived advantages and disadvantages of trees in farm management, identification of key factors which would promote treegrowing by farmers and target messages likely to be effective for use in treegrowing extension programs.

The study involved two different areas of Victoria: the Shire of Dundas, a south-western grazing region and the West and South Ridings of the Shire of Charlton, a central cropping region.

Results

Few interviewed had never planted trees and more than one third had first planted trees more than 20 years ago, although mostly for shelter around houses and sheds. A significant proportion had planted trees for the first time in the past five years. Half the farmers in both shires claimed to have planted trees this year and three quarters claimed they would be planting trees in the coming year.

There was no relationship between a positive orientation to tree planting and age, or an awareness of farm tree groups, for farmers in either shire. Farmers in both shires with a predisposition to tree planting tended to be more highly educated and were more likely to have identified land degradation problems on their properties.

Table 1 summarizes the advantages of trees as perceived by Dundas and Charlton farmers.

Advantages	Dundas (N = 41)	Charlton (N = 41)
Shade and shelter	37	36
Improved the landscape	17	19
Wildlife	16	12
Decrease salt effects	9	3
Wood, fuel	6	8
Wood, construction	5	4
Help in wet areas	4	4
Improve the soil and grass	7	2
Increase the value of the property	3	2
For the next generation	4	-
Improve stock performance	3	-
Personal satisfaction	1	1
Decrease wind speed	-	7
Control, reduce water table	-	4
Attract the rain	-	2
Reclaim land, erosion control	1	2
Fresher atmosphere, decrease CO_2 levels	-	2
Restore the balance of nature	-	2
Other	1	1

The three advantages of trees mentioned most commonly were shade and shelter, landscape improvement and wildlife habitat. Farmers in both shires also noted the value of trees in providing firewood and construction timber and in using soil moisture to decrease waterlogging. Dundas farmers were more aware of the benefits of trees for salinity control and improving farm productivity, whilst Charlton farmers were more aware of the value of trees in reducing wind speeds. These differences in emphasis can be important when designing extension programs. The table may also point to areas of lack of landholder awareness such as the relationship between trees and improved stock performance in both shires and the relationships between trees and salinity in the Charlton shire and trees and erosion control in Dundas shire.

Table 2 summarizes the perceived disadvantages of trees.

Disadvantages	Dundas (N = 41)	Charlton (N = 41)
None really	9	8
Use up moisture	5	18
Expense	7	4
Difficult to establish and maintain	7	2
Make farming inflexible	5	5
Trees drop limbs and leaves, work	6	7
Attract and harbour vermin and birds	4	2
Fencing	4	3
Take up useful land	1	11
Hazard to drains	2	1
Stock camps, dusty wool	6	-
Affect pasture growth	3	-
Fire hazard	3	-
Encourage weed growth	3	-
Time	2	-
Use up nutrients	-	11
Branches smash fences	-	6
Other	2	2

These disadvantages can be seen as barriers to farmers beginning or expanding treegrowing programs.

Nearly one quarter of farmers from both shires saw no disadvantages with trees. For those who did there were marked differences between shires reflecting the differing agricultural practices.

Charlton farmers were more concerned than Dundas farmers about trees using up moisture and nutrients and taking up useful land. Dundas farmers were more concerned than Charlton farmers about the expense and difficulty in establishing and maintaining trees and dusty wool caused by sheep camping under trees.

Trees growing extension programs should aim at overcoming these barriers by correcting misconceptions (for example "trees are always a fire hazard") or suggesting management solutions to valid concerns, (for example, rebutting "trees take up useful land" by encouraging treegrowing on roadsides, waterfrontages, around dams, eroded areas and other unproductive land).

Communication strategies

Galileo multidimensional analysis was used to establish the most effective messages and combinations of messages for use in treegrowing extension programs.

Dundas Farmers -

Improving Farm Productivity - Reversing Land Degradation

Charlton Farmers -

Shade and Shelter - Improving Farm Productivity - Improved Management of the Farm.

In summary, extension programs need to be tailored to give consideration to differences between regions. This study indicates that for tree growing extension programs differences in agricultural enterprises between regions are more important than sociological differences.

Copies of the detailed report from this study are available from Land Protection Division.

The Potter Farmland Plan - a progress report

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The Potter Farmland Plan commenced in the Hamilton area late in 1984. The initial stages of the project were discussed in Volume 3 of the newsletter. The project has established demonstration farms which aim to show farmers and the wider community how a whole farm planning approach which integrates agricultural and ecological principles can be applied on real farms. Briefly the project can be outlined as follows:

Design: Fifteen demonstration farms:

6 at Glenthompson: 60km east of Hamilton, rolling treeless plains, Ordovician sediments, severe gully erosion, dryland salinity and tree decline.

5 at Melville Forest: 35km north of Hamilton, former redgum (E. camaldulensis) woodland on soils derived from Rhyolite, severe tree decline, emerging gully salinity and erosion.

4 at Wando Vale: 80km west of Hamilton, steeply dissected lateritised tableland, severe gully, and tunnel erosion, slumping and hillside seeps, severe tree decline and emerging salinity.

Whole Farm Plans prepared for each farm. Substantial implementation of the plan from 1985-1987 with Potter Foundation assistance, completion of the plan by the landholder from 1988 onwards.

Funding:

Ian Potter Foundation - $800,000; 1985-1988
Landholders - $200,000 over three years 1985-1987
Department of Conservation, Forests and Lands - office accommodation, technical and administrative assistance.

Staff:

Andrew Campbell and John Marriott, assisted by a Local Advisory Group, and reporting to a Melbourne-based Executive.

Works

1985-87:	150 kilometres of fencing	60,000 trees in shelterbelts
	200 hectares of direct-drilled perennial pasture	44,000 trees in woodlots
		54,000 trees in clumps and gullies
	5 new water supply systems	2,000 trees in stock-proof guards
	50 hectares direct seeded trees	

Costs:

(on ground)	Potter:	$275,000
	Landholders:	$200,000
	Total:	$475,000

Area of influence: 4200 hectares, i.e. Approx $113/ha including labour.

Cost for a normal farmer: $7/ha/year over 10 years, excluding labour (mostly tax deductible under Sec 75(D).

Demonstrated benefits embodied in the integrated whole farm approach to planning and implementing farm improvements:

Farm layout modified
(to reflect land types)

- more sustainable land use
- higher effective carrying capacity
- reduced erosion (less stock camps)
- better shelter (separating different aspects)

Pasture establishment
(direct-drilled using Baker points)

- improved productivity
- better utilisation of saline areas
- increased plant water use

Revegetation

- increased liveweight & wool prodn
- increased effective carrying capacity
- increased plant water use
- improved wildlife habitat
- wood and fodder products diversification
- more attractive environment
- improved fire protection

Improved access
(with laneways)

- time savings
- reduced stock stress
- fire protection
- shelter
- timber and fodder production
- ability to dry sheep easier

Water supply

- improved stream water
- quality
- no stock access to creeks
- preservation of wetland
- control of water point
- location
- drought-proofing
- improved dam water quality
- reduced erosion
- reduced muddying & bogging
- reduced evaporation from
- dams

Assessment, documentation and monitoring: The revegetation works were assessed by Forestry students from the University of Melbourne from December 1985 to May 1987. The assessment showed that 78% of the 216 separate planting operations assessed had survival rates greater than 90%, 1 to 2 years after planting. Of the failures, most were due to insufficient protection allowing stock entry. In other words, the establishment techniques used were successful, and variations in herbicides used, soil disturbance, time of planting, and degree of watering and fertilising, did not significantly influence survival rates.

With minor variations, the establishment technique used was: Autumn deep ripping of planting lines, heavy grazing in August, spraying with combination knockdown and residual herbicides in late August/ early September (e.g. 'Weedzol'/'Gesatop' @ 61/31 per ha applied along riplines with a 'micron herbi'), follow up spray if necessary in late September, and planting using the 'Hamilton Treeplanter' hand planter, with community groups. Usually no watering.

Assessment of direct-seeded areas was difficult, due to problems locating seedlings where weeds were prolific, and stocking rates (assessed using $1m^2$ plots at 200 plots/ha) varied from zero to 40,000 seedlings per hectare, using a seeding rate designed to achieve about 2000 trees/ha of 6-8 indigenous species, assuming a 1% germination rate. Although the assessment was inconclusive, it is worth mentioning that many of the sites which appeared to be unsuccessful 6-12 months after seeding, now have quite satisfactory stocking rates 2-3 years after seeding. We have used a range of site preparation techniques, but cannot draw firm conclusions, as all have been successful on some sites, and all have failed on some sites. One technique which does appear promising however, is as follows: early spring knockdown spray to prevent weed seed set, mouldboard ploughing in late Spring to a dept of 4-6 inches, leaving the site rough, followed by broadcasting seed by hand, usually in mid November. Possible follow-up spray with 'Fusilade' if grass competition is a problem.

The assessment results are outlined in the following report:

Bail, I.R. (1987) "Tree Survival on Demonstration Farms of the Potter Farmland Plan in Victoria's Western Districts: a Preliminary Assessment". Special project submission, fourth year B.For.Sci. Faculty of Agriculture and Forestry, University of Melbourne.

A study of landholder attitudes to the type of activities embodied in the project was commissioned, and was carried out in 1986, comparing the attitudes of the PFP participants with those of 40 farmers randomly selected from within the Shire of Dundas (roughly in the centre of the PFP area of influence), and forty farmers randomly selected from the Shire of Charlton (in the Mallee, well away from the PFP, with very different types of farms and land). The study used a quantitative method of attitude analysis called multidimensional scaling, and was designed so that it can be replicated at a later date to determine the impact of the Potter Farmland Plan on landholder attitudes over time. Copies can be obtained from the University of Melbourne.

Cary, J., Beel, A. and Hawkins, S. (1986) 'Farmers' Attitudes Towards Land Management for Conservation". School of Agriculture and Forestry, University of Melbourne.

The Potter Foundation-funded operational period of the Potter Farmland Plan winds down during 1988, after which landholders have agreed to complete the implementation of their whole farm plans at their own pace. Andrew Campbell's secondment to the project ends in March 1988, and John Marriott's term of employment ends in September 1988. It is hoped that there will be a permanent position established in Hamilton with a combination of government and private support, to continue the monitoring, public relations and extension activities of the project. The incumbent would be a contact person for visitors to the project, and would also be involved with the development of short courses for farmers in whole farm planning, three of which will have been completed by February 1988.

Possibilities for private forestry in Victoria

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The current list of possible profitable forestry activities on private land in Victoria is reasonably extensive.

a. Agroforests of radiata pine in southern and northeastern Victoria (rotation 30 years) should be profitable if royalties for clear timber are buoyant.

b. Conventional plantations of radiata pine close to major industries (Central Gippsland, Northeast Victoria, Otways, Ballarat, Portland) should be profitable if landowners do their own logging and pruning or if local contractors are willing to log small areas - the main obstacle to profit is the difficulty of disposing of small material from the first and second thinnings but this problem is easing. (Rotation 30 years.)

c. Plantations of mountain ash (or perhaps alpine ash, shining gum, cut-tail or yellow stringybark) on a rotation of 40-80 years in the wetter parts (over 1000 mm a year) of Victoria. Thinings may not be feasible because of the possibility of butt damage during logging.

d. Irrigated plantations of poplar in northern Victorian (rotation 20 years) yield veneers, furniture-quality timber and pulpwood. At present sales are healthy.

e. Other irrigated forests would yield general purpose timber and fuelwood on a rotation of 20-30 years - the main species would be eucalypts, wattles and perhaps paulownia. The Goulburn and Loddon Valleys are the main areas for this activity.

f. General-purpose forests of eucalypts, including wide shelterbelts, would yield firewood, posts, poles, veneers and sawlogs. Red ironbark, sugar gum and red gum seem good possibilities here, especially the latter as exportable sawn fencing timber. (Already NSW sawmills dispatch material to 20-30 countries.) Rotations would be 30-60 years.

g. Blackwood should be an excellent timber crop, most likely grown in sheltered gullies in the wetter parts of the state, within plantations of eucalypts. Rotations would be 40-80 years. Unfortunately little is known about the silviculture of this species in Victoria.

h. Plantation designed to produce firewood only. The species used will depend on the locality.

i. There may be other specialty timbers such as (coniferous) cedars, redwood, oak and the best bet, black walnut, that would repay careful tending over a rotation of 40-80 years in the wetter parts of Victoria.

j. Perhaps eucalypts can be grown on private land for the mechanised production of eucalyptus oil. Rotations would be 4-8 years.

k. Sewerage farms planted to trees, using wastewater for irrigation and fertilisation.

1. Forests of log-quality macrocarpa cypress (and perhaps other cypress species) - the timber is used for many of the same purposes as western red cedar, but it is harder. (Rotation 30-40 years.)

We reason that, if people can make money from many indirect benefits, then they will grow more trees.

Activities of the Natural Resources Conservation League of Victoria (NRCL)

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Extract from a letter by the Director, Mr L.G. Schultz.

Our League has a deep interest in, and concern for rural tree decline.

Our League started as a non-profit, non-government organisation in 1944 to get more trees back into the Victorian countryside following the devastation and loss of tree cover from the 1939 bushfires.

The League's philosophy embodies the following principles:

1. Our existence depends on the use of the natural resources of the earth.
2. Each generation has a moral obligation to control the utilisation of renewable natural resources and provide for their replacement for the benefit of future generations.
3. Non-renewable natural resources should be used wisely and without waste.
4. Study and research are necessary for the understanding, protection and best use of natural resources.
5. Technological advances should provide the means for the more efficient use of natural resources. At the same time technology should aim to provide practical alternatives and less natural resource dependent processes.
6. Public awareness through education, is a pre-requisite to the development of individual responsibility, which is essential for the success of any conservation policy.

The League is a Limited, Non-Profit Company Incorporated under the Companies Act of Victoria. To encourage the achievement of its philosophy, the following services are available.

- On-site inspection by field officers and advice on tree planting and regeneration.
- Demonstration plantations in selected country locations.
- Participation in country shows, conferences, field days and demonstrations.
- Visits by schools to our nursery and education centres.
- Talks and lectures to clubs, community groups and organisations.
- Courses for municipal employees and other interested groups in the League's education centre.
- Visits to schools and youth groups such as Scouts and Guides.
- Organisation of Arbor Week/Junior Tree Lovers' League, in association with the State Schools' Nursery.
- Forums on topical conservation and natural resource matters.
- A quarterly magazine, "Trees & Natural Resources".
- A variety of publications ranging from tree catalogues to the planting advice and reprints of selected articles from the magazine and elsewhere.
- Supply of trees to farmers, municipalities, government departments, schools, public and community organisations.

Two recent activities which might of of interest to newsletter readers are:

1. Central Tree Register

   For some years the League has been disturbed that our State does not have a full record of trees planted. There seems to be details of areas cleared of trees or denudations, but insufficient central data on "restoration".

Accordingly in October 1987, the League wrote to all Cities, Councils, Shires, Government Departments and members, advising that the League would maintain a "central tree Register", starting with 1987 calendar year and subsequent years and we asked everyone to tell us how many trees had been planted in each calendar year.

So far, the response has been excellent.

We have also agreed to be part of a "two million" tree national program for the bicentennial, and will report the Victorian numbers as part of that program.

2. Community Plantings

Since 1951, the League has promoted and taken part in over 20 demonstration plantings which have been community based in the locality of the plantings. A very good example was Charlton in 1986 where all sections of the community were actively engaged in the plantings which had maximum impact on the community and in the press. Other notable League examples were Mount Marth, Kerang and Colbinabbin.

As a bicentennial effort, the League wrote to all Cities, Councils, Shires and Government Departments, urging similar community plantings and offering advice and help. Replies have been good both from Government Ministers and Councils who report some excellent plantings in progress.

Agroforestry Research for Degraded Land in North Queensland

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At the beginning of the century, much of the Atherton Tablelands and the coastal lowlands of North Queensland were covered by tropical rainforest. Since then, a great deal of this forest has been cleared for agriculture. During the land clearing operations, little thought was given to erosion control or to the maintenance of some forest cover. Consequently, areas of low productivity or land unsuitable for agriculture are now evident.

A productivity survey conducted by officers of the Queensland Department of Forestry in 1970, identified 56 000 ha of degraded farmland on the Atherton Tableland while in 1983, the Department of Primary Industry reported 38 000 ha of land in an unmanaged condition or more suitable for non-agricultural uses. Although the two surveys were based on different areas and used different classification criteria (resulting in the different estimates of degraded land), the results do highlight the severity of the problem.

A suitable land use management option for a significant proportion of this degraded privately owned land, which is not in contiguous blocks, is the adoption of agroforestry systems. This would involve the integration of agriculture or pastoral production with tree production.

It has been demonstrated in many parts of the world that this type of land use would be more beneficial to the landholder than if either agriculture, pastoral activities or tree production was the sole activity on the unit of land.

Agroforestry has the advantage over conventional large scale plantation programmes of utilising efficiently scattered small sized blocks.

Private agroforestry systems, as practised in the southern parts of Australia and New Zealand, in which the landholder relies on public agencies for advice and planning assistance, would be a suitable sound approach for North Queensland. This approach obviates the need for Governments to purchase these small parcels of degraded land.

In order to provide information and advice on various agroforestry systems and tree cultural techniques the Queensland Department of Forestry has established a number of trials and demonstration plots, including -

- Pinus caribaea var. hondurensis (PCH) grown in improved pasture grasses in a beef cattle production area. PCH grows fast on rich basalt soils and provides shade for cattle. It produces construction timber and the thinnings are useful following preservative treatment for landscaping and exterior use.

- Araucaria cunninghamii (hoop pine) grown in improved pasture. Hoop Pine is a native rainforest conifer which produces excellent high quality timber.

- Araucaria cunninghamii (hoop pine) grown in frosty sites, or sites covered in woody regrowth or grass. Hoop Pine can be successfully established on frost-prone sites, provided a special weed control prescription is followed. The Coen and New Guinea provenances of hoop pine have generally denser foliage and larger needles than provenances from south Queensland and are well

adapted to controlling woody weed regrowth and grasses after the trees have become established. These trees also provide shade and their foliage is usually unpalatable to cattle.

. Eucalypts grown in improved pasture. Eucalypts grow fast in a competition free environment. Top durability class species (E. microcorys, E. tereticornis, and E. cloeziana) have the potential to provide post and rails from thinnings and poles from mature trees. They may also be able to produce sawn timber over larger growing periods.

timber in pasture grasses or for

Forest
Research
CSIRO

With Compliments

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Telex 62751

Exotic Species
Cedrela odorata
Khaya nyasica
Tectona grandis

erant but have the potential to be open
or for the expansion or enrichment of
specis may also produce useful cabinet

North Queensland, coupled with an
responding increase in demand for
ere is need to supplement the supply of

n cultural techniques (site preparation,
and species provenances best suited to
elands and coastal lowlands of North

... and apologies for the delay.

Best wishes,

Jill

Agroforestry research in south-eastern Queensland

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Officers of the CSIRO Division of Forestry and Forest Products, Tropical Crops and Pastures as well as staff of the School of Environmental Studies of Griffith University are presently writing up their fundings for the agroforestry study STAG (the acronym stands for Soil, Trees and Grass). The experiment is located at Samford (Lat. 27°S, Long. 152°E, 50 m ASL) and was sown to a Setaria pasture in November/December 1983 and planted with Eucalyptus grandis seedlings in November 1984. The design was of a Nelder fan type with nine circles and eighteen spokes. Tree stocking increases towards the centre of the experiment from 22 trees ha-1 in the outside circle to 3580 trees ha-1 in the inner circle. The purpose of the experiment was to identify the main problems in developing a stable tree-pasture agroforestry system in a subtropical environment and to assess how the components competed for water, nutrients and light.

The site receives an annual rainfall of about 1100 mm, two-thirds of which falls in the six warmest months (October-March). The soils are red and yellow podzolics and originally supported a tall open dry sclerophyll forest of E. microcorys, E. maculata, E. propinqua and E. tereticornis. The site was not one which normally supported E. grandis but based on earlier trials it was known that reasonable growth could be achieved for at least three years. Separate harvest blocks of trees at four representative spacings were installed to provide biomass data which could in turn be applied to the trees in the Nelder fan.

Monitoring of tree growth (height, DBHOB, and diameter at 0.3 m, 1.0 m, 2.0 m and 3.0 m) was carried out at approximately six-weekly intervals. Less frequent measurements were made of crown depth and crown spread. Pasture production and its botanical composition were assessed at least twice yearly and the pasture slashed to 0.15 m as considered necessary and to simulate grazing.

For the first three years it was found that pasture production was not reduced under tree stockings up to 300 trees ha-1 (see Table). However when pasture production was reduced at higher tree stockings it was accompanied by a proportional increase in green leaf and its nitrogen content, while there was a reduction in phosphorus content.

Tree height growth has favoured the denser stockings near the centre of the experiment since age twelve months. The increase in height from the outer circles has been quite appreciable (8.4 m at 42 stems ha-1 to 11.4 m or more at stockings over 305 stems ha-1). Maximum diameter growth was at the densest stocking at age eighteen months but has progressively moved out to be at 158 stems ha-1 at age 3.5 y. Optimum individual tree biomass of about 40 kg at age 3 y was at a stocking of 305 stems ha-1.

The experiment shows that it is possible with careful management to grow eucalypts and pasture together on the one piece of land. There is considerable scope to vary both tree and pasture species in attempting to find suitable combinations for other climatic and edaphic conditions. Even in this relatively equable climate, the availability of soil water has been shown to be the major controlling factor for tree and pasture growth.

Other aspects studied in the project were water usage by both trees and pasture in relation to tree stocking, soil microbial biomass in relation to tree density, the effect of tree stocking on wind profile measurements and nutrient cycling through litterfall by the trees.

Table 1. Pasture and tree production at selected spacings in the STAG experiment.

Tree stocking	Summer 86 pasture yield (kg ha^{-1} DM)	Relative yield of pasture as percentage of yield in open and up to 158 stem ha^{-1} at age 2.5y	N% content of pasture green leaf	Tree mean height at age 3.5y (m)	Tree mean DBHOB at age 3.5y (cm)	Estimated stem conical volume (m^3)
3580	150	1	1.63	11.8	8.6	0.029
1140	1400	60	1.36	11.9	11.4	0.053
305	3780	115	1.24	11.4	13.5	0.071
82	4660	100	1.16	9.7	14.0	0.069
42	4580	100	1.07	8.4	12.1	0.048

Relevant papers

Cameron, D.M., Rance, S.J., Jones, R.M. and Charles-Edwards, D.a. (in prep.). Project STAG: An Experimental Study in Agroforestry.

Eastham, J., Rose, C.W., Cameron, D.M., Rance, S.J. and Talsma, T. (submitted to Ag. & For. Met.). The Effect of Tree Planting Density on Evapotranspiration from an Agroforestry Experiment.

Combating dryland salinity through tree replanting

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This project is specifically concerned with dryland salting, a problem which has removed thousands of hectares of agricultural and pastoral land from productive use in all mainland states (e.g. Bettenay 1986). Some 6.8 per cent of Victoria already contains large patches of badly salted surface soils and some 16.2 per cent contains small salted patches, largely as a result of rises in naturally salty water tables following the destruction of trees - the deep reaching natural pumps which keep water tables down by transferring water direct from subsoil to atmosphere.

In an important paper published in the Australian Journal of Agricultural Economics in 1981, Greig and Devonshire demonstrated a strong relationship between salt concentrations in a number of Victorian streams (S mg/l) and three variables describing stream catchments - rainfall (R mm/an), proportion of forest cover (T pc) and proportion of sedimentary rock (G pc) in the catchment area.

viz. $\log S = 1.9624 + 0.0092(100-T) + 0.0045G - 0.008R$

It can be hypothesized that, in areas of shallow and rising water tables particularly (and this includes much of the agricultural areas of Australia), stream salinity levels reflect the dryland salinity risk of the upstream catchment. Furthermore within a catchment, an area's contribution to overall stream salinity is dependent upon the three variables cited by Greig and Devonshire. In this project we have;

1. Applied the Greig and Devonshire relationship to the 1595 one-eight degree grid cells which comprise Victoria so as to determine each grid cell's contribution to stream salinity. Each one-eighth degree grid cell represents half of a 1:25 000 map sheet.

2. Modelled each grid cell's contribution to stream salinity against the recorded occurences of dryland salinity as recognized by state agencies, e.g. against a map produced by the Victorian Department of Conservation, Forests and Lands (Boruvka and Matters 1987) showing lands known to be severely, moderately or minimally affected by dryland salinity. This model consists of sets of predictive decision rules which relate the salinity values from the Greig and Devonshire relationship to recognized dryland salinity occurences. Classification tree methods were used to identify the prediction rules. These methods, based on binary decision trees rather than classical parametric methods, are a new and powerful way of developing prediction rules (Brieman et al. 1984). The predictive value of these decision rules has been used to identify areas, in addition to those currently exhibiting symptoms, at risk from dryland salinity. This includes onset of dryland salinity in areas not currently identified by authorities and deterioration of areas already identified.

Some tentative conclusions from the exercise to date are:

1. A substantial number of minimally and moderately affected cells (341 out of 1596) have the potential to become severely salt affected. Currently, 109 cells are already severely salt affected.

2. Likewise, a substantial number of minimally affected cells (646 out of 1595) have the potential to become moderately salt affected. Currently, 259 cells are already moderately salt affected.

3. There are a few areas (22 out of 1595 cells) in Victoria where tree planting alone is unlikely to have any effect on reducing dryland salinity risk because of the overriding and unmodifiable legacy of having a basal sedimentary geology of marine origin coupled with a relatively low rainfall.

4. The majority of currently and potentially severely salt affected areas (244 out of 406) would require less than ten per cent of the area to be replanted to reduce the salinity hazard to moderate levels.

5. Most currently and potentially moderately salt affected areas (681 out of 821) would require more than 50 per cent of the area to be replanted to reduce the salinity hazard to minimal levels.

6. In recognition of demands for new cleared lands, the model has also been used to identify areas currently minimally affected by salt where clearing up to 50 per cent of the area would not induce moderate salinisation. There are in fact only 97 such cells.

Now that the model has been shown to perform acceptably in Victoria, it is intended to apply it to each of the 50 000 eighth degree grid cells covering Australia. This will involve capturing, in computer readable form, a new national map of present vegetation and holding it, along with previously captured rainfall and geology data, in Australian Resources Information System (ARIS) (Walker and Cocks 1984). It is anticipated that the model will need modifying in some areas when applied nationally (e.g. in areas subject to cyclic salt incursions).

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(This report is based on portion of a paper entitled Rural land degradation in Australia: The role of trees in ecological solutions by Ive and Cocks, prepared for the International Forestry Conference hosted by the Ausralian Forest Development Institute to be held in Albury, 25 April - 1 May 1988).

Trees for combating salinity

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Background

Salinity and waterlogging represent major categories of land degradation in the Murray-Darling Basin. To date most of the economic costs have been incurred in irrigation areas, however, seepage and scalding also threaten considerable losses of productive land in dryland agricultural areas. The key to successful control of dryland salting is improved water management which will usually include tree planting in combination with agricultural and engineering measures (Morris and Thomson 1983). Successful interception of water passing beyond the root-zone in recharge areas is important for long-term reductions in groundwater accessions. Establishment of trees in groundwater discharge areas for the purposes of lowering raised water-tables is an important element in the reclamation of salt-affected soils. This practice may markedly reduce the upward movement of salts to the soil surface and allow easier re-establishment of pastures and crops. In irrigation areas, tree planting for groundwater control will probably be confined to non-productive areas such as road verges, laneways, in channel and drain reserves, and around farm buildings (Acil 1983), unless economically important, fast-growing, salt and waterlogging-tolerant species can be found.

Current research

The Division of Forestry and Forest Products (DFFP) has recently undertaken a major collection of salt-tolerant tree and shrub germplasm and instigated glasshouse and field evaluation for salt tolerance.

Sampling the germplasm of potentially salt-tolerant species is an important first step in developing trees for combating salinity. Seed sampled by the Australian Tree Seed Centre (DFFP) from populations growing naturally in saline areas has provided valuable base material for screening and selection.

Important factors in sampling seed include:

1) broad area sampling of a population to encompass genetic variation

2) sampling from individuals at a spacing designed to decrease the possibility of collections from siblings

3) recording data on the habitat and microenvironment of each individual (including associated species, size and position of the individual in the landscape and soil characteristics)

4) recording a detailed location for the collection site including latitude, longitude and elevation

In glasshouse screening experiments for salt tolerance, 3 to 4-month-old seedlings were salinised with step-wise increases of a mixed salt solution or NaCl in sand

culture using automated drip-irrigation. Measurements were made of survival, symptom development and height growth. Large interspecific differences were found in salt tolerance of tropical and subtropical Acacia, Melaleuca, Eucalyptus and Casuarina species (Aswathappa and Marcar 1988). For example 50% of Acacia stenophylla seedlings were still alive at 1850 mol m^{-3} salinity and continued height growth up to 1000 mol m^{-3}, whereas in A. torulosa 50% of seedlings were dead at 350 mol m^{-3}. Some of these species have temperate provenances which can be utilised in southern Australia.

In the colder Tableland zones of NSW, salt-tolerant trees must also be able to withstand the often severe winter frosts. Several frost-tolerant Eucalyptus species have been recently screened for salt tolerance (Marcar 1988). Ten species in the subgenus Monocalyptus were all found to be very salt-sensitive (no survival at 300 mol m^{-3} NaCl) whereas those in the subgenus Symphyomyrtus were moderately salt-tolerant (100% survival at 300 mol m^{-3}). Species in the informal series Ovatae viz. E. ovata, E. aggregata and E. camphora proved most tolerant, however, these were still significantly less salt tolerant than other more-tolerant species such as E. camaldulensis.

Surface and/or subsurface waterlogging is frequently associated with soil salinity in southern Australia, particularly during the wetter winter/spring months. In glasshouse experiments, waterlogging significantly decreased growth and transpiration of plants subject to salinity. These responses were related to stomatal closure, reduced development of aerenchyma and an increasing inability of roots to exclude salt ions.

The Division of Forestry and Forest Products is also involved in the micropropagation of individual seedlings selected for salt tolerance. Micropropagation has the advantage over cuttings of a much higher multiplication rate, a greater degree of control and small space requirements (Hartney 1984). The range of clonal material is continually being increased as more salt and salt/waterlogging tolerant selections from different genera become available, but earlier work had placed emphasis on Eucalyptus.

It is essential that salt-tolerant material identified from glasshouse screening experiments or field sampling be rigorously evaluated under field conditions. This Division is involved with the NSW Soil Conservation Service in small-scale tree species evaluation trials on saline sites near Yass, Ryalston and Wellington. Sites have been characterised for soil salinity and are also monitored for changes in watertable heights. For the most part only frost or cold-tolerant species have been included. Species performing well after 6 months include Acacia saligna, A. stenophylla, Casuarina glauca, Melaleuca halmatuorum, Atriplex undulata and E. camaldulensis (CML 52 clone). The severe adverse effect of surface waterlogging coupled with soil salinity has once again been demonstrated on these sites.

Conclusions

Considerable progress has been made in the sampling and glasshouse evaluation of Australia's salt-tolerant woody flora but we urgently require information on:

1) the most suitable tree and shrub species/provenances to plant on and near to saline seeps and scalds, e.g. on the Tablelands and Slopes regions of southern and central NSW

2) the most effective means of establishing these species

3) the impact of these species on groundwater tables, salt concentrations in the root-zone and soil amelioration

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Tree species selection for salt-scald reclamation

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Agricultural clearing of native vegetation in Australia in regions of saline subsoils has often caused increased salinisation of low lying discharge areas. The raised groundwater table associated with secondary salinisation has resulted in the decline of remaining native vegetation in lowland and stream margin environments (Froend et al 1987).

According to Morris and Thomson (1983), reclamation of seasonally waterlogged and salinised land may be affected by planting tree species selected from environments with similar climatic and edaphic regimes to those of the environment to be reclaimed. However, one problem with the above rationale is that seed from a tree growing in a saline area is expected to produce individuals genetically different from the parent due to segregation, and thus exhibit a range of salinity tolerance. This inherent range in tolerance to salinity and waterlogging within a species has been documented in a number of Australian species (Sands 1981: Pepper and Craig 1986; van der Moezel and Bell 1987a). In regard to this, it would be desirable, not only to choose tree species with expected tolerance to salinity and waterlogging, but also, to select individuals within the species showing especially great tolerance. Micropropagation enables individuals of superior tolerance to be clones, producing many thousands of trees of proven superiority (McComb and Bennett 1986).

A grant from the Department of Industry, Technology and Commerce under the Biotechnology Research Grants Scheme supports researchers from the University of Western Australia, Murdoch University, Alcoa of Australia Ltd., CSIRO-Division of Forestry and Forest Products and Plantex Australia Ltd. to mass produce trees with high tolerance to salinity, waterlogging, and drought stresses, while ensuring high growth rates and high water usage. The process begins with seeds collected

from trees near salt scalds throughout Australia by the CSIRO Seed Collection Centre. Seedlings are grown until about three months of age at the Alcoa Nursery at Marrinup before being screened for superior tolerance and growth characteristics at the University of Western Australia (van der Moezel and Bell 1987b, van der Moezel et al. 1988). Following the experimental trials, the selected superior seedlings are delivered to Murdoch University for the research to determine the best echniques to tissue culture these trees before the commercial-scale production is carried out at the Plantex Nurseries. In addition, ectomycorrhizal fungi are being selected by CSIRO and will be combined with the clones to further enhance their tolerance to stressful environmental situations. A range of clones are being field tested to determine their tolerance and growth characteristics in secondary salinised regions in the Western Australian Wheatbelt.

Species in the genera Eucalyptus, Casuarina, Melaleuca and Acacia are currently receiving attention and superior Eucalyptus clones will be avilable for marketing in the coming year. These exceptional clones should provide all land managers with additional tools to manage and rehabilitate degraded or marginal land. Researchers interested in participating in field trials are asked to contact: Mr E.D. Kabay on (09) 364-0241 or at the above address.

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SELECT: A microcomputer package for selecting tree or habitat combinations

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The origins of the SELECT program lie in difficulties experienced by the Yass River Valley Revegetation Project in making reliable and consistent species recommendations for planting native trees in the diverse land units comprising the Yass River valley.

Traditionally tree planters have had to rely upon information gleaned from books, informed opinion, bitter experience and good luck for identifying 'right tree - right place' combinations. Unfortunately, integrating these diverse information sources and consistently recalling correct recommendations for each possible site is difficult and error prone. A microcomputer however is ideally suited to holding large quantities of information which can be recalled quickly in various forms when required. Nevertheless, to exploit these capabilities software must be designed to correctly store and recall the information upon demand.

Design criteria set for the SELECT program demanded that it should have minimal hardware requirements, use a standard computer operating system and language to minimize difficulties in transferring it to other microcomputers; also that it should be interactive and capable of use by the most incomputerate tree planting enthusiast. Consequently, SELECT was written in the BASIC language for an IBM microcomputer (or clone) with a single disk drive and (optional) printer.

The program was developed to assist with two tasks:

1. select suitable habitat for a particular species of interest,

2. select suitable species for a particular habitat of interest.

Eight major types of tree habitat, defined primarily in terms of soil and landform, were identified within the valley ranging from inhospitable acid skeletal soils and sensitive potentially saline areas to the appealing riverbank areas. Published species distribution maps provided a list of candidate species for the Yass River valley and members of the Environmental sub-committee judged each species against the habitats identified. For each species, each habitat type was classified as preferred, desirable or undesirable. Responses were collated and differences of judgement resolved.

A feature of the program is its simplicity in use. Just insert the disc into an IBM microcomputer (or clone) and type: SELECT and hit the RETURN or ENTER key. After this it is a matter of answering the questions that appear on the screen either with number codes for species and habitats as displayed or Y for 'yes' and N to 'no'. The program has been intentionally set up as a single program file which not only assists in copying the disc for distribution but more importantly lessens the opportunity for the program file and any data files to be mismatched as later versions of the program are developed. Recognizing that combinations of more than one habitat type are common, the program is also able to identify species suitable for a complex habitat comprising for instance acid skeletal soils on exposed ridges.

SELECT was first demonstrated at a Field Day hosted by Yass River Valley Revegetation Project (May 1987). It was subsequently used by the Project team to efficiently allocate 15 000 tubestock of native species raised by the Project. Following the distribution of a questionnaire to participating landowners it took

one hour, with the aid of SELECT, to allocate the tubestock to some 40-odd landowners. Most importantly, this was achieved with the assurance that the correct species had been chosen to meet the habitat requirements identified by the landowner. To facilitate its anticipated ongoing use, SELECT has been installed at the Yass office of the Department of Agriculture.

Amongst other applications, SELECT has been used to prepare a list of species suitable for revegetating a proposed sand and topsoil extraction site along the Yass River. This list forms part of Yass council's reply to an Environmental Impact Statement prepared by the extracting firm. In addition, Department of Main Roads has used SELECT to identify native species suitable for revegetating the road verges after construction of the Hume Highway Yass bypass.

Interest has recently been expressed in having the program made more widely available to the rural community through Viatel by incorporating it into the Elderslink service. Although currently possible, the full impact of this proposal would not be realized without the coverage of habitat types and species being extended beyond the Yass River valley.

It is hoped that further progress on this can be achieved with the assistance of a Masters degree student (Forestry Department, ANU) during 1988.

(This report forms part of a paper entitled Rural land degradation in Australia: the role of trees in ecological solutions, prepared for the International Forestry Conference hosted by the Australian Forest Development Institute to be held at Albury, 25 April - 1 May, 1988. The author is the current chairman of the Yass River Valley Revegetation Project, a broad based community group formed to increase the public interest in the need for rural revegetation and provide facilities for assisting people with revegetation).

Tree & Shrub Trials, Harden-Boorowa

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Following local concern over the extent of Eucalyptus dieback in this area, and doubts about the suitability of many of the species commonly planted, funding was provided in 1986 through the Community Employment Programme to establish a series of demonstration trials. These were intended:

(i) to compare the growth rates and suitability of a range of trees and shrubs, and
(ii) to indicate the relative incidence of and susceptibility to insect attack.

The effects of good management practices and the benefits in the longer term of windbreaks were to be additional benefits.

Five plots were established in autumn 1986 on the following properties:

1.	R. Taylor	"Weirview", Harden - on the eastern side of the Harden-Jugiong Road, approximately 5 km south of Harden.
2.	D. Lean	"Waradgery", Galong - on the western side of the Galong Road, approximately 2km north of Galong.
3.	R. Flanery	"Goonawarra", Galong - on the southern side of the Harden-Boorowa Road, approximately 18km south-west of Boorowa.
4.	P. Mason	"Hawk Hill" Boorowa - on the western side of the Boorowa-Binalong Road, approximately 12km south of Boorowa.
5.	D. Marsh	"Allendale", Boorowa - on the eastern side of the Boorowa-Cowra Road, approximately 8km north of Boorowa.

Each plot included thirty species of trees and shrubs (mostly natives), set out in five rows of six species. There were ten (10) plants of each species at a spacing of 6m x 6m.

The species planted were:

Acacia mearnsii
A. melanoxylon
Atriplex nummularia
Casuarina cristata x cunninghamiana
C. cunninghamiana
C. stricta
Chamaecytisus palmensis
Melaleuca armillaris
M. bracteata
M. linariifolia
M. styphelioides
Tamarix aphylla

Eucalyptus acaciiformis
E. aggregata
E. blaxlandii
E. botryoides
E. camaldulensis
E. camaldulensis obtusa
E. camaldulensis subcinerea
E. cinerea
E. cladocalyx Dwarf
E. gardneri
E. globulus
E. globulus bicostata
E. globulus compacta
E. leucoxylon macrocarpa
E. macarthurii
E. melliodora
E. scoparia
E. sideroxylon

In a few cases, these were "second choices" because of the unavailability of some species.

Deep ripping was carried out prior to planting, and fertiliser (100 gms Starter 15) and weedicide (Fusilade 212) applied in the spring. There was only one follow up watering in the first summer.

The 1986 winter was one of the most severe for many years and numerous trees were severely affected throughout the tablelands. The trial plots were also severely affected and many replacements were necessary in spring, especially around Boorowa.

(Lesson 1: autumn planting in cold climates is very risky).
Species which suffered badly in all plots were:

Melaleuca armillaris
M. linariifolia
M. styphelioides
Eucalyptus cladocalyx Dwarf
E. camaldulensis obtusa
E. gardneri

There was little insect attack in 1986, except on Atriplix nummularia which was severely defoliated by a leaf miner. Some foliage browsing was also evident on the three Eucalyptus globulus varieties and Eucalyptus cinerea.

At the end of the first twelve months, most species had shown good growth, with individuals up to two metres tall. Best growth was shown by:

Acacia mearnsii
Casuarina cunninghamiana
Chamaecytisus palmensis
Eucalyptus botryoides
E. globulus
E. macarthurii

The picture changed considerably in 1987. Severe defoliation occurred during autumn, particularly Eucalyptus cinerea, E. globulus, E. globulus bicostata, E. globulus compacta. It was much less severe on Eucalyptus macarthurii, E. melliodora, E. scoparia.

The combination of unusually early and late frosts with the insect attack resulted in the deaths of many plants. In the Boorowa area, whole plantings of a number of species were completely wiped out, particularly the Eucalyptus globulus varieties, the Acacia species, and Chamaecytisus palmensis.

Eucalyptus macarthurii and E. scoparia again demonstrated their suitability.

After almost two years, these plots are beginning to provide some very interesting results. The unsuitability of the widely planted Eucalyptus globulus and its varieties is obvious, along with the uncertainty of a number of others.

Equally the adaptability of Eucalyptus macarthurii is clear, with the old standby Eucalyptus melliodora.

A complete assessment of each plot will be carried out in late autumn 1988.

Eucalyptus regeneration program New England Tablelands N.S.W.
Armidale - Uralla - Walcha
Progress Report No. 7 - January 1988

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Aim: To monitor natural regeneration on farmland near Armidale N.S.W. and to initiate a series of eucalypt re-establishment trials.

Introduction: In 1979 the New England Eucalypt Dieback Research Fund was established with donations totalling $80,000 from the local community to fund research into dieback. In 1984, with 3/4 of its funds exhausted it began the Eucalyptus Regeneration Program. 1988 is the final year of the project. In the first half of the year I will be completing my MSc thesis based on the results of the work. This will include sections on dieback and vegetation changes since settlement, phenology of eucalypts, early seedling establishment, lignotuberous regeneration, direct sowing and tree planting. It will be a synthesis of work completed between 1982-83 as part of a MSc (prelim) project plus the current work (1984-1988).

The final report for the project will then be published in the form of a 100 page book with accompanying brochures, wall charts and video. It will be aimed at landholders, school children and others interested in tree establishment and will emphasize a 'how you can do it' approach. Also to be published this year are three papers based on a trip to Victoria in 1987 a part of this project written jointly by myself and Ian Reeve of the Rural Development Centre:

"Growback in Victoria - Community Responses to Tree Decline". (A report on what's being done in Victoria to correct tree decline, salinity and soil erosion by community groups, individuals and governments.)

"Sowing the Seeds - A guide to nurturing community support for tree planting programmes."

"Planting Trees - How they do it in Victoria." (A report on tree planting and propagation techniques used in Victoria.)

These papers are available on request from the authors.

Broad Achievements of the Project

1. Natural Regeneration

a) Lignotuberous advanced growth

About 113 ha. over 11 properties have been fenced off by landholders to allow natural regeneration and for tree establishment work. Of this about 81 ha. is regenerating well with (in places) quite dense regeneration. Three years after fencing many of the regenerated seedlings are up to 1-2 m in height. 182 advanced seedlings are being monitored in detail on 5 of the sites, of 4 eucalypt species, 1 acacia and one other native shrub. Measurements are bing made on height and density changes after exclusion from stock.

b) Flowering and seed fall patterns

The flowering cycle of 112 trees of 13 eucalypt species has been monitored in detail over 3 years. 26 trees (10 species) have also been fitted with seed traps so that seed fall can be measured.

c) Early Seedling recruitment

Seedling recruitment was observed over Spring/Summer of 1985. 124 newly established seedlings were monitored and survivorship and height changes measured until 1988. In subsequent seasons recruitment was rare and only a few seedlings were found and monitored.

2. Eucalypt re-establishment Trials

a) Planting trials

Five planting trials were established over 5 sites in 1985 and 1986 with about 1300 seedlings of 24 species and 6 different planting techniques (including mulches, fertilizer, terrasorb and planting times).

In 1987 a further series of trials was established. This time the same two species and planting designs were replicated over 4 sites involving about 1300 trees. The trials were designed to examine:- pre-planting techniques (Roundup, Roundup + Simazine, Ploughed and Chipped); 2 planting techniques (hand planting versus machine planting); 4 tree guard types (milk carton, grotubes, Rural Trees Australia guard, none); sawdust mulch and fertilizer combinations; 5 post planting maintenance techfniques (Roundup, Fulsilade, nothing, cultivation and hand weeding).

A major planting by the Armidale Tree Group of about 12,000 trees around the water supply reservoir of Armidale (Malpas Dam) was also monitored as part of this project. All trees were planted using the same technique i.e. prerip, chip by hand, sawdust mulch, milk carton guard, stake, and water in. 33 native species and 6 exotic species were planted. Height and survival changes are measured annually and comparisons will be made between species, soil type, aspect, slope and degree of disturbance. Overall survival after the first year was 97%.

b) Direct Seeding Trials

In 1985-86 about 18 different sowing trials were established on several sites. These trials embraced about 30 different techniques including various soil preparations, sowing rates, sowing times, mulches, species and follow up treatments, pasture and soil types and sowing methods. Some of these trials gave promising results, particularly ones where the site to be sown was first graded to remove top soil and then chisel ploughed or ripped.

On the basis of these, three further trials were established in 1987 to examine in more detail 3 ground preparation techniques i.e. grading and ripping, herbicide applications and ploughing.

Concluding remarks:

The project has been a success in increasing knowledge in the community about dieback and tree establishment. One field day to show the work was well attended -another is planned this year. A number of talks have been given to school groups and two public talks have been given. In addition the project has attracted a number of newspaper articles and has close links with the Armidale Tree Group - a community tree planting group.

After three years of trying many tree establishment techniques the project will be able to recommend to local land holders many techniques which do work, in replacing trees lost to dieback, and warn of many which do not.

Results of revegetating a roadside verge by direct seeding - Wongan Hills/Calingiri Road - Western Australia

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1. INTRODUCTION

This report is based on results of direct seeding of approx 1780km of a roadside verge virtually denuded of all vegetation during road works. The verge is approx 2.5-3 m wide on each side of the road. Brief details are:

i) The weed bank in the soil was virtually buried beneath surplus loamy gravel, exotic to the site.

ii) Topography is one of gentle slope of 1° 15' to 2° 00' with soil changes from shallow sandy clay gravels to loamy sands (see slides of the area)

iii) Rainfall in this area occurs in winter and averages about 400mm/annum.

iv) Two (2) mixtures of native W.A. and Australian scrub and tree species were prepared as a total seed plus fertilizer mixture (see Tables 1 & 2).

v) Two (2) fertilizer preparations were used to aid seedling establishment and seed distribution (formulations are shown in Table 3).

vi) Site preparation - grasses were sprayed with "Sprayseed" weedicide at 10-12 litres/ha plus "Glean" at 20-25gm/ha approx 13 days prior to sowing. Verges were ripped in a "hit and miss" pattern to avoid erosion with a scrub ripper in two rows.

vii) The upper slope section was sown in 1983 and again in 1984 (as per Table 1) due to poor germination in 1983 with species used in this area.

viii) Ripped sections were lightly compacted with tractor tyres prior to sowing in 1983 only.

ix) It was observed that a number of indigenous species also re-established after roadworks had been completed. The most prevalent of these were leguminous. These totalled 46% on upper slopes and 32% on lower slopes of the overall volunteer population. The major species reqpresented were Acacia lasiocalyx and Acacia leptospermoides.

Conclusions and Recommendations

1. The technique of re-establishing vegetation on the roadside verge in the locality has proved to be successful with respect to suitable species.

2. The reasons for success appear to be correlated with

   i) beneficial seed bed preparation which enabled weed growth to be delayed 12-24 months

   ii) species pretreatment where necessary, was suitable to allow successful establishment i.e. scarification of wattle species used.

iii) beneficial harvesting of water from the bitumen road surface to seeded area.

3. The rates of application of seed are not considered excessive (3.982kg'ha). Tables 1 and 2 indicate comparative success of various species on each site. Acacia spp and Callistemon, Calothamnus and Casuarina gave best results.

4. The lesser number of seedlings on the north side are considered to be due to greater exposure to wind and loss of seed by aeolian borne soils from the adjacent paddocks.

5. Suitability of species indicates that leguminous species establish best with Callistemon and Calothamnus species second best and Casuarina obesa ranked third. Eucalypt species did not establish well at rates of application in these trials. The average rate was estimated at 7 viable seeds/m^2 for all eucalypts on lower and mid slope and an average of 46 viable seeds/m^2 for all eucalypts on upper slopes (see Table 1 and 2). Higher sowing rates are evidently needed for acceptable levels of establishment.

6. It is considered feasible that the greater use of local legumes would have improved overall results.

7. No conclusions can be drawn regarding the relative efficiency of fertilizer used except that "M.A.P." (mono ammonium phosphate) being slow release would probably be a more suitable type to use.

It is known that phosphatic fertilizers are injurious to Proteaceous species. This factor may be implicated in the low establishment of Hakea spp.

8. Recommendations

i) Revegetation efforts using this method should include a majority of local legumes species and Casuarina and Calothamnus and Callistemon.

ii) Eucalypt species used need to have higher sowing rate/m. Further trials could define suitable levels more accurately.

iii) The technique cannot expect to achieve success unless weeds can be controlled and soil movement minimized.

(iv) Ripping the site appears to improve water harvesting, reduces water erosion and serves to trap seed for later germination.

Acknowledgements

The help of Ms P. Hussey, R. Collins and K. Rothenbury is much appreciated in collating data in this paper.

SOWING MIXTURE (1) - UPPER SLOPES - SANDY GRAVEL SOILS — TABLE 1

SPECIES	COMMON NAME	YEAR OF SOWING 1983 QTY (GMS)	YEAR OF SOWING 1984 QTY (GMS)	TOTAL WT. (GMS)	EST'D No. VIABLE SEED/M²	TOTAL SEEDLINGS STOCKING (Nos.) Exp'd Side (Nth)	TOTAL SEEDLINGS STOCKING (Nos.) Prot'd Side (Sth)	% REPRESENT'N Exp'd Side	% REPRESENT'N Prot'd Side	RANKING (BY No. Exp'd Side	RANKING (BY No. Prot Side
1.Acacia acuminata	Jam Wattle	80	100	180	3.11	14	36	25.45	19.78	1	3
2.Acacia pulchella	Prickly Moses	80	100	180	10.18	12	40	21.82	21.98	2	2
3.Acacia podalyriaefolia	Qld Silver Wattle	25	125	150	1.61	-	2	-	1.09	-	8
4.Acacia saligna	Western Wattle	-	100	100	1.54	7	55	12.73	30.22	4	1
5.Callistemon phoenicens	Fiery Bottlebrush	10	12.5	22.5	87.9	8	24	14.55	13.19	3	4
6.Calothamnus rupestris	Cliff Net Bush	7.5	12.5	20.00	0.75	3	4	5.45	2.198	6	7
7.Allocasuarina campestris	Tammar	-	7.5	7.5	1.29	-	9	-	4.94	5	5
8.Allocasuarina huegeliana	Rock Oak	-	7.5	7.5	7.0	-	-	-	-	-	-
9.Euc. leucoxylon var. rosea	Yellow Gum	12.5	50	62.5	7.06	-	1	-	0.55	9	9
10.Euc. dundasii	Dundas Blackbutt	12.5	-	12.5	1.63	-	1	-	0.55	-	9
10a. Euc gardneri	Blue Mallet	20	-	20	0.93	3	6	5.45	3.30	6	6
11.Euc. loxophleba	York Gum	15	-	5	3.11	3	4	5.45	2.198	6	7
12.Euc. torquata	Coral Gum	-	30	30	8.98	4	-	7.28	-	5	
13.Euc. wandoo(inland)	Wandoo	-	25	25	24.67	-	-	-	-	-	
14.Hakea laurina	Pincushion Hakea	12.5	-	12.5	0.09	1	-	1.8	-	7	
15.Hakea multilineata	Grass Leaf Hakea	-	17.5	17.5	0.48	-	-	-	-	-	
16.Pericalymma elliptica	Swamp Tea Tree	4	-	4	4.56	-	-	-	-	-	
17.Pericalymma laevigatum	Vicnti Tree	4	-	4	2.02	-	-	-	-	-	
18.Melaleuca elliptica	Granite Ti Tree	-	7.5	7.5	5.63	-	-	-	-	-	
	TOTAL	283	625	908	172	55	182				

Estimated Area Sown = 2280m²
Overall Sowing Rate/m² = 0.1241gm/m² (1983)&0.2741gm/m² (1984)=0.3982gm/m² (1983 & 1984)
Fertilizer/Spreader = 40kg (Baileys 3:1:1)
+5kg "Agras" No.2
=141kg/ha

Total for Sandy Gravel (U/S) = 237 seedlings

SOWING MIXTURE (2) - MIDDLE AND LOWER SLOPES - SANDY SOILS — TABLE 2

SPECIES	COMMON NAME	TOTAL WT. (GMS)	EST'D No. VIABLE SEED/M²	TOTAL SEEDLINGS STOCKING (Nos.) Exp'd Side (Nth)	TOTAL SEEDLINGS STOCKING (Nos.) Prot'd Side (Sth)	% REPRESENT'N Exp'd Side	% REPRESENT'N Prot'd Side	RANKING (BY Nos. Exp'd Side	RANKING (BY Nos. Prot'd Side
Acacia acuminata	Jam Wattle	250	1.87	130	99	54.85	32.78	1	1
Acacia podalyriaefolia	Qld Silver Wattle	50	0.33	2	-	0.84	-	8	-
Acacia pulchella	Prickly Moses	-	-	-	7*	-	2.32	-	8
Acacia saligna	Western Wattle	250	2.19	23	46	9.70	15.23	3	3
Callistemon phoenicens	Fiery Bottlebrush	20	33.31	15	43	6.33	14.24	4	4
Calothamnus rupestris	Cliff Net Bush	20	0.392	35	29	14.77	9.6	2	5
Casuarina obesa	Swamp Oak	25	2.8	16	55	6.75	18.21	5	2
Euc. camaldulensis	River Gum	20	1.78	-	5	-	1.65*	-	9
Euc. cladocalyx var nana	Dwarf Sugar Gum	30	1.24(est'd)	3	11*	1.27	3.64*	7	7*
Euc. gardneri	Blue Mallet	45	2.14	8	4	3.38	1.32	8	10
.Euc. leucoxylon var rosea	Yellow Gum	25	1.55	2	2	0.84	0.66	8	12
.Euc. loxophleba	York Gum	-	-	-	4	-	1.32	-	10
.Euc. platypus var heterophylla	Coastal Moort	20	0.9(est'd)	-	1	-	0.33	-	13
.Euc. torquata	Coral Gum	-	-	-	14*	-	4.63*	-	6*
.Hakea multilineata	Grass Leaf Hakea	50	0.78	1	4	0.42	1.32	9	10
.Pericalymma elliptica	Ti Tree	10	6.5	-	-		-	-	-
.Melaleuca incana		12	5.661	2	3	0.84	0.99	8	11
	TOTALS	827	61	237	302				

Estimated Area Sown = 4000m²
Overall Sowing Rate/m² = 0.2063gm/m²
Fertilizer/Spreader = 137.5kg/ha
"Agras" No.2

Total for Sandy Soil (U/S) = 539

* = Values doubtful due to transplanting and in filling

Direct seeding trials of native plants in Gippsland

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Following the completion of the Gippsland tree seeder in October 1987 a series of trial seedings were carried out at 5 sites in the Yarram Woodside area, 3 sites in the Walkerville area and one site at Lang Lang.

In the Yarram area sites had been prepared by cultivation many times through the winter. One site had had gypsum incorporated into the light sandy loam. All were shelter belts from 6-10 m wide and 0.5 to 2 km long. All seed was coated with Austrasorb and finely divided clay after mixing with mucilage. The eucalyptus seed was coated with nutrient mixes as well. Three or four rows were sown in each case. The machine sows seed at the rate of about 5 km per hour. Seeds used were Eucalypts, Acacias, Melaleucas and Casuarinas of local provenance and as supplied by the Department of Conservation Forests and Lands. Sowing took place from 20 October to 11 November.

At Walkerville in two sites the topsoil was graded off the row positions to a depth of about 7 cm and a width of about 50 cm. The machine sowed directly into this bed. Sowing took place from 19 November to 22 November.

At the third site the surface was sprayed with "Roundup" after heavy grazing in July, cultivated with a chisel plough several times, resprayed with "Roundup" and further cultivated before sowing. Sowing took place on 19 November.

At the Lang Lang site "Atrzine" had been applied to the surface before cultivation; gypsum had been cultivated into the heavy clay soil. Sowing took place in December.

Results to date (29 January 88)

some germination occurred at all Yarram sites. Most results are unsatisfactory. Good rains occurred within 7 days of sowing. A hot spell in January and lack of follow up rains resulted in little growth and some loss by dehydration. Weeds were a large problem in all cultivated sites. General results were better in areas of unimproved pasture. It is considered that sowing should take place earlier in the spring as the area has a history of unreliable late spring rain.

One Walkerville site was in loose sand and wind scour prevented any results. The other two sites showed good germination. The best result was in the graded area where seedlings are present at intervals of from 10 to 100 cm. All species sown are represented i.e. eucalypts, acacias, melaleucas and casuarina. The seedlings are up to 5 cm high. Weed growth is small compared to the cultivated sites.

The other Walkerville site shows good results with euclaypt seedlings up to 10 cm high at intervals of about 1 m. There are some melaleuca and a few casuarina seedlings. The best results appear where seed was coated with clay; results from coating with nutrients and austrasorb are at present inconclusive. Weed growth, particularly clovers, is a large problem. A small area sown with Tagasaste into a section deep ripped, sprayed with "Roundup" one week before sowing produced a large number of seedlings showing good growth up to 20 cm high. This seed was presoaked in boiling water and coated with "Austrasorb" and clay.

Excellent rain occurred immediately after sowing; follow up rains were received at intervals of about 14 days; the latter part of January had heatwave conditions which have curled up leaves of eucalypts in the cultivated site particularly. At Lang Lang germination was good and the best results appear where gypsum had been incorporated into the soil.

Some hothouse trials have been carried out testing the effect on germination of eucalypts of using Atrazine as a preemergent herbicide. Results are not yet fully collated.

Further trials will be carried out in the autumn and spring of 1988, concentrating on grading the surface before sowing. Attempts will be made to build a grading module into the seeder. The search for a postemergent herbicide which will kill broadleafed weeds but not the species sown will continue.

A simple floppy fence to exclude possums (or cats)

J. Bayly-Stark
Department of Lands, Parks and Wildlife
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HOBART Tas. 7001

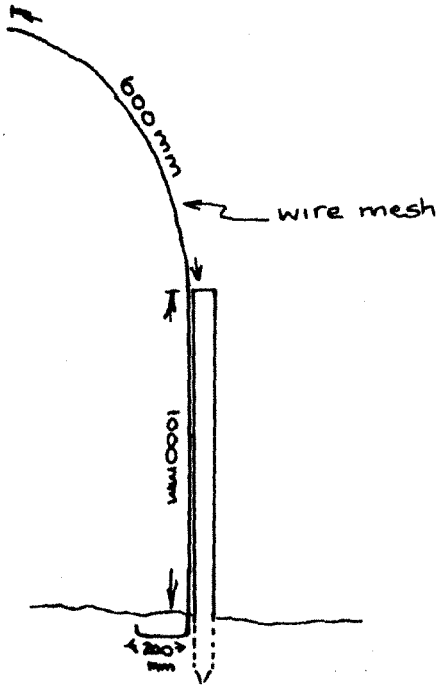
How many exclosure plots, how many areas of plantations, seedling or self sown regeneration have been rendered useless by the agile possum? Too many. There are numerous expensive solutions to these problems of course but frequently the effort and cost involved threaten the viability of the project.

The following is a simple fence design which was developed two years ago to exclude brush-tailed possum (Trichosurus vulpecula) and feral cats (Felis catus) from a research aviary complex. I cannot claim that the fence has been rigorously tested but we have had no further problems with cats and possums scaring the living daylights out of our precious birds.

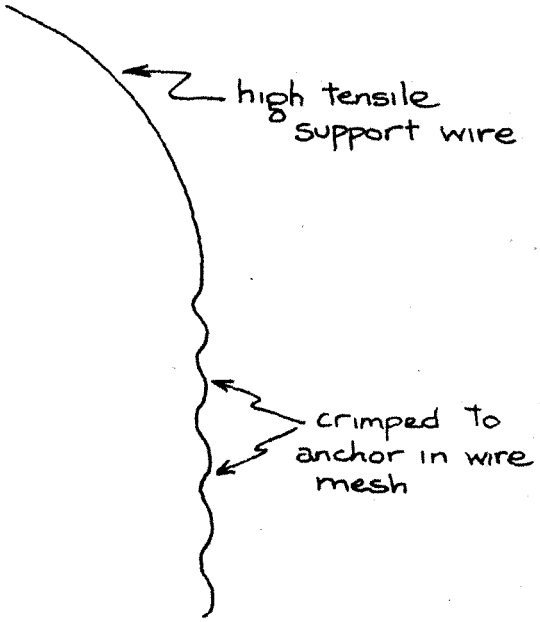
Figures 1a and b show how a single length of 1800 mm width heavily galvanised chicken wire can prevent animals going under, through or over a fence. The bottom 200 mm are buried and returned toward the animal. 1000 mm of the fence is supported by a conventional system of strainer posts and star picketts. The remaining 600 mm of wire is supported on lengths of flexible high tensile heavy gauge fencing wire. The supporting wires are bent so as to curve the upper section of the chicken wire over a climbing animal. It will not support the weight of the animal and flops down on top of it. The resilient high tensile support wires then spring back into position when the animal drops off.

Corners are readily overcome by adding an insert as shown in Figure 2.

Figure 1a



1b



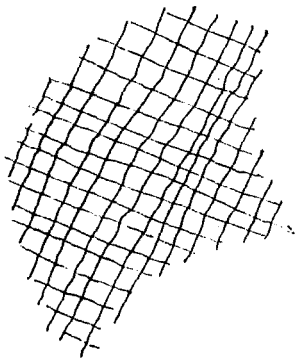


Figure 2.

shape of wire mesh corner insert.

PUBLICATION NOTICES

Please direct all enquiries about these publications to the people listed as contacts.

Annual Revegetation Research Newsletter - March 1988

by

Paul Brown, Penny Hussey and Dave Kabay
Revegetation Newsletter
C/- Tree Research Centre
10 Doney Street
NARROGIN W.A. 6312

AIM: To enable researchers to keep abreast of others in the field of revegetation using native species.

It will cover revegetation work aimed principally at

- *farmland and rangeland*
- *roadsides and borrow pits*
- *mining*

where a significant aim of the project is to return the land to a stable community of native species.

The Newsletter will follow a similar format to the "Tree Decline Newsletter". It will contain brief reports on TECHNICAL information and planned, current or completed RESEARCH into revegetation, including such topics as methods of revegetation (direct seeding, planting of potted stock, natural regeneration); site preparation; weed control; species selection trials and major demonstration plantings. Other items of general interest (e.g. recent publications, technological and machinery innovations, notifications of meetings and visits) will also be included.

Contacts:

Paul Brown, Penny Hussey & Dave Kabay

Farm Trees Annual 1988

A new venture to be published by Rural Press Ltd (owner of 'National Farmer' newspaper) and edited by Geoff Wilson, Managing editor of 'Agrovision'.

The Annual will show Australian farmers how to make a dollar from farm trees.

Articles and reviews in the Annual will show how to increase farm revenues through:

- *Enhancing productivity of existing farm enterprises - particularly livestock (shelter, shade, fodder).*
- *Conservation of soil and water resources on farms, with particular emphasis on control of salinity and soil erosion.*
- *Sale of tree produce (pine and other timber for pulp, posts, poles, sawlogs and peelers, plus specialty timbers, nuts, pods, essential oils, pharmaceutical raw materials, honey, seeds etc.*

In addition the "Farm Trees Annual" will be an Australia-wide reference to where to obtain further information and advice on farm trees.

It is proposed that the "Farm Trees Annual 1988" will be printed early in April, 1988, and will be launched late in April to coincide with the Australian Forest Development Institute's International Bicentennial Forestry Conference in Albury-Wodonga.

We are planning to promote its sale in the following ways:

1. *At the AFDI conference, where around 1,000 people are expected to attend.*
2. *Via publicity in Rural Press publications that would stimulate direct mail orders. (The Rural Press publications include "National Farmer", "Farm", "The Land", "Queensland Country Life", "Stock and Land", "Stock Journal", "Western Farmer & Grazier" and "Hobby Farmer").*
3. *Via newsagents throughout Australia.*

The first print run will be 20,000 copies, followed by other print runs to service sales as and when needed.

Advertising space will be sold in the annual to help meet its costs. Organisations or companies can buy bulk copies at discount prices.

Contact:

Geoff Wilson
Managing Editor
Agrovision
P.O. Box 283
CAULFIELD SOUTH Vic. 3162

Studies on an area of dryland salting near Thangood, Central Queensland

by

J. Standley, B.A. Cowie and A.E. Larsen

Part I - *Description and drainage*
Part II - *Establishment of trees in the area*
Part III - *Information from piezometer (water level) records and water analysis*
Part IV - *Drainage and salinity in the trees study area, 1984-1987*
Part V - *Survival of trees, 1984-1987*

Contact:

David Chapman
Soil Conservationist
Q.D.P.I.
Box 6014
ROCKHAMPTON Qld. 4702

or

John Standley
Q.W.R.I.
Box 5282
TOOWOOMBA Qld. 4350

'Trees for the Southern Tablelands'

by

Greg Harris
Soil Conservation Service
QUEANBEYAN N.S.W. 2620

Information about the planting of trees for properties on the Southern Tablelands has been often difficult for the public to obtain. The majority of books on plants are intended for urban plantings or a less harsh environment than our area.

Hopefully this book will encourage people to plant more trees in the rural environment. Don't be discouraged by "prophets of doom" who say it can't be done. The results of trials and demonstrations at the back of this book prove that if the correct species are selected and correct methods used you can grow trees without regular watering.

This book is devoted to Australian species. This is partly because this book's readers will probably wish to plant Australian trees and shrubs and also because there are so many people saying that they have heard that nativ plants can not be successfully grown.

Omitting one of the ten tree planting tips can lead to failure. Where the seed for the seedlings come from is most critical for widely occurring species while less critical for species which only grown on the Southern Tablelands.

Nature is variable even over a small distance. Trial plantings of your own are often the best advisor. This book though should guide your selection and should assist you to be more successful.

Remember to select the right tree for the right place.

Contact:

Greg Harris
Soil Conservation Service of N.S.W
P.O. Box 189
QUEANBEYAN N.S.W. 2620.

Growing Carobs in Australia

Henry Esbenshade and Geoff Wilson

Carob (Ceratonia siliqua)

A number of innovative Australians are just beginning to develop agroforestry regimes with the ancient Mediterranean tree, the carob. Carobs have been cultivated in countries around the Mediterranean and mid-east since history was first recorded, and have always provided human food and livestock fodder from upland areas not suited to cultivation.

In times of famine the carob provided a valuable substitute for grains, and is recorded in the Bible as 'St John's bread'. The Egyptians were probably the first to cultivate carobs on an agroforestry regime, with goats and sheep grazing underneath on pasture and carob pods.

The most recent people to adopt it as an agroforestry tree species are a group of Australians, principally in South and Western Australia, where climate and soil types are well suited to its drought tolerant, deep tap-rooting habit.

But, while the carob is especially suited to the deep sands of both Western Australia and South Australia, plus the Mallee of Victoria, big areas of both outback Queensland and New South Wales also have potential for this tree crop - as Henry Esbenshade's book shows.

Australian farmers can use the carob for:

- *Livestock shade and shelter*
- *Livestock fodder*
- *Soil erosion control on difficult, dry sites*

The carob tree thus has great potential in vastly improving farm productivity in big areas of Australia's dry country.

All is not roses, however. Hentry tells the carob story like it is - pointing out the difficulties as well as the advantages.

This book is a text well worth serious study by many thousands of Australian livestock producers wanting to make a better dollar from sheep and cattle throughout inland Australia.

Growing Carobs in Australia contains more than 60 color and black and white photographs showing what the frontrunners are now doing with carob tree growing in Australia.

Contact:

Henry Esbenshade
Department of Geography
University of Western Australia
NEDLANDS W.A. 6009

....Henry also has a strong interest in agroforestry/forestry in China, and would welcome correspondence with people who have had experience in this field. (ed.).