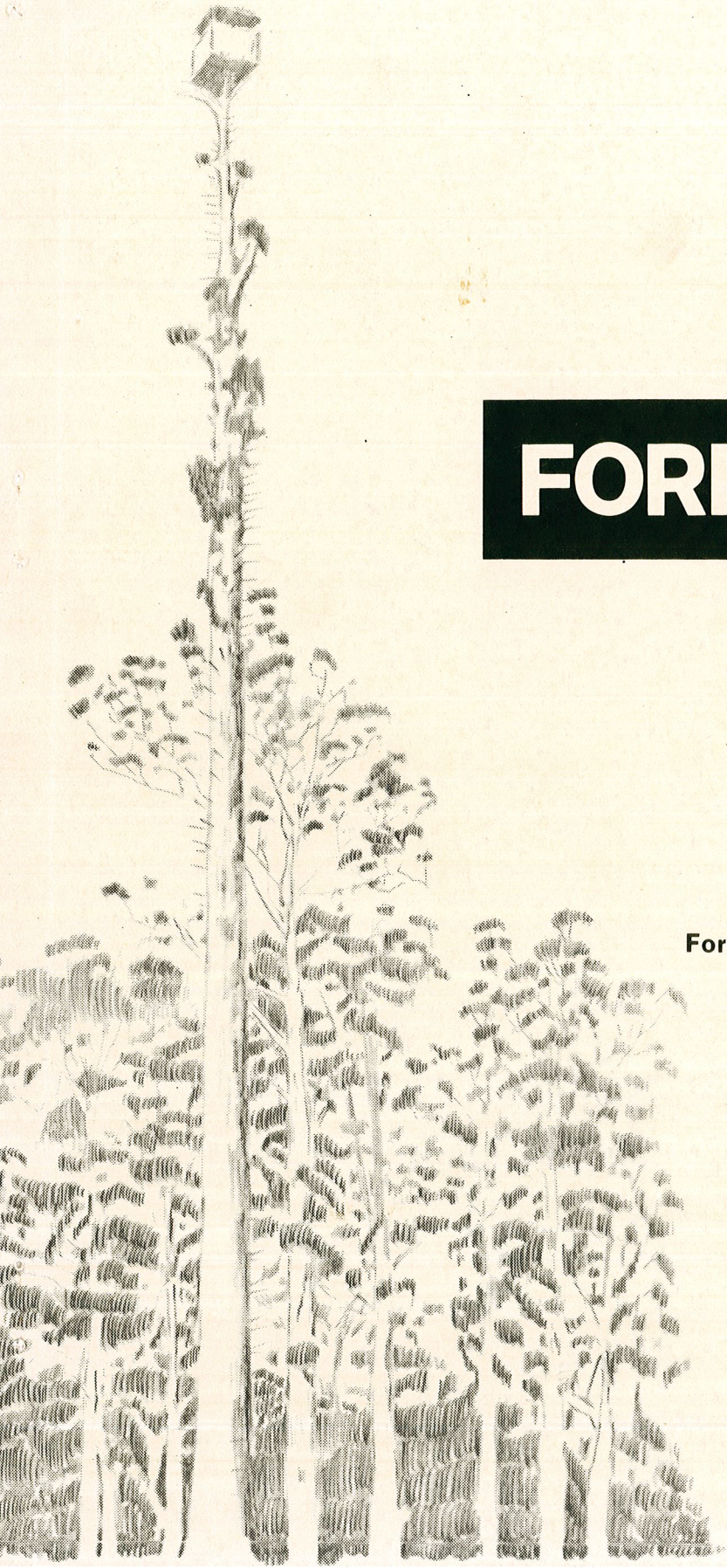

FOREST NOTES

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CONTENTS

EDITORIAL NOTE:

This edition of Forest Notes is evidence enough of the wonderful response to the request for material. It was thought best to include it all, even though there was sufficient material for two issues.

Editors

COMO.

HORTICULTURAL ASPECTS OF FORESTRY AND ORNAMENTAL TREES

by A.J. HART

1. INTRODUCTION

This topic is regarded as appertaining to the present day problems being encountered in forestry with reference to new discoveries and results in ornamental trees, particularly native Eucalypts.

Comments therefore will refer to a wide range of problems, currently under investigation including -

(i) Dieback disease and rehabilitation in brief.
(ii) Rehabilitation of gravel pits mined areas.
(iii) Rehabilitation of salt affected land.

Other areas of concern with little or no action at present are Mistletoe infestations, lerp attack on trees in watercourse situation and insect attacks of importance on other species.

2. With reference to Red Flowering Gum, there is as yet no definite results from trying to breed canker resistant strains. It appears many of the resistant strains died of other causes and it is not proven that survivors are canker resistant, as yet.

Other species of horticultural interest are -

Eucalyptus calophylla rosea
Eucalyptus haemotoxylon
Eucalyptus leucoxylon var. leucoxylon
Eucalyptus crebra
Eucalyptus wandoo (differences between inland and coastal form)
Eucalyptus laeliae

The following hybrids are also of importance -

Eucalyptus botryoides x saligna
Eucalyptus saligna x grandis
Eucalyptus wandoo (Golden Sport ?)

3. DIEBACK DISEASE (Phytophthora cinnamomi)

The basic requirements for spread of the disease in forest areas are -

(i) a suitable dispersal agent or agents (man),
(ii) adequate moisture - (which also acts as a dispersing agent),
(iii) adequate food, particularly protected rootlet type species high in 'N' and other nutrients and sugars.

Briefly, the problem of rehabilitation is being tackled by natural regeneration where possible with Marri, W.A. Blackbutt and Wandoo. If necessary, exotic Eucalypts, which are highly resistant to the pathogen, are introduced.

4. REHABILITATION OF GRAVEL PITS AND MINED AREAS

Problems still exist in relation to revegetating such areas.

The reasons for revegetating are mainly those of aesthetic and erosion control plus a degree of safety in some instances.

Rehabilitation of gravel pits now involves battering of banks and ripping the pit floors to a depth of 2' to 3' at least and replanting in the rip slightly on the mound created. Stock type used in this are generally jiffy potted stock of native species, but techniques are now extending to broadcast sowing after preparation with a variety of native shrubs as well.

Mined areas require to be treated similarly however, topsoil return is an important phase of rehabilitation as well as ripping.

Coal mine areas are particularly difficult due to age of the waste heaps and easily erodable surfaces and sharp angle of repose.

5. SALT AFFECTED LAND

Although dieback itself is materially assisting in allowing salts to pass into water catchments at a higher rate than normal, the major cause of salting of water courses has been caused by excessive clearing of vegetation, particularly on or near water courses in the past.

The effects are now spreading to adjacent arable land. The 1974 Department of agriculture survey revealed 167,294 ha was previously under crops or pasture or 1.17% of all cleared land. Aerial photos may be the only way to get a precise figure of saltland extent. The extension has increased rapidly in the period 1955 to 1970.

Rehabilitation of such areas rests on the following measures -

(1) fencing off affected areas from grazing

(2) replanting to forageable grasses

(3) replanting to trees

The implementation of (2) and (3) depends upon intended land use. The basic aim is to lower the water tables which causes deposition of salts on the soil surface. The planting of grasses is ineffective in rehabilitating already affected areas and does not prevent the spread of surface deposition to other areas.

Species suitable for such areas are -

(1) Salt River Gums
(2) Swamp Mallet
(3) Athel Tree
(4) Coastal Moort
(5) River Gums (near periphery of affected areas)
(6) Stocking Gum
(7) Swamp Oak

Stock type recommended, is potted stock of 5-6 cm height using a pit planting method on mounds of 5-6 cm preferably.

Associated problems of wind erosion and windbreak shelter belts can be tackled using various species depending on locality.

Reference for suitable species for many different sites, should be made to Forests Department information leaflet No. 37. Generally however, results indicate replanting of naturally occurring species has better long term prospects.

6. PEST PROBLEM OF TREE SPECIES

A. Four main species regarded as of importance (perhaps economically).

(i) Bag moths (Hymenopterous group) attack Manna Wattle and River Gum.

(ii) Greg. gall weevils (Curculionid) attack wide range of species, but mainly River Gum and Karri "off site". Influence of range of extensions likely.

(iii) Cerambycid Beetle (Phorcantha semipunctata) attacking Tallowwood and others on drought prone sites.

(iv) Lerps (Pysillids) as boring larvae leaf sucking attacks - prevalent on Flooded Gum and River Gums can cause deaths of trees on water courses.

The cause of most significant insect attack is due to trees concerned being primarily placed under stress due to drought and shallow or soil depth, which aggravates low moisture levels. It is thought to be connected also with a consequent change in forms of Nitrogen available in the tree tissues. Control measures are centred on boring holes into the bole to implant translocated poisons.

B. Mistletoe - increasing observations indicate a rather rapid spread of this species (Arnyema miquelii) particularly on Marri (Gosnells area) and Wandoo and Eucalyptus rudis and patens along water courses of the lower south west generally.

Control measures not easy and most work centred in Eastern States where problem is being attacked using translocated poisons in the bole using 3.4.D & MCAB. Loss of host trees also occurs.

C. Rusts of Poplar (Melampsora-larici-populina local spp.). Since the discovery of Poplar rusts in Adelaide in 1971, it has now spread to W.A. local occurrences being observed first about 1975-76. This problem has therefore tended to discourage poplar growing.

For your further information, I refer you to the following Brochures and pamphlets.

1. Journal of Agric. Vol. 17, No. 2, 1976, pp 42-49.
2. Information Sheets F.D. Nos. 4, 28, 37 and 38.
3. Regeneration in the Karri Forest Community 1974 Forests Department of W.A.
4. Forest Focus. No. 14, April 1975.
5. Forest Focus. No. 16, December, 1975.
6. Suitable Trees for Planting on the Wheatbelt - Forests Department of W.A.
7. Suitable Trees for Planting in the South West and Esperance Plains.

THE INTEGRATION OF FORESTRY AND AGRICULTURE

A WESTERN AUSTRALIAN OVERVIEW

by

F.E. Batini

SUMMARY

The history, purpose and some of the benefits and problems of integrating forestry and agriculture are discussed. The current situation in Western Australia is highlighted.

A BRIEF HISTORY

For many years foresters and agriculturists have been in direct competition for the use of land resources in the south-west of the State, particularly in the greater than 750 mm rainfall belt, where the bulk of the commercial forests are located.

Foresters suffered from the fact that their Department was not formed for almost 100 years after the establishment of the colony, and in that time very large areas of prime forest were cleared and changed to agricultural production. From the time the Department was formed in 1918, it fought a continuous battle to ensure that suitable vacant Crown Land was reserved as State Forest in quantities deemed sufficient for the needs of the population. That it succeeded in eventually reserving an area of 1.8×10^6 ha (out of an estimated area of 6×10^6 of forest) was largely due to the high clearing costs and very low fertility of the jarrah (Eucalyptus marginata) forest on lateritic soils.

We had many examples of prime forest being destroyed for agricultural production, in some cases agriculture which eventually failed. Some of the better known were the "Group Settlement Schemes" in the extreme south-west of the State. Schemes that ringbarked and destroyed thousands of hectares of prime karri (E. diversicolor) forest (Hunt, 1958). But even as late as the 1960s, the Department still faced a continuing demand for forest land to be released for agricultural production. Crown Land Tribunals were considering the future of large areas of vacant Crown Land. Farmers were demanding more and more land and many of the Department's officers were involved in land inspections to see whether these alienations should be recommended or not. The State's agricultural development of the 1960s spilled over into what has been described as the "million acre madness"; where a million acres a year of predominantly light lands were bulldozed and cleared to establish marginally economic agriculture. The changes which agriculture has created to the landscape

have been extreme, its effect on native flora and fauna in many areas, has been devastating, and more recently, its insidious and detrimental effects on the water quality of some of the State's major streams have come into prominence.

On the credit side, agricultural products (primarily wheat and sheep) have been key factors in the development and prosperity of this State. Farmers too have felt seriously concerned about the effects of reserves or State Forest adjoining their properties. They saw these as sources of pests (such as rabbits, emus or kangaroos), weeds and also possible source of fire. Others considered that the forester's attitude to alienation restricted their farm size to an "uneconomic" unit. The situation could be likened more to an uneasy truce than to open warfare.

In many cases, the wheel then turned its full circle and land cleared for agriculture was resumed or repurchased and planted again to a tree crop. In water supply catchments (Helena, Collie and Metropolitan catchments) privately owned land was resumed by the Crown to decrease the level of pollutant discharge (e.g. fertilizer, weedicides, faecal matter, salt, etc.). Because of the depressed butterfat markets some farms in the "karri belt" were purchased and replanted to karri (Underwood, 1973). But probably the most interesting phase has been the repurchase of farmland in the Blackwood Valley system. In this area, some 17,000 ha of farmland were repurchased by the Forests Department on the open market, and were subsequently planted to Pinus radiata. Originally, the farmers appeared to welcome our purchase of the poorer sections of their farm (shallow soils on steep slopes, often covered with bracken) while they retained the more fertile bottom land. Some Shire Councils and the remaining farmers now consider that too much land was repurchased and that this has had detrimental effects on the social and service facilities which serve these farming communities (McTaggert, 1977).

More recently, some farmers have strongly opposed the influx of privately managed pine plantations in the Blackwood Valley. These are seen to be primarily a "tax dodge" by absentee landowners (doctors, lawyers etc). Further development is now viewed as a real threat to the survival of the remaining farmers (bush fire control, weed and pest control, loss of social amenities, etc.). However, Councils have been less opposed to private plantations, since these are liable for Shire rates, whereas the Forests Department's are not.

For many years, grazing in parts of the indigenous eucalypt forest has occurred. In many cases, grazing leases predated the dedication of State Forest, and were then allowed to continue. The tuart (Eucalyptus gomphocephala) forest has been grazed intermittently for over 140 years (Skillen, 1977); where it is a useful means of reducing the fuel hazard. In this area, some degree of damage has occurred. In the eastern jarrah and wandoo (E. wandoo) forest considerable grazing has

also occurred, apparently with minimal adverse impact (Walker, 1977). More recently, grazing leases have been encouraged on some of the repurchased farmland in the Blackwood Valley.

AN UNHOLY ALLIANCE?

Foresters have spoken on many occasions about multiple use of forest resources and it is interesting that this has now been extended to include a mixture of trees and agriculture, both on areas held as State Forest and on areas which are privately owned. A new word, "agroforestry" has been coined to describe this alliance. It is important to differentiate between woodlots, shelterbelts and agro- (or farm) forestry as vastly different means of achieving an integration between forestry and agriculture (McQueen et al, 1976). These all have different objectives and will yield vastly different products (both qualitatively and quantitatively). The other side of agroforestry is the farmer who has only part-cleared his block. To date he has often done this for reasons other than timber production: cost, aesthetics, salt control, shelter, pasture production over a longer period. However, this parkland system could well reduce his total production. Anderson (1977) has reported that dry matter production and clover content increased radially from the tree bole.

Preferably, agroforestry should be viewed as a complete production (not as opportunistic) system (McQueen et al, 1976). However, there is little doubt as to where the major interest of each party lies. Retention of farmer interest in a long term tree crop may well prove a problem. If it wanes and the trees become neglected, considerable investment loss could occur. The concept of agroforestry should also be broadened beyond those trees which merely have a timber value. Other values, e.g. chemical (mallet bark), fodder (mulga), aesthetic, shelter, honey potential, fuel, salt tolerance must also be considered (Glencross, 1977).

We may well ask why the foresters and agriculturalists who last saw each other at first year university, should combine again in agroforestry projects. Obviously, there should be benefits to both parties. From the forester's point of view the returns which some agricultural production ensures in the early part of a pine rotation, are particularly important to increase the profitability of his venture, (Knowles, 1972), particularly at very high discount rates, such as those which are prevailing today. Fire and weed control and provision of access are problems which have faced us for many years. The cost in recent years has escalated sharply and cheaper techniques seem to be available by the use of grazing animals. With the trend to plant less fertile soil types, a greater input of fertilizers is required. This necessitates the optimum use of fertilizer and perhaps the use of clover or similar legume to provide a continuing source of nitrogen. It is possible that trampling by animals will also increase the rate of nutrient recycling. In

South Australia, an apparent second rotation decline with subsequent rotation of pine has been reported (Keeves, 1966). Nutrient recycling, green manuring, leguminous understorey and grazing would appear to have potential of reducing this decline.

The Forests Department's "Donnybrook Sunkland" project aims to establish 60,000 ha of pine in that region within 30 years (Forests Department, 1975). It is anticipated that some 20 per cent of the area could be managed under an agroforestry regime. These would form broad fuel reduction buffers around and within the plantation cells. The additional cost of pasture establishment, fencing, watering points, etc. is considerable. Since Treasury Loan funds are limited, this will place a constraint on the area which can be managed under the joint system.

The farmer too can see some benefits from trees on his farm. In some areas (such as Esperance and the lower south coast), shelter belts have been planted to provide control of wind erosion which, in these districts, can be particularly severe. The effect of shelter belts on crops and animals has been documented for the northern hemisphere. However, while there is considerable theoretical knowledge on the length, shape, orientation and density characteristics of shelterbelts (Brown and Hall, 1968, Hall et al, 1972), I found difficulty in obtaining published experimental data on the actual benefits (or otherwise) of shelterbelts. No evidence of any benefit of shelter was presented in any of the workshop papers. Opinions on the usefulness or otherwise of shelter varies, depending upon the person whose opinion is sought (Richmond, 1977). However, animals are seen to make use of shade and shelter in times of stress and it is probable that some research in these fields would be worthwhile.

For many years, farmers have improved the aesthetic appeal of their homesteads by planting with trees and the Forests Department has, for over 70 years, provided nursery stock at near cost, for farmer use. In more recent years, sales depended largely on farmers' affluence, but quantities around the 150,000 to 200,000 seedlings per year have been sold. Further, the Forests and Agricultural Departments have combined in a programme of arboreta plantings on agricultural research stations, farming properties and Shire land. These now cover the agricultural areas of this State in over 50 arboreta, some of which are exclusively on salt land (Hewett and Edmiston, 1977). In some instances, farmers have looked for longer term investments from trees on their land. Enquiries ranged from as far away as the Kimberleys and the Pilbara (where commercial production is deemed to be unlikely in the near future) to the south-west, where a considerable area of privately owned land (7600 ha) has been planted to Pinus radiata in recent years (Forests Department, 1976).

The community too can see value in re-establishing trees on farmland. This value lies in erosion control, the reduction of flooding, silt in streams and reservoirs, and, more importantly in the control of salt

land, particularly in catchment areas which supply domestic or irrigation requirements. As mentioned previously the major streams of South-Western Australia: the Swan-Avon system, the Murray and the Blackwood are brackish or saline, largely as a result of agricultural clearing (Stoneman, 1976). Other streams in major catchment areas, such as the Collie and the Warren are of marginal quality as the result of agriculture. One of the techniques to avoid increases in salinity has been to resume farmland. This has occurred on the Helena and the Collie Catchments but the cost of resumptions is extreme. If, however, a suitable system of integrating forestry and agriculture could be found, such that the agricultural potential was retained and the trees reduced the flow of water and salt into the streams, then a solution that was economically, socially and politically more acceptable might be achieved.

For example, Williams (1977) calculate that in the Collie catchment an area of 105 km^2 would need to be reforested to achieve a salt level of 400 mgl^{-1}. This was calculated on the assumption that only 25% of the cleared area would need to be replanted, (which I personally feel is an optimistic value). Using more pessimistic estimates, the area to be reforested could range between 168 and 273 km^2 to achieve the 400 mgl^{-1} target. This constitutes a major programme, which could take considerable time to reverse the current salinity trends (15 to 20 years). It should preferably be implemented quickly and hence, inevitably, from a position of considerable ignorance (Williams, 1977).

TO THE FUTURE - WITH HOPE?

Although agroforestry appears to have considerable potential, research in this field has only just commenced. Many basic questions require answers. What are our needs? Which species should be considered? How long should the testing process take? Research is opening up new fields for investigations; fields requiring the joint expertise of the forester, economist, the agricultural and social scientist. With the benefits of joint studies, there are also some disadvantages (co-ordination of efforts, competition, authorship, etc.).

One of the problems is that trees take many years to express their site potential (perhaps 15 or 20) and many of us, particularly the agriculturists, are not used to waiting such a long time for an answer. I would recommend that the tree screening phase should certainly be longer than the 5-6 (or even 1-2!) years suggested by Biddiscombe et al (1977). In the first 10 years of the inland arboreta trials the outstanding species (survival, growth rate, health) was E. occidentalis (flat-topped yate). Five years later, most of these trees were either blown over or dead.

There is some disagreement as to whether the additional cost of older (2/0)seedlings offsets the gain due to earlier grazing potential in the farm situation (Borough, 1977, McQueen, 1977). In this State, a smaller

(1/0) seedling, given adequate site preparation (weed and vermin control, fertilizer) is preferred. The potential farming loss can be further reduced by inter-row cropping, hay baling or silage during the tree establishment phase.

We must also be aware of the negative interactions between trees and animals. Many grazing animals, particularly goats, horses and cattle, can severely damage or kill trees. The use of repellants, guards, pre-conditioning of grazing animals, mineral licks, etc. have all been employed to counter these effects. However, our basic understanding of why animals graze trees is still poor.

Another example of the interactions which may occur is given by the Phytophthora cinnamomi/tree/animal interaction. Pinus radiata is extremely susceptible to the Phytophthora fungus when grown in shelter belt conditions, especially beyond 20 years of age (Newhook, 1959; Batini, 1968). It appears that susceptibility is increased by compaction and camping of grazing animals and by some extract in cattle urine which stimulates the sporulation of the fungus. At the other end of the scale, there is no recorded damage of Pinus radiata by Phytophthora when the pine is grown in plantation form. Work by Shea (1975) has demonstrated the effects of dense Pinus radiata plantations in depressing soil moisture and soil temperature, to levels which are sub-optional to P. cinnamomi at least for a large part of the year. Where will the balance lie with agroforestry? Will it favour the tree ... or the fungus?

Even if agroforestry was demonstrated to be highly successful in research and operational trials, there is also the problem of extending these data to the farming community. A problem of education, of extension, of communications. The agricultural advisers will be well aware of this. In the forester's experience too, many farmers appear to have little appreciation of the requirements of a tree crop. Do we face an appalling ignorance and conservation on all sides? How will these barriers be broken? Who is going to staff and maintain this service?

Of great importance are the questions relating to the economics of the joint forestry/agricultural venture; questions such as the demand/supply positions for the various products (timber, fibre, meat, cereal, etc.). With timber resources, the time scale between establishing a plantation and a financial return can be quite considerable. The discounted profit may be quite low at the higher rates of discount. In contrast, agriculture, with its annual costs and returns, provides quite a different economic framework. The types of products to be grown in the mixed system (whether they be hardwood or softwood; chipwood, case log, saw log or peeler log quality) will have very great influence on the economics of the venture. Harvesting cost, distance from market or port, quantity and quality of resource will have key bearing on the profitability of the final outcome.

In many cases, it may be necessary and highly desirable for Farmers' Co-operatives to be set up to market their product efficiently. These apparently work quite well in some overseas countries, e.g. U.S.A., U.K. and in Europe. This aspect is currently being considered by private growers in this State. Certainly, the marketing of farm timber could be hindered by the fact that sales would be too large, established, timber firms, who could exercise a monopolistic price policy (Douglas, 1977). Alternatively, other systems of recompensing tree farmers (incentives, contracts, annuity payments) could be considered (Bond, 1977). Should private plantations be encouraged in areas which are in close proximity to State owned plantations? Will the operations in the two systems be integrated to the benefit of both parties or will both compete actively against each other for the available markets?

It is recognised that the increased labour requirements of forest operations provides an avenue for stability (or preferably an increase) in rural population. The provision of grazing leases and of part-time employment are further benefits which are available to the local community (McTaggert, 1977). However, practical aspects such as security of tenure for leases (1, 3 or 5 years?), the actual fees paid (currently $7 to 17/ha) and the timing of grazing (e.g. fire control requirements necessitates that pasture be heavily grazed by late spring) will need to be negotiated with lessees, and periodically reviewed. What will be the effects of agroforestry on a large scale, on regional employment and decentralisation? Will it in fact bring more people into the local community, thus improving services, or will the people who obtain their employment from the forest, live in the larger centres, further draining the farming community of the services which are so necessary to its well being and long-term survival?

LAND USE PLANNING

It is important also to view the integration between forestry and agriculture in the general land use scheme. How should these two activities be integrated? In what proportion? Which areas favour each? How is the mix best obtained? These are important considerations, not only for social or economic values, but also for other factors, such as the aesthetic quality of the landscape. Computer models (such as TOPAZ-WA) are currently being used to assist the land use planning process (Bennett et al, 1977).

I believe that variety and contrast enhances aesthetic appeal and that some integration between forestry and agriculture (such as has occurred in the Blackwood Valley) can in fact improve the appeal of the area, particularly if the plantations are designed to blend and not intrude into the landscape. The use of landscape planners in the evaluation and management of the visual resource, especially where large scale, long term and highly visible changes to landscape are proposed, is desirable

(Schmidt, 1977). The British Forestry Commission have for some years been advised by a landscape consultant (Crowe, 1966). In this State, landscape proposals have been prepared for the Blackwood Valley (Gobby, 1974) and the Department currently employs a forester with professional training in landscape architecture.

Though much of this discussion has centred on economic aspects of growing trees and agricultural crops, there are other aspects of integration which could be briefly considered. These include facets such as recreation on farms, hunting or wildfires management on private property. These aspects are widely explored overseas, especially in England, Europe and in the U.S.A. In some cases, these alternatives provide a much greater economic benefit to the farmer, than does the agricultural produce from his land. The demand for these services in Western Australia seems to be low at the present time but it is quite likely that this will change. Especially as more and more people choose to live in the industrialised larger cities and their access to the countryside is reduced.

It is also interesting to note an apparent reversal away from a system of agroforestry in some parts of the U.K. and France. In some areas, Normandy and Britanny in particular, hedgerows around fields were once common. These provide shelter to stock and crops and were regularly pruned for firewood. More recent policies have chosen to "improve" agricultural production (large fields, greater use of mechanisation, specialisation etc.). In the process the hedgerows have disappeared. With what long term results?

CONCLUSION

I believe that a better integration between forestry and agriculture can provide substantial benefits to our society and may lead to better use of the available land resources. The Australian Agricultural Council is to be commended for sponsoring this workshop.

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FERAL PORK CHOPS

F. Batini

INTRODUCTION

Throughout the history of Australia many domestic pigs have "gone bush". These have multiplied and spread through a considerable area to form the current population of feral pigs. The size and importance of these populations fluctuate markedly in response to seasonal conditions and hunting pressures. Feral pigs are declared noxious animals in N.S.W., Victoria, Queensland and W.A. The States most affected by these pigs are Queensland and N.S.W. Within W.A. they are established in the Kimberleys, Pilbara and North West and in the lower Murchison and Geraldton areas. A major population has colonised parts of the State Forest area in the lower south west.

Distribution within State Forest

Feral pigs were first reported in the Darling Range in 1870 and were present around Williams in 1914. It is now considered that they occur in the forest from the Serpentine River southwards to Kirup, Grimwade and Boyup Brook.

Hunting or Management?

About 100 hunters of feral pigs have been identified. Few actually shoot the pigs and hunting with dogs is the most common form. Some are in fact "farming" the feral pig - as indicated by stories of castrated pigs, boar releases for the purposes of upgrading stock, translocation of captured pigs (especially sows in litter) to other areas. It has been estimated that 2000+ feral pigs are captured and slaughtered each year.

Concern?

Concern about feral pigs has been expressed by several bodies and some of these met in November 1975, to exchange ideas and information.

Agriculture Feral pigs could be carriers of disease (e.g. foot and mouth, leptospirosis, tuberculosis etc.). Since feral pigs are slaughtered privately, health problems (e.g. salmonella) could occur.

A.P.B. Pigs are declared vermin.

Forests Pigs could be of concern from the spread of dieback, water supply and native fauna points of view.

Fisheries and Wildlife Expressed concern with respect to native animals and destruction of habitat.

Water Supply (PWD and MWB) Possibility of disease spread, turbidity problems and pollution of water supplies.

Farmers group Concern with damage to crops and fences.

These groups were concerned about the possible effects of quarantine, in that it could assist in a rapid buildup of feral pigs and result in a population explosion. Current evidence suggests that sows become pregnant at very light weights and commonly raise quite large litters.

RESEARCH

It was obvious that further data was required to identify the nature and scale of the problem (or perhaps to decide if a problem existed!). Several projects have commenced. These include:

a) Autopsy and serological examination of blood samples. To date these have shown feral pigs to be remarkably healthy. Evidence suggests that these pigs have little contact with domestic stock.

b) "Sensitivity analysis" of pigs to naturally occurring and other poisons (1080, warfarin etc.). Baiting techniques. Effects of poisons on native fauna and water supplies.

c) Trapping techniques.

d) University project.

The six departments involved have agreed to sponsor a student at the Zoology Department, (University of W.A.), for a period of 1 to 2 years. This student is Mr Kim Masters, a resident of Collie, who is currently undertaking a Master's Degree. Several aspects are under investigation. Both direction and support is being provided by the Departments represented on the feral pig committee.

One aspect of this study is a survey which will attempt to gather all available information in order to obtain a clearer overall picture of the status of the feral pig. A questionnaire has been prepared and issued to Government employees, pig hunters, farmers etc. By now, I trust that you have returned your copy and thank you for your assistance.

KARRI PROVENANCE TRIALS

A.R. Annels

NATURAL OCCURRENCE

Karri, Eucalyptus diversicolor, occurs between latitude 34° - 35° South, longitude 115° - 118° East. Within these boundaries there are approximately 150,000 ha of karri. The main karri belt is associated with the river systems of the Donnelly, Lower Warren, Gardner, Deep, Shannon and Lower Frankland. Outliers are found at Karridale, Margaret River, Yallingup, Black Point, Mt. Barker, Porongorups, Mt. Many Peaks and Rocky Gully. In the central area of the karri occurrence the tree typically grows on a red-brown-yellow-brown loamy sand derived from granite gneiss exposed by stream flow. Near the south coast karri grows on soils formed on large residual granite-gneiss outcrops on previously drowned coastline. The Karridale and Mt. Many Peaks outliers grow on red sandy soils derived from limestones. Rainfall in the main karri areas is 1125 mm per annum or higher, but possibly falls as low as 875 mm in some of the outliers, although these outliers could occur in localized pockets of higher rainfall. Karri growing near the coast in some areas must at times be subject to considerable quantities of salt laden wind. The non-continuous nature of karri occurrences and the comparatively isolated nature of some of the outliers suggests the possibility of some variability in trees raised from seed from different areas.

PROPOSALS TO TEST VARIABILITY

In 1970, it was decided to test variability within the species by trial planting of seedlings raised from seed of trees from different karri areas. Plantations or orchards were to be established at three different sites, situated in the Donnelly Valley and in the Pemberton and Northcliffe areas. These planting sites, although not covering the full natural range of the species did cover the main physiographic types of the commercial range of karri forest and were also in reasonable proximity to Manjimup Research Station. Fifty seedlings from each seed source were to be planted in the Pemberton orchard and replications of fifty each, when available, planted in the Donnelly Valley and/or the Northcliffe orchards.

Trees to provide seed were to be selected as the best available in all known stands of karri including outliers. The number of trees to be sampled was based on the number of stands within a drainage system with 75% of the total number of trees being allocated to the main karri range and 25% to the outliers.

SEED COLLECTION AND PLANTING

During the years 1971, 1972, 1973, while karri seed was available in the crowns, it was collected from approximately 120 trees. Collections were obtained either by shooting down a branch from standing trees, or collecting directly from crowns of trees cut during trade operations. Each tree was described and given a Serial number which was applied to that particular seed lot. Plants were raised in Jiffy Pots in a sterilized sand-peat mixture. Planting was carried out in units of ten plants, replicated five times on randomly selected sites within each years planting, i.e. 1972 and 1973 seasons.

RESULTS

In late 1976 a portion of the 1972 planting in the Pemberton and Northcliffe orchard was measured and although there were considerable differences in average height of serial numbers collected from different stands there were also large differences in height of individuals collected from the same stands. Although results of height measurement at this age are inconclusive a trend which does emerge is that karri from the main range is making better growth than that from the outliers with the notable exception of that from the Porongorups.

Table showing average height of stems by seed sources at age 4 years

Block	Mean Ht. (cms)
Yallingup	533.5
Mt. Many Peaks	565.5
Black Point	631.0
Mindanup	651.0
Boranup	655.5
Boorara	672.5
Mattaband	688.5
Poole	696.0
Jane	698.5
Marinup	715.5
Porongorups	734.5
Warren	757.0

It is possible that karri from the coastal outliers, i.e. Yallingup, Karridale, Mt. Many Peaks and Black Point, have adapted to growing on a different soil type and may not be so suitable for growing on typical karri soils. The only significant differences in height growth are between Yallingup and Warren Block seed sources. Increasing age of the planted stems may show greater differences in height and also in form of these different seed sources.

FUTURE PROPOSALS

It is intended to utilize the information obtained from these trials to plant several areas for future seed production, utilizing parent seed from trees or areas which show superior growth and/or form habits.

A REVIEW OF KARRI SILVICULTURE RESEARCH

by Cameron Schuster

The work of the Manjimup Research Station in silviculture is basically of an applied nature, in that the main objective of the research is to determine new techniques, and modifications that will assist the operations staff in their duties. There have been many researchers in the field which dates back to the mid 1930's, with perhaps the major researchers being Messrs Hart, Loneragan, White, Christensen and Kimber.

PAST RESEARCH

To date the research into karri silviculture has been centred mainly on determining the basic techniques that are required for the successful regeneration of karri after cutting, and it has been through this research that the current seed tree and planting practices have largely evolved. These techniques determined by work in the 1960's and before, are still used in principle for karri regeneration practices, however because the area being cut has increased to such an extent, it is becoming increasingly difficult to regenerate all areas using these methods.

Some of the more detailed past research includes projects on karri espacements at planting, and three very large trials on regeneration success in various forest mixtures using differing regimes of seed trees for regeneration. These plots will continue to yield important information into the future, on the likely progression of the regeneration stands we are now creating.

Some of the most valuable of the past research work has centred on the karri floral cycle, and on provenance collection and the establishment of seed production areas. The determination of the karri floral cycle has been particularly important in the programming of seed collection and cutting cycles, although its influence in this last facet is declining. The initial provenance research, began in 1972, has yielded three potential seed production areas of known heritage, and is a vital part of the future programme.

In summary the past research has been aimed at determining the basic techniques of karri forest management, with particular attention to problems of an applied nature, and in this context a basis for proper management decisions has been made possible.

CURRENT RESEARCH

There are several initiatives being actively pursued at present, again with the overbearing objective being to increase the efficiency and success of the karri regeneration programme.

One that has occupied a great deal of time in the last couple of years is the question of artificial seeding of clay pelleted seed. This technique is very much quicker than planting in the field, and although it has been very successful, the major inhibiting factor at present has been the use of seed, and the collection cost of that seed. In late autumn this year some trials testing both lower seed broadcasting rates, and the technique of spot sowing into favourable sites were established, and if successful these should perfect the technique to the stage where it may become operational.

A natural precursor to any artificial regeneration is the availability of a high quality seed resource, and to date this has been achieved by seed collection from cutting areas in mature forest. However, this is very expensive, and as the demand for artificial regeneration grows, seed collection in these stands will possibly be unable to sustain the demand with the present conditions of labour availability. In an attempt to improve this situation a new project, involving the previously established progeny test areas has been initiated with the aim of providing juvenile age seed production areas of high quality parent trees. In addition to this several closely spaced planting areas have been set aside this year for possible future conversion to seed production areas.

In association with these seed production areas, provenance trials will be initiated to determine which provenances actually display superior growth in different regions so that progeny from these families may be included in future seed production areas.

Many other projects have been initiated in the last few months, and one of the more important of these is an investigation of the role of prescribed burning in the karri floral cycle. This could be of some importance in the planning of any future seed collection or regeneration requirements that may be made on an area. Another project which may grow in importance as the stands created from the current regeneration programme reach the age of first thinning, is a large fertilizer trial to determine firstly the fertilizer response curve for these stands, and secondly the most efficient improvement that may be possible in stand growth after fertilizing.

In the main, the other projects being undertaken by this section revolve around small trials aimed at increasing operational efficiency in the short term, and these largely result from direct requests for information from field staff (an example of this is a current trial examing karri fertilizing regimes at planting).

SUMMARY

This brief resume of the karri silvicultural research merely highlights that our main objective, as before, is increasing the efficiency of karri regeneration programmes, because in essence this would appear to be the yardstick (or metrestick) by which the Department's operations in the southern forests can be measured. A great deal of success has been achieved to date by research staff in this field, and at present the opportunities for increasing our knowledge of karri forest management seem to be increasing day by day.

THE EFFECT OF CLAY ROOT DIPPING, ON OPEN ROOTED KARRI NURSERY STOCK

by D.A. Haswell

INTRODUCTION

The practise of clay dipping seedling roots for out planting, has been adopted with varying degrees of success for both coniferous and hardwood nursery stock. The objective of this treatment is to reduce root dessication, caused by exposure during the lifting, transporting and planting phases.

Root dessication is a critical factor affecting survival, when planting open rooted karri nursery stock. A trial was therefore established during the winter of 1976, to test the effect clay root dipping had both on survival rate, and subsequent growth rates of karri seedlings.

AIM: To determine the effect of clay root dipping on the survival rate, and height growth, for open rooted karri nursery seedlings.

METHOD: Three plots were established, representing the following days between lifting/clay dipping, and planting viz.

Plot 1 : planted 2 days after lifting

Plot 2 : planted 4 days after lifting

Plot 3 : planted 7 days after lifting

Each plot comprised a control planting which was established 24 hours after lifting, and plantings where roots were treated with either kaolin or bentonite clay slurries.

The two clay dipped treatments were planted in blocks of between 4-5 lines, and were installed alternately down the long axis of each plot. Controls were established between each pair of treatments.

RESULTS: Survival Analysis (sample measured : 100%)

The results tabulated indicate an analysis of plot, treatment and overall survival.

Survival Analysis (sample measured: 100%)

	PLOT 1-2 DAYS			PLOT 2-4 DAYS			PLOT 3-7 DAYS		
Treatment	Planted	Alive	%	Planted	Alive	%	Planted	Alive	%
Kaolin	546	443	81	524	402	77	572	397	69
Bentonite	561	439	78	528	402	76	617	363	59
Control	106	85	80	104	92	88	100	80	80

Height Growth Analysis (sample measured 20%)

	PLOT 1-2 DAYS			PLOT 2-4 DAYS			PLOT 3-7 DAYS		
Row No.	Treat-ment	Live Plants	Aver. Ht. (cm)	Treat-ment	Live Plants	Aver. Ht. (cm)	Treat-ment	Live Plants	Aver. Ht. (cm)
9	K	27	50	B	10	55	K	20	71
10	C	25	50	C	24	50	C	23	72
18	K	26	60	B	20	50	K	5	50
27	K	23	65	B	19	72	K	25	60
36	K	25	53	B	26	67	K	30	84
45	K	21	86	B	25	75	K	25	96

Summary by Treatment - Height Assessment

Treatment	No. Plants	Average Height (cms)
Kaolin	227	69
Bentonite	100	65
Control	72	57

It was not intended to compare height growth between plots, because once survival had been achieved, the clay dipping treatment would have an identical effect on height growth, irrespective of lifting and planting interval.

CONCLUSION

It can be observed from the results, that clay dipping does not confer a significant advantage, in terms of decreased mortality of transplanted seedlings. Plots 2 and 3, which were established 4 and 7 days respectively, after dipping show a significant decrease in survival, when compared to the control planting. Plot 1, which was established 2 days after dipping, appears to closely approximate the survival rate of the controls.

Height growth following root dipping is significantly elevated, when compared to controls. For this experiment, Kaolin and Bentonite treated roots, improved the height growth response by 21% and 14% respectively. Clay dipping however would not be considered a treatment for open rooted karri seedlings to improve height growth, as a greater response can be more readily achieved and controlled using P_2O_5 - N fertilizer, at the time of out planting.

It is therefore concluded that clay root dipping of karri seedlings does not improve field survival, and only confers a marginal advantage in terms of height growth. It is recommended that root treatments of this kind be discontinued on an operational basis.

MARRI FLORISTICS

A.R. Annels

We have all heard the saying "The marri is blooming early, it will be a heavy winter". How many have enquired what is early for marri bloom? To try to obtain the answer and also the frequency of blooming and the time taken from floral bud initiation to capsule maturity, a range of marri trees were studied in the Manjimup-Pemberton Divisions. Twenty-four trees of various sizes were selected in February 1976 when flowering was commencing.

Observations made in 1969 and 1970, showed a flowering time of February-March with the 1970 flowering being the result of buds initiated during the leaf flush, i.e. December-January of that season. The trees studied in 1976 bloomed through February and had finished flowering by the fourth week in March. In mid January 1977 many of the trees were again showing floral buds and by mid-February flowering was again commencing. At this stage, when flowering commenced, most of the previous year's capsule crop was mature enough to contain viable seed. Trees which have not initiated floral buds in 1977 either have a very heavy crop of capsules from 1976 flowering or two crops of capsules from the 1976 flowering and some previous flowering.

From 1936 to 1940 records were kept of the flowering of different tree species suitable for honey production, copies of blossoming times for the Manjimup district show that marri bloomed at the following times during this period.

September 1936 to May 1937
May 1938 to November 1938
February 1939 to May 1939
February 1940 to June 1940

With the exception of the 1938 flowering this shows a general pattern of summer flowering. It is not known whether old records of flowering were general flowering, or whether single odd trees were sufficient to comment upon.

From indications at this stage, it appears that marri in the Southern areas, i.e. Manjimup-Pemberton districts, initiates floral buds in December-January, flowers in February-March and mature seed is available in the capsules 12-15 months later. Flowering periodicity appears to be possibly controlled by vigour of the tree which in the forest situation is largely dependent on the quantity of capsules in the crown. Trees with a light capsule crop appear capable of blooming at a 12 monthly period but those with heavy crops or a combination of two lighter crops do not appear to have either a vigorous leaf flush or floral bud initiation. This may explain why, in certain years, a large percentage of the marri blooms, and in other years there are comparatively small numbers blooming. Open-grown trees seem to flower much more frequently and this is possibly because they are not under so much stress for either nutrient or water and can sustain both capsule development and growth simultaneously.

HIGHWAY POLLUTION

For anyone who has purchased a new motor vehicle over the last 2 or 3 years, the modifications that are now provided to meet standards of exhaust emission will be all too familiar. Effective they may be, but they also seem to prevent the motor from running smoothly and effectively increase the fuel consumption rate.

In a State with such low intensity of population it can also be argued that exhaust emission prevention is probably quite unnecessary, but that better fuel consumption is vital to allow access to the massive area we have.

In contrast to exhaust emission it is of interest to note an extract from "Mobile Source Air Pollution - Who Won the War?" by S. William Gouse Jr., published in the November 1972 issue (Vol. 4 No. 1) of the International Journal of Environmental Studies.

> "The first serious attempts to deal with mobile source air pollution in the United States occurred around the turn of the century. The problem was the horse. The average horse produces approximately 22 lb of solid waste and 1 gallon of urine a day. Writers in popular and scientific periodicals were demanding 'the banishment of horses from American cities.'
>
> One authority wrote in 1908 that the 120 000 horses in New York City 'were an economic burden and an affront to cleanliness and a terrible tax on human life'. The solution to the problem of the horse, agreed the critics of that time, was the adoption of the 'horseless carriage'.
>
> In a city like Milwaukee in 1907, for instance, with a human population of 350 000 and a horse population of 12 500, the horse meant 133 tons of manure a day. Or, as a health official in Rochester calculated in 1900, '15 000 horses in that city produced enough manure in a year to make a pile covering an acre of ground, 175 feet high and breeding 16 billion flies'.
>
> In addition, there was a serious abandoned dead horse problem not unlike abandoned auto problems. Owners of horses tended to leave the dead animals where they fell. They were even more difficult to trace than today's registered abandoned automobiles".

A selection of locally written poems by anonymous poets,
Dwellingup Research Station

ALFOIL

They clear the land and spread their spoils,
But the trees they plant can't stand their soils,
They start their growth at a mighty rate,
But the ground's too hard to penetrate.
Soon there'll be a barren sight,
Unless we win the rehab. fight.

JARRAH DIEBACK

It's a sad and sorry sight,
Of jarrah and its plight,
Against the deadly dieback disease,
That's killing our forest with apparent ease.

Of the cure we know not what,
But fire and ants may count a lot,
Prickly moses and water bush,
May do their bit to halt the push.

THE FUNCTION OF A MANAGER

As nearly everyone knows, a Manager has practically nothing to
do except to decide what is to be done;
to tell somebody to do it;
to listen to reasons why it should not be done;
why it should be done by someone else;
or why it should be done in a different way;
to follow up to see if the thing has been done;
to discover that it has not;
to enquire why;
to listen to excuses from the person who should have done it;
to follow up again to see if the thing has been done;
only to discover that it has been done incorrectly;
to point out how it should have been done;
to conclude that as long as it has been done, it may as well be
left where it is;
to wonder if it is not time to get rid of a person who cannot do
a thing right;
to reflect that he probably has a wife and a large family, and
that certainly any successor would be just as bad, and maybe worse;
to consider how much simpler and better the thing would have been
done if one had done it oneself in the first place;
to reflect sadly that one could have done it right in 20 minutes,
and, as things turn out, one has had to spend two days to find out
why it has taken three weeks for somebody else to do it wrong.

CRICKET AS EXPLAINED TO A FOREIGN VISITOR

You have two sides, one out in the field and one in. Each man that's in the side that's in goes out and when he's out he comes in and the next man goes in until he's out.

When they are all out, the side that's out comes in and the side that's been in goes out and tries to get those coming in, out. Sometimes you get men still in and not out.

When both sides have been in and out, including the not-outs, that's the end of the game.

Howzat!!

DROUGHT

Drought and dust everywhere,
Water users just beware.

Dams are getting mighty low,
As nature deals her crippling blow.

Pines and eucs are dying out,
Choked by such a stunning drought.

Little fish are caught upstream,
Unable to fulfil their dream.

Farmers crops are dying fast,
City garden's may not last.

Some say harness the mighty Ord,
A price others say we can't afford.

What we need is rain, more rain,
To fall to earth to ease the pain.

But summer days not far away,
It won't rain now until next May.

COLLIE DIVISION

A. Walker

A fitness Test compiled by the U.S. Forest Service was recently given to all staff and employees on a voluntary basis. Results of 34 men tested were:

Excellent - Good	18
Fair	14
Poor	2

As a follow up to the tests a trial programme of training has been implemented on a voluntary basis. The programme consists of 5 minutes jogging (about 1000 metres) followed by 5 minutes of simple exercises on Tuesday and Thursday mornings commencing at 8 a.m. The response has been very rewarding to date.

A safety Presentation was held on 22nd August to mark the achievement of 12 months Accident Free. Mrs Craig and Mr Beggs attended with Sandy Lewis, M.L.C. Inscribed Parker Pens were presented to all Staff and Employees and the guests joined us for morning tea before departing for Perth. Collie still holds the record for Man Hours (401,000) and our ultimate target is to exceed that figure and go on to 500,000.

Since logging for Wesply Dardanup commenced in January 1977, approximately 20,000 m^3 of particle board logs have been removed from Bussells Plantation (to September 1st, 1977). Approximately 150 ha in P.62, P.63 and P.64 have been thinned. No problems with access or siltation into Wellington Dam have been observed in the mild winter experienced. Twelve fallers, 1 Kockum forwarder and 1 Mack road train semi, supply 120 m^3 per day to the plant.

About 9 ha of mixed species were planted this year on the former Stene Property 30 km east of Collie (recently purchased by P.W.D.). The aim of the strip plantings is to lower the water table close to the streams in order to prevent the flow of salt laden ground water into the stream system. If the trials are successful it could herald the encouragement of further strip plantings on cleared land in Wellington catchment.

STAFF NEWS

Alan Walker transferred to Manjimup. Drew Haswell to Collie.

Jack Kenbeek transferred to Pemberton. Mick Zwart to Collie.

Merrilyn Kearney selected in W.A. Country Hockey Touring Team to tour Malaysia.

THE LITTLE SPARK

Psst!! over here
Yeah, that's right
Guess what I am
I'm a little spark
The picnickers just had a barbecue
Yes, that's right. A barbecue.
Anyway, getting back
I am very hungry
So I am going to eat dead leaves
Yum! That was dee-licious
Now I'm getting hungrier
I have decided to eat bigger and better things
Eating everything that's in my path
Oh!! Oh!! sounds like trouble
Fire engines are coming
Oh no!! I'd better hurry
And get out of this place
Brrr!! That's cold
The firemen have caught me
I am slowly going out
I am going fast
Going, going, going.

Michelle Dawson
HIGH WYCOMBE. W.A.

(submitted at the suggestion of Mrs Dawson, August, 1977).

BUSSELTON NOTES

Busselton Division is used to receiving a fresh sea breeze each day, but over the past twelve months it has experienced a wind of change in regard to staff. First to get blown away was Frank Townsend who now resides in Bunbury. He was replaced by Dave Bottrill from Nannup. Following this Frank McKinnell also left for Bunbury and John Skillen was moved to Dwellingup; John was replaced by Charlie Kelers who finds the move has improved both his luck at fishing and at golf. Peter Stirling's move from Research to Division entailed a thirty metre walk, so he was not greatly inconvenienced. New arrivals into Research were John McGrath (Agronomist) and Ian Richmond ex A.N.U., Canberra.

The Division achieved its target of two years accident free working and recently received a presentation of awards from the Minister for Forests, Mrs June Craig and the Conservator.

Due to this Division's heavy involvement in the Sunkland Project, a record estimate in excess of one million dollars was submitted this year, 25% of this for outside contracts alone.

Jock Gilchrist is travelling overseas on his Long Service Leave. He is at present in Scotland, sampling the Highland waters and no doubt recording dirty jokes to be told on his return. Jock was kind enough to send suggestive post-cards from South Africa and Scotland to make sure that he wasn't forgotten.

The forest is a peculiar organism of unlimited kindness and benevolence, that makes no demands for its sustenance and extends generously the products of its life activity: it affords protection to all beings, offering shade even to the axeman who destroys it.

Gautama Buddha

WANNEROO PINE COUNT - PINJAR P76

L. MATHEWS

The count was conducted in mid November 1976 to achieve the following objectives:

1. To sample each days planting to correlate with weather.

2. To examine the difference, if any, in results between different planters.

3. To compare 2 year old stock with 1 year old stock.

To do this a single row of pines was sampled for approximately 200 m then by switching to the next row to sample a different planter. After four individual rows had been sampled (i.e. 800 m approximately) the counter crossed back into the first row and continued the same pattern until the end of the rows.

This gave several sample lines for each of the 4 planters and a good average for the days planting. Each sample run was approximately 3 km long and represented 1 days planting.

HIGHLIGHTS OF MORTALITY COUNT RESULTS

The overall percentage of deaths was 15.2% an increase of more than 10% on previous years.

Virtually without exception 80% of the deaths were due to shallow planting i.e. not deeper than 5 cm above nursery level. This combined with long dry spells during the planting operation was the major reason for the failure.

1. Daily results compared to weather. Also see graph.

The highest percentage of deaths for any day was 33.1% on the 8th July.

This would undoubtedly be due to the long dry spell following that date.

In comparison the lowest percentage of deaths for any day was 1.62%. This occurred on the 20th July, the first planting day after the above period. Good rain fell on this day, and crews were fresh after a 3 day break off the planting. It is possible that of the 4 planters sampled the majority were more experienced.

2. Comparison of Different Planters

For this comparison the best individual average was compared to the worst individual for each day. It was assumed that the best individual was the more experienced planter. Four individuals were sampled for each days planting.

Over the whole planting period the average death for the best planters was 7.3%.

The average death for the worst planter was 22.5%. i.e. The inexperienced planters have a mortality rate of 15% more than the best individuals.

This affects the overall average deaths. For example on 22nd July the daily average was 13.81% deaths. If the area sampled for the worst planters was ignored the daily average would be 8.3%.

Theoretically if that single inexperienced planter was replaced with an experienced planter the total mortality rate would drop 5% for that day. Of the 8 planters on that day only 3 or 4 could be considered as experienced.

3. Comparison of 1 and 2 year old stock.

The first trial of 2 year old pinaster stock were poorer quality plants than is expected to be supplied in future.

There was very little difference in height growth in the trial, however, it appears as though 2 year old stock have a better survival rate.

RESULTS: 1 year old
First planter average 9.7% deaths for day.
Second planter average 3.52% deaths for day.

2 year old
First planter average 0.32% deaths for day.
Second planter average 1.27% deaths for day.

The above samples are directly along side each other, there is some suspicion that the planters on 1 year old were not as experienced as the 2 year old planters and this will have some bearing on the results.

The second trial area of 2 year old stock appears much more healthy than the first and more noticeable in the field compared to 1 year olds. This is no doubt due to a better quality of stock.

Mortality rates in the second trial area averaged 5.45% and ranged from 1.8% to 7.4% between different planters.

Two year olds may have a better survival rate and there is no evidence to suggest that they are any worse off than 1 year olds. In this case there should be little reason why unused 1 year old stock cannot be held over for the next planting season. This is possible using various techniques to limit the size growth in the nursery.

SUMMARY MORTALITY

From the results of the pine count, it appears that there are several contributing factors which have caused the 1976 planting mortality rate to be high.

These are:

1. Shallow planting.

In general 80% of the failed plants have been planted too shallow. However, quite a number of plants obviously planted shallow have survived and are very sturdy. This supports the statement made at the planting post mortem that in previous years we have got away with planting shallower than recommended because of good planting conditions, this leads on to the next reason for failure.

2. Dry Planting Season

During a period of 18 days (in which only 5 mm of rain was recorded in the field) a reliable estimate of 71,000 plants failed - 9 of the 18 days were planting days. The mortality rate during this period was approximately 20% and would definitely have been higher if it were not for infill hand planting done in the worst areas.

3. Inexperienced Planters

This season there were numerous different planters operating the planting machines. Planting crews were not as stable as previous years. Results show that the worst planters have an average mortality rate 15% above that of the experienced planters.

Recommendations for future planting operations.

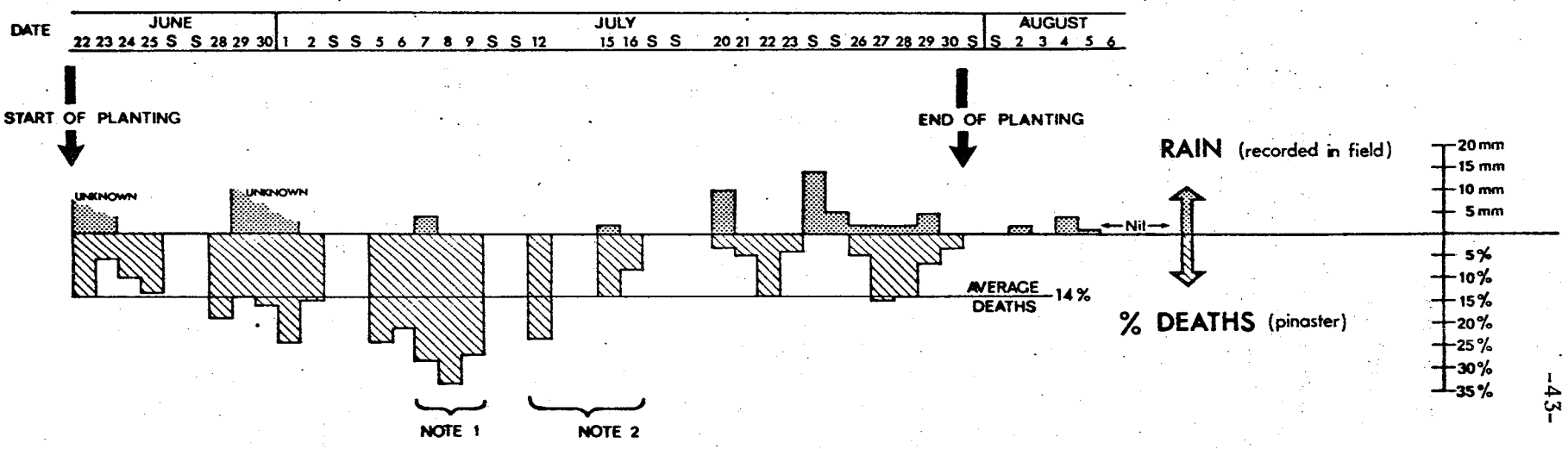
1. Much closer supervision in the field to assure planting depth is at least 5 cm above nursery level. This aspect of planting to be continually hammered throughout the season.

2. Planting operations to cease on the third or fourth consecutive day without rain. A closer look at long range forecasts will help determine when to cease.

3. Some form of training prior to planting operations should be attempted to accustom inexperienced planters to the operation. Once crews have been selected they should remain stable throughout the season. In any event when new employees are "given a go" at planting it should only be done so in the best possible conditions. i.e. During a very wet period. Closer field supervision should be carried out when this does occur.

With the above findings in mind it is expected that with the help of reasonable planting weather, mortality rates should drop below those of previous years. It is hoped that this will be the case for 1977 planting.

RAIN AND % DEATHS COMPARISON



NOTE 1. Mortality could have been higher if not for infill hand planting carried out on these days.

NOTE 2. Mortality rate dropped despite lack of rain, possibly due to -

(1) good follow up rains on 20 and 24 July, 1976
(2) crews were fresh after a 2 day break ,
(3) two best planters returned to planting pinaster from 9 July
(4) plants on machines continually saturated at baseline stops.

RATES PER HECTARE

by P.D. Staley.

Application of weedicides, trace elements, soil fumigants etc. in solution where these are applied from boom sprays or other similar apparatus necessitates calculating a speed of travel to apply the right volume of solution per hectare.

The following is submitted as a quick and accurate method of calculating such speeds and examples are typical applications.

Tractors are usually used to carry or tow spraying equipment and tractor speed required for proper rates of application are dependent upon -

1. Rate of discharge of solution from tank.

2. Width of swathe covered by boom spray.

3. Required rate of application per hectare.

The actual rate of discharge is usually measured by recording the time taken to discharge a known volume from a tank at the constant required pressure.

The following calculation will provide the exact speed in metres/hour for a known -

A Rate of discharge

B Width of swathe

C Required rate of application (litres/ha)

$$\frac{\text{Litres discharged from test tank} \times 10{,}000 \times 60}{\text{Required rate of application (litres/ha)} \times \text{swathe width (metres)} \times \text{Time to discharge test tank (minutes)}}$$

Example $\quad \frac{455 \times 10{,}000 \times 60}{790 \times 5.69 \times 17}$

$= 3572.5$ metres/hour

Where tachometers are still graduated in Miles per hour the following converts metres/hour to miles/hour :

$$\frac{\text{Speed in metres/hr} \times 0.62}{1{,}000}$$

Example $\frac{3572.5 \text{ m/hr} \times .62}{1{,}000}$

= 2.21 miles/hr.

To go one step further, for mixing weedicides and trace elements and applying at required rates/ha (either liquids or solids in solution) the following will calculate the quantities of weedicide or trace elements etc., to be mixed with each tank of water.

$$\frac{\text{Required rate of application/ha (Weedicide, trace element etc.)} \times \text{Volume of tank (litres)}}{\text{Required rate of application of solution per ha (litres)}}$$

Example $\frac{15 \text{ kg} \times 455 \text{ litres}}{1125 \text{ litres}}$

= 6.06 kg per 455 litre tank.

FIELD MEASUREMENT OF TEMPERATURE/DEPTH RELATIONSHIP DURING A FIRE

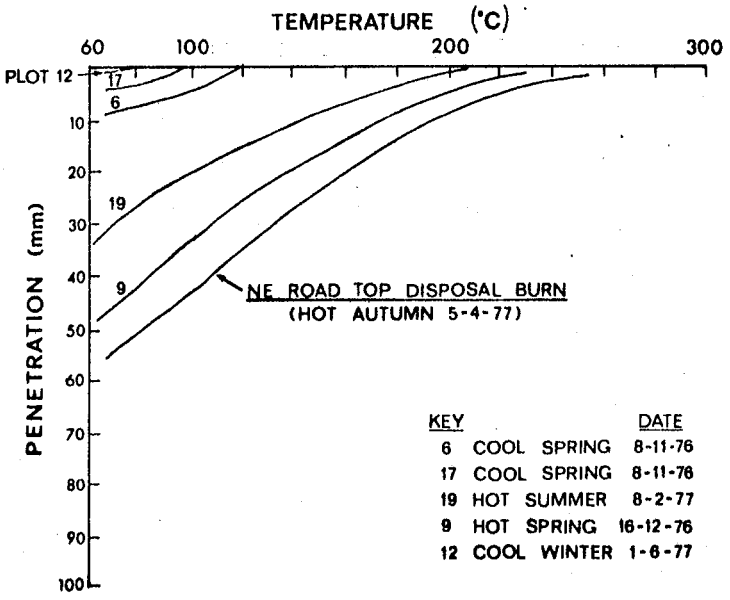
P. Jenkins, Dwellingup

It is know that relatively hot fires are required to prepare native legume seeds for germination. The bulk of these seeds have been shown to be buried between 3 and 6 cm in the soil. Hence, the fires must be capable of producing temperatures approaching 100°C at this depth range.

Asbestos tags have been used at Dwellingup to provide a temperature - depth relationship under field conditions.

The tags, measuring 10 cm x 25 cm were buried vertically, with their 25 cm top edge level with the soil surface. Each tag had eight temperature sensitive chalks drawn vertically upon them, ranging from 66°C to 343°C. One hundred and fifty tags were buried at each of a series of burns between November 1976 and June 1977. The burns were varying intensities in typical Jarrah forest.

Penetration on the tags was estimated by measuring the length of the chalk line that burnt off. The mean of the penetration, at each chalk temperature was then calculated, and subsequently graphed.



CONCLUSION

It can be seen from these field results that the Department's current cool spring burns do not penetrate the soil sufficiently to create dense legume stands. Hot autumn and summer burns have been shown to heat the soil to sufficient depth.

Current research suggests that dense legume stands may inhibit the activity of the dieback fungus, Phytophthora cinnamomi.

In order to bring about areas of dense legume such as Acacia pulchella (prickly moses) it may be desirable to change the current burning policy away from cool spring hours.

SOMEBODY SAID THAT IT COULDN'T BE DONE

Somebody said that it couldn't be done -
But he, with a grin, replied
He'd never be one to say it couldn't be done -
Leastways, not 'til he'd tried.
So he buckled right in, with a trace of a grin;
By golly, he went right to it.
He Tackled The Thing That Couldn't Be Done!
And he couldn't do it.

ANONYMOUS

RESEARCH NOTES - DWELLINGUP

Hydrology

Six large weirs have been completed this year in the Little Dandalup and North Dandalup catchments. A tremendous team effort which utilized gangs from Dwellingup and Jarrahdale showed once again the all-round adaptability and skill of Forestry personnel. Approximately 1,000 bags of cement, 100 tonnes of yellow sand, 150 tonnes of blue metal and 10 tonnes of steel reinforcing mesh were used. Concrete was mixed by portable mixers and poured in stages as form work sections were erected. The P.W.D. Engineer closely supervised the first weir and the other 5 were built by departmental gangs under research supervision. Each weir is fitted with stainless steel plates to ensure permanency and accuracy. Continuous recorders and pluviographs are syncronized to record rainfall events. Early indications suggest that the weirs are performing satisfactorily. The catchments include two with no dieback infection, two with serious gully infection but healthy well-stocked ridge top forest and two seriously affected by dieback. The latter appear to be producing significantly higher amounts of water. The catchments will be monitored for 4 to 5 years. At this time, treatments will be carried out to determine the hydrological function of each type of catchment vegetation.

Many water samples are still being collected from Harvey, Yarragil and South Dandalup catchments for sediment and salinity tests. Most sub-catchments are weired to enable annual water yield to be assessed.

Dieback

Vast amounts of trials are being carried out to evaluate the effect of forest legume understorey on *Phytophthora cinnamomi*.

Dwellingup Divisional fire crews and staff have been very busy in the past fire season effecting a range of trial burns of varying intensity. These have been closely monitored by Research Staff. Autumn burns have been most effective in achieving our aims of killing the weed species *Banksia grandis* and promoting growth of legume understorey.

Considerable work has been carried out to fence sections of these burns because of the intense browsing by herbivorous animals. The burn areas appear to be too small and the kangaroo are very effective in cropping the nitrogen-rich native acacias.

A trial has been initiated in Park Block in an attempt to reclaim dieback diseased areas using direct seeded native acacias boosted with superphosphate. Once again, there has been trouble with browsing animals forcing their way into fenced areas.

A reinforced concrete "dieback dip" for vehicles on roads has been successfully built and tested by Dwellingup Research. The dip, approximately 10 metres long, 3.5 metres wide and 0.30 metres deep, has been constructed on the access road to a dieback-free catchment which must be visited regularly for salinity and sediment samples. Similar dips could be built for $1,000. Water samples are being sent to Como to check copper sulphate levels to ensure they will be effective on Phytophthora cinnamomi but safe to the environment.

Rehabilitation on Mine Sites

Direct seeding of mixed acacias and Eucalypts pioneered by John McCormick looks even more promising. His method of random spot fertilization after one year with a balanced fertilizer is producing interesting results. Assessments will be carried out in September to determine the progress of species in different pits and whether some tend to dominate the site. These results will give a useful guide to which species are most successful and what seed sowing rates are necessary.

Root penetration, run-off trials and transpiration studies are continuing to yield valuable information as a guide to future planning.

Fauna

Amphion 6, the unburnt forest pole stand which has been in that condition for in excess of 40 years, continues to yield above-average catches of Mardos according to fauna research officer Mike Mason. He reports trap rates of 20% on recent trapping in conjunction with studies with the Forest Cadets.

Water samplers on the South Dandalup tributaries sample run report increased numbers of feral pigs in the Quarantine area.

Silviculture

Low level colour photography of the Pindalup Ecology area will be a useful tool and guide to forest management and stand manipulation. Film taken by the Manjimup flight crew under the direction of Bob Chandler will enable close observations to be made on the effect of carying burn intensity on stand composition.

Long-term thinning trials will be assessed shortly to yield data on the potential growth on various Jarrah forest stands. Such information will be a useful guide to how much wood could be put on if forests were thinned heavily to produce water and high value log timber for slicing.

Alex Malajczuk has visited Dwellingup recently to help Dwellingup Research evaluate the performance of full sib pinaster plots in dieback gravels. Early indications are that growth and form compares very favourably with the best he has seen. Growth rates will be assessed shortly. It is possible that good quality widely-spaced Pinus pinaster, once past the fire-sensitive stage, could compare very favourably with open stands of marri on lower slopes in areas used for water production where the trees afford catchment protection and aesthetic appeal.

A visit to Glyde Turton's (CSIRO) pine fertilizer experiments at Gleneagle showed how poor sites could be made productive with fertilizer. It is possible that lower rates of fertilizer may have the same effect if necessary trace elements are added. It is hoped that all or part of these trials will be continued after Glyde's retirement to enable his work to realize its full potential.

Fire Ecology

The Pindalup fire ecology trial has been established in the past two years. Assessment of vegetation types were carried out before burning. Different intensity spring, summer and autumn burns were put through eleven plots. Control areas have been established. The trial will now be re-assessed to discern relationships between fire intensity and time of burning to plant regeneration and vegetation types.

Other assessments are being done at Young, Curara and Plavins Blocks. This work is hoped to give information on acacia regeneration as well as ecologic changes caused by fire.

Staff Personnel

Dwellingup Research and Division recently shared in a great night of feasting and drinking to celebrate the end of last year's burning and weir building programme. Dr. Shea gave a great speech and showed many slides of staff completing these tasks. The night was capped off with a keg paid for by John Skillen and Syd Shea!

Research members are very sorry that Mr Bill Hayes (the Admiral) who controlled the Divisional store for most of his 27 years has been forced to resign because of ill health. Bill set a fine example to everyone in the way he conducted himself in his official capacity and when he was off the job. We wish Bill and his wife a long and happy retirement.

WATER AND SALT YIELD VARIATIONS IN THE SOUTH DANDALUP AND YARRAGIL CATCHMENTS

E.J. Herbert and S.R. Shea

Water and salt yield measurements in the South Dandalup and Yarragil Catchments are continuing for the third successive year. It is now possible to make some preliminary contrasts between the data obtained for the years 1975 and 1976.

The rainfall recorded at Dwellingup for 1975 was 1036.8 mm, and 1064.3 mm in 1976. Rainfall recorded by the Metropolitan Water Board at the South Dandalup Dam wall for 1975 and 1976 was 1372.9 mm, and 963.9 mm respectively). Although the difference in rainfall is small, the factor which controls rainfall caused runoff, that is, rainfall distribution through time, varied significantly between the two years. In 1975, 56% of the total rainfall fell in the winter months of June, July and August whilst only 35% of the total rainfall fell in the corresponding period during 1976. A similar amount (34% of total rainfall) in 1976 fell during the dry summer/autumn period which extends from November through to May, whilst only 9% of total rainfall fell during this period in 1975. It is this difference in rainfall distribution through time which is thought to contribute to the observed variations in streamflow and salt yield.

In both catchments there was a decrease in water and salt yield during 1976. Salt yields, however, were relatively larger than corresponding water yields in most micro-catchments (see attached graph) when expressed as a percentage of 1975 data. Thus, it was observed that when water yields decrease, the weighted average salinity increases due to lack of dilution from direct runoff. To paraphrase, during years of low winter rainfall the proportion of groundwater to total streamflow is increased.

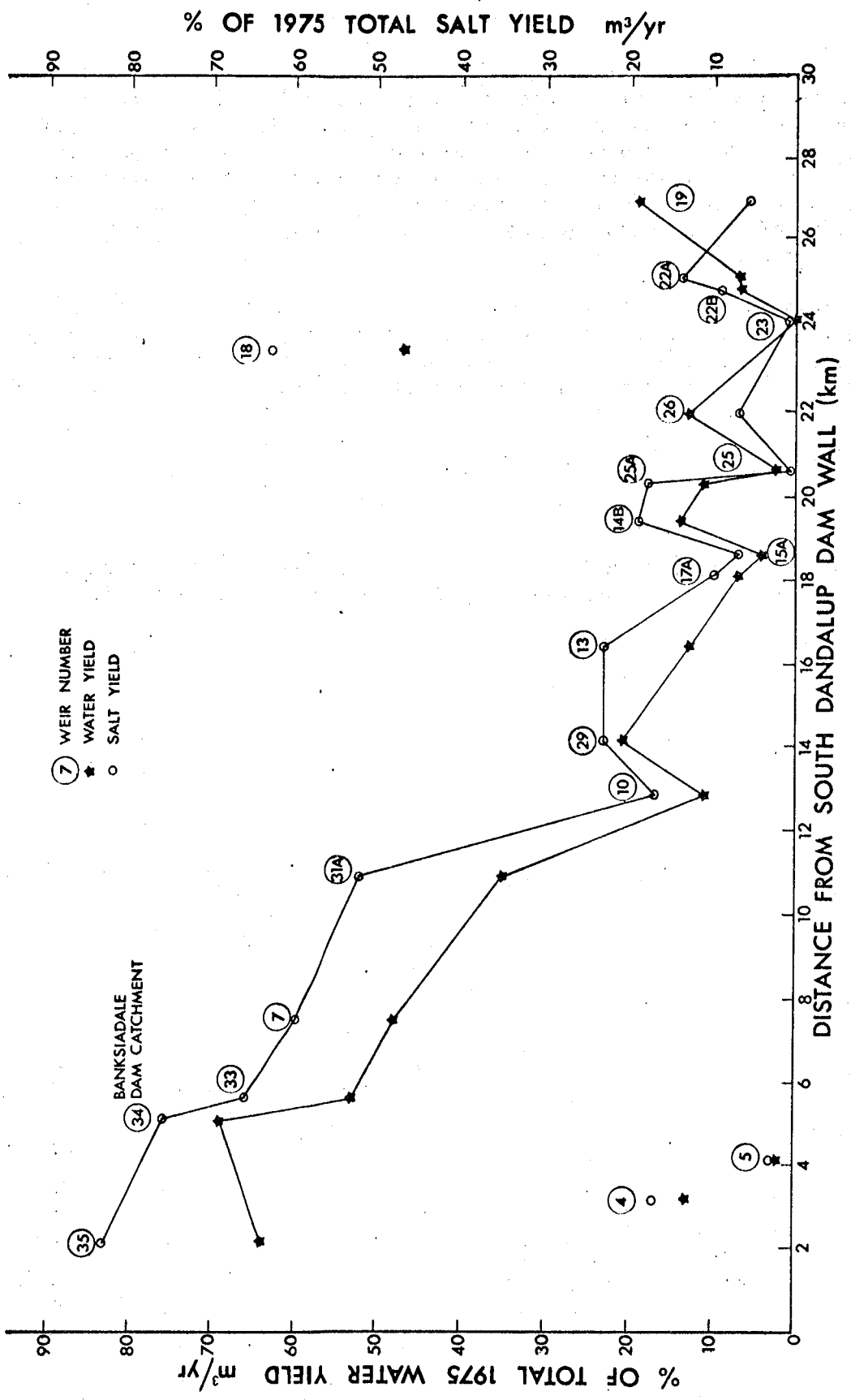
In general, water yields of most micro-catchments were 20% of those obtained in 1975. In the South Dandalup catchment a sharp decline in both water and salt yield occurred at approximately 13 km east of the dam wall. This decline is also associated with a sharp reduction in percentage yield, an increase in weighted average salinity and baseflow salinity (Shea & Herbert, in press). It seems feasible to suggest that at this point in space the rainfall excess threshold has not been reached, that is, there has not been sufficient rainfall to recharge

groundwater aquifers nor to generate large quantities of overland flow. This phenomena is demonstrated in the Yarragil catchment where analysis of long term P.W.D. data obtained from their weir on the Yarragil Brook showed that significant run-off did not occur in those years receiving less than 1000 mm rainfall. Rainfall above this amount caused the run-off/rainfall curve to increase in a sigmoidal pattern (Herbert, unpublished data).

It can be hypothesized that as you proceed eastwards in the northern jarrah forest the above situation becomes the norm, that is, in most years there is little rainfall excess and hence little run-off, which over time has led to the formation of salt profiles in the catchment soils.

REFERENCE

SHEA, S.R. and HERBERT, E.J. (in press). The potential to increase water yield in the northern jarrah forest of Western Australia.


% OF 1975 TOTAL SALT YIELD m³/yr
% OF TOTAL 1975 WATER YIELD m³/yr
DISTANCE FROM SOUTH DANDALUP DAM WALL (km)
WEIR NUMBER
WATER YIELD
SALT YIELD
BANKSIADALE DAM CATCHMENT

NATIVE LEGUME SEED PREDATION, COLLECTION AND DISPERSAL MECHANISMS

by C.E. Portlock

The Australian ant fauna is among the richest and most varied in the world in individuals, species, and ecologic forms (Taylor, 1972). Over 1,500 species of vascular plants in Australia have ant-attracting structures (elaiosomes) on their seeds or fruit. These ant-attracting appendages aid in the dispersal of seeds. Only 300 species known from the rest of the world have these ant-attracting appendages.

Ants can be classified into three groups: non-collectors, elaiosome collectors, and general collectors. Non-collectors show little interest in diaspores. Myrmecia, Componotus, and the species Iridomyrmex purpureus were observed to be non-collectors (Berg, 1972).

Species that regularly collected diaspores without as well as with elaisomes are termed general collectors. The harvester ants are general collectors. They use the endosperm and embryo for food. In a study of the Western Harvester ant, Pogonomyrmex occidentalis, of Colorado, the maximum area cleared was 27.3 m^2/ha in an ungrazed area. This represented 0.3% of the total area (Rogers and Lavigne, 1974). Soil moisture increased because of the elimination of transpiring plants. Soil moisture was also higher within the vicinity of the nest. A few decorator ants, which utilize plant materials for special building purposes such as Chelaner and Pheidole, can also be classified as general collectors.

Typical elaisome collectors are selective in relation to plant diaospores and under optimal conditions will collect solely or predominantly those with aleisomes (Berg, 1972). Genera which were found to be aleisome collectors are Rhyditoponera, Iridomyrmex and Melophorus.

Pheidole, plant families whose seeds are regularly dispersed by ants are: Euphorbiaceae, Leguminosae, Rhomnaceae and Steruliaceae. Important genera are Hibbertia, Goodenia and Acacia. Most Australian elaiosomes are relatively dry and hard and firmly permanent. Most of them maintain their form and size indefinitely relative to the rest of the diaspore. The best developed Australian elaisomes with regard to their effect upon the ants are those of Caesia, Bossiaea, Tetratheca, Hibbertia, Monotoca and Opercularia.

Since our pot trials showing that legumes inhibit the growth of Phytophthora cinnamomi, I have been interested in the availability of

legume seed in the Northern Jarrah Forest. In soil sampling experiments that I and others have carried out, we have found a surprising lack in numbers of legume seed. Germination of clumps of fireweeds after a hot fire seemed to indicate some sort of collecting going on. Further soil sampling experiments indicated that numbers of legume seeds were greatest at 3 to 6 cm in the soil profile. Seeds were also found in samples as deep as 12 cm. Following this up, I made observations on three different species of ants and set up a few rough, preliminary experiments.

Most of my observations were made and experiments done at White Block on a hillside roughly 100 metres from the Wren Road gate into the Quarantine Area. On Monday, December 13, I first noticed seeds being dispersed by the Acacia strigosa study plant at White Block. This bush was estimated to have had 220 seed pods with an average of 5 seeds per pod; making roughly 1,100 seeds on the bush. It was an average sized bush in more of an open area than the other bushes. Three lines of five funnels (15 cm in diameter) were placed every ½ metre from the stem of the study plant.

RESULTS: Strigosa study plant (1,100 seeds estimate).

	R	%	L	Average	
0.5 m	10	9	10	9.6	10
1.0 m	5	4	5	4.6	5
1.5 m	2	2	3	2.3	2
2.0 m	0	2	0	0.6	1
2.5 m	0	0	0	0	0

Roughly

550	seeds	50%	of	the	seeds	fell	between 0. m - 0.58 m
275	"	25%	"	"	"	"	" 0.58 m - 1.08 m
110	"	10%	"	"	"	"	" 1.08 m - 1.58 m
55	"	5%	"	"	"	"	" 1.58 m - 2.08 m
0	"	0%	"	"	"	"	" 2.08 m - 2.58 m

There was also a sheet of cardboard put down at the study plant. The number of seeds dropped at particular distances were noted.

Distance	Seeds
.50 - .60	6
.60 - .70	7
.70 - .80	3
.80 - .90	7
.90 - 1.00	11
1.00 - 1.10	6
1.10 - 1.20	3
1.20 - 1.30	5
1.30 - 1.40	10
1.40 - 1.50	2
1.50 - 1.60	1

From this one study plant there appears to be two peak distances at which seeds are dispersed: 0.9 - 1.00 and 1.30 - 1.40.

On the same day, December 13, 1976 at 1400 hours a Melophorus D28 ants nest was first sighted actively gathering seed. Further observations pinpointed a daily seed collecting activity period from 1300 to 1600 hours. During the morning activity period 0900 - 1100 hours no seed collecting was observed. Seeds were taken into the nest at a conservative average of 1 every three minutes. Using this average, one ants nest in one day can take in roughly 180 seeds. Seeds were seen being taken into the nest on December 13 and December 17. On January 3, 1977, a new nest .45 metres away from the original was actively gathering seed. The old nest was not active and was dug up. The soil was sieved and the seeds recovered.

Melophorus Nest 1

	65 Ba	33 As	0-3 cm
	15 Ba	25 As	3-6 cm
	8 Ba	4 As	6-9 cm
	7 Ba	11 As	9-12cm
TOTAL	95 Ba	73 As	

There were often pairs of nests observed quite close together which seems to indicate one move of nest a year. The Number 2 Melophorus ants nest was observed to have a few insect carcasses, body parts, and in one instance a dead Componotus ant was seen carried into the number 2 nest. Melophorus nests appear out of nowhere when seeds

begin dropping, and disappear three months later. They do not reappear until the next years seeds begin dropping. The distances that Melophorus ants were observed carrying seeds to their nests were 2.7, 2.1, and 2.8 metres away. One Lelophorus nest had 2 Bossiaea seeds outside the nest and the closest Bossiaea seed-bearing plant was 7.3 metres away.

From various ants nests dug up it became apparent that the later in the season that they were sampled for seed, the fewer seeds were recovered from them. In particular, the number of seeds on the surface dropped greatly over time. For example:

		FEBRUARY					MAY			
		0-3	3-6	6.9	9-12		0-3	3-6	6-9	9-12
Rhyditoponera	1	181	79	24	12	5	16	6	6	4
Marradong Road	2	58	25	68	12	6	3	3	7	4
Dieback Rehabilitation	3	33	39	30	1	7	1	3	2	0
Area	4	28	22	21	20	8	2	7	2	2

Roughly -

December 18	Rhyditoponera	No. 1	200 A.p. seeds
		No. 2	450 A.p. seeds
January 6	Rhyditoponera	No. 1	130 A.p. seeds
		No. 2	200 A.p. seeds

Another observation made during the processing of the data was that the deeper you get the greater the percentage of undamaged seeds.

The question of seed predation comes up here. Various species of birds and insects are suspect. From October 8 to January 10, 1976, I monitored the forest floor with pitfall traps. Weekly visits to change the traps at White Block enabled observations of various bird species. The most predominant of these was the Bronzewing Pigeon. It was not observed in the area until December 1976 and thereafter at least one pair every week was observed in the area. Five were spotted on one occasion.

From the 32 pitfall traps, 16 in an open area and 16 in an adjacent mixed legume area it became apparent that there is a greater diversity of individual insect species in legume areas. The fireweeds represented in the legume area in order of dominance were Acacia strigosa, Bossiaea aquifolium, Acacia pulchella and Mirbelia dilatata. There is also an influx of species richness during seeding.

Species Richness

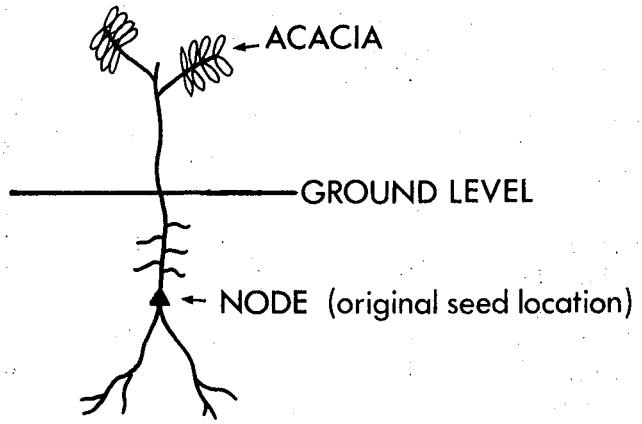
Number of individual insect species trapped per week

	mixed legume	open	totals	seeds in traps
October 8 - October 15	5	4	9	0
October 15 - October 22	6	5	11	0
October 22 - October 28	8	3	11	0
October 28 - November 4	9	3	12	0
November 4 - November 12	7	2	9	0
November 12 - November 19	7	4	11	0
November 19 - November 26	7	6	13	0
November 26 - December 4	10	7	17	0
December 4 - December 13	6	6	12	0
December 13 - December 20	9	6	15	8 Strigosa 5 Bossiaea
December 20 - December 27	6	4	10	7 Bossiaea 5 Strigosa
December 27 - January 3	4	7	11	0
January 3 - January 10	6	5	11	0

ACACIAS AND HEAT

R.M. Buehrig, Dwellingup

It has been found that a node on the root of acacias is the location of the seed capsule from whence the plant originated.



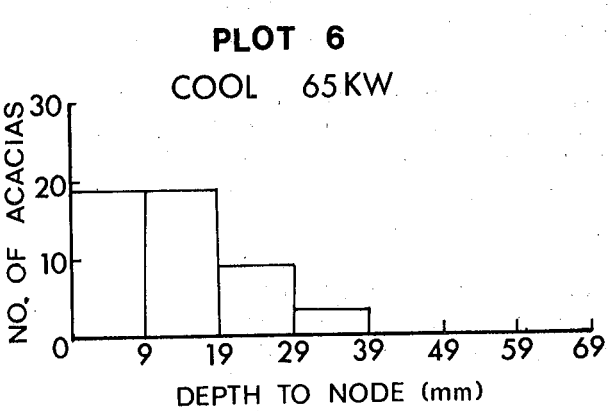
Since acacias require heat to germinate it was believed that measurement from the node to ground level would vary in different fire intensities.

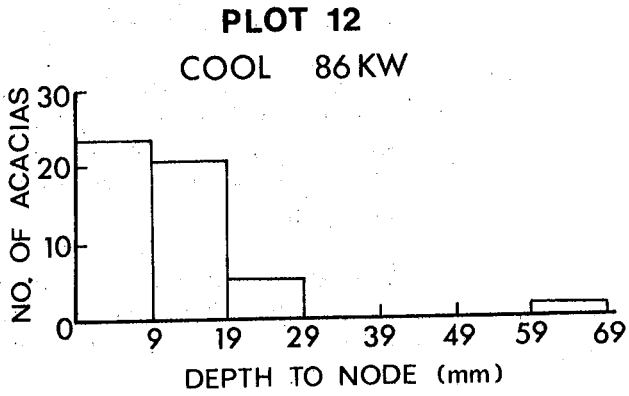
To study this in a field situation two cool (65 Kw, 86 Kw) and two hot (639 Kw, 1207 Kw) burns were sampled. Fifty random samples were measured from each burn plot. The accompanying graphs show the distribution of samples in relation to depth of the root node.

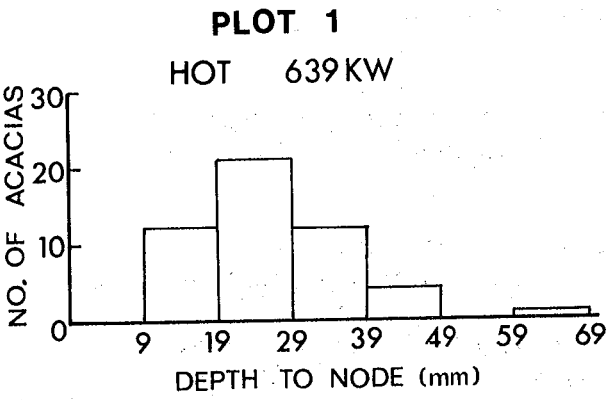
It will be noted that in the cool burns (Plots 6 and 12) the depth of germination is skewed toward the shallow side whereas in the hot burns (Plot 1 and 18) a more normal curve is evident.

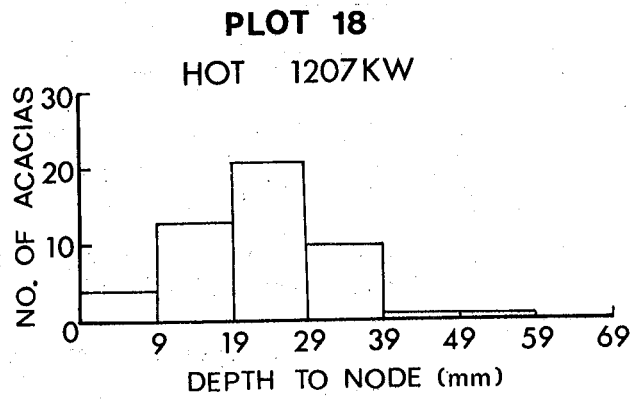
The probable reason for the different curves for depth of germination is the different heat intensities of the fire. Hot burns regenerate acacias from deeper levels. The marked lack of germination from shallow levels (0-9 mm) in the hot burn is undoubtedly due to destruction of seed by heat. The germination from shallow depths, in cool burns, occurred only where acacias were present immediately before burning.

One may speculate that an assessment of fire intensity could be made by studying the distribution of acacia node depth.


PLOT 6
COOL 65 KW
NO. OF ACACIAS
30
20
10
0
9 19 29 39 49 59 69
DEPTH TO NODE (mm)


PLOT 12
COOL 86 KW
NO. OF ACACIAS
30
20
10
0
9 19 29 39 49 59 69
DEPTH TO NODE (mm)


PLOT 1
HOT 639 KW
NO. OF ACACIAS
30
20
10
0
9 19 29 39 49 59 69
DEPTH TO NODE (mm)


PLOT 18
HOT 1207 KW
NO. OF ACACIAS
30
20
10
0
9 19 29 39 49 59 69
DEPTH TO NODE (mm)

DWELLINGUP MURRAY RIVER PLANTATION

W.D.P. Armstrong, Dwellingup

The Dwellingup Murray River Plantation is in area of forest attracting a sharply increasing number of visitors each year.

Most visitors to the area have accepted the presence of the pines (if somewhat grudgingly). An excellent opportunity exists for the Department to demonstrate to the public that there is more to forestry in this area than log production and pine planting.

The area could be improved aesthetically by the replacement of groups of pines and native regrowth with a varied range of evergreen and deciduous trees not normally associated with this area.

These areas could primarily be managed with the objective of providing unusual, interesting and beautiful pockets of forest in this relatively large area of pines.

The variety in tree shape, leaf colour and size through the seasons in contrast to the regularity of their surrounds could be quite dramatic.

As a side benefit some possibly useful information could be obtained on the growth potential of these species in this environment.

Most importantly these plantings should be of mixed species and every effort made to avoid any suggestion of row planting.

Suggested species could include willows, beech, birch, larch, horse chestnut, cyprus, aspen, evergreen oak (holm), elm etc.

ON SAFETY!

(A paraplegic chair, you know,
Needs manual two wheel drive to go).

So always drive with care and skill
and not to maim, or scare, or kill.
By keeping both hands on the wheel,
Both eyes upon the road, you will,
With nerves in gear and brain awake
A gentle foot upon the brake,
Live on my friend, avoid the skids
And get there safe with wife and kids.

hebegebe

A SCENARIO :

THE SPEECH OF D.F.O. CODSWOLLOP ON THE OCCASION OF THE

SAFETY PRESENTATION

THE SCENE: The lawn behind DHQ. Divisional staff and employees are gathered in the foreground. Dignitaries are on a rostrum at the right. An "Award of Merit" flag flutters at a mast.

(DFO Codswollop steps to microphone to make the Speech in reply).

Codswollop: Madam Minister, Mr Conservator, distinguished guests, ladies and gentlemen. It is with mixed feelings that I stand before you today. Firstly, I would like to thank you for the kind words spoken with respect to our achievement last month of the coveted seventeen years without an accident. Having been the DFO here during this entire period, I can only say that this wonderful achievement truly reflects the dedication and hard work put in by all staff and employees to the cause of Safety and I reiterate the Hon. Minister's congratulations and add my personal thanks to all concerned.

However, it is with some concern that I must now report a somewhat disquieting trend, if not a discernible decline, in our divisional safety performance over recent weeks. There are aspects of recent accidents which have surprised many of us and bear mention in passing at such an occasion as this.

Let me cite one or two pertinent examples.

The very day after the record 17 years accident free period was achieved our first mishap occurred when forest workman Smith suffered a serious eye injury when he was putting on his safety spectacles. He somehow contrived to pierce his left eye-ball with the ear-piece of the safety glasses. The very next day, overseer Creed broke his right ankle when overzealously tightening the laces of his safety boots.

Later that very day, our veteran storeman was most severely injured when the Accident Record Board blew over in a strong gust of wind and crushed him against the safety guard rail in front of the office.

Subsequently our mechanic was badly strangled when a retractable seat belt he was fitting to the D6 suddenly retracted with violent force and became entangled with the earmuffs affixed to his safety helmet. To cap it off, Assistant Forester McKay suffered a severe hernia that very day while endeavouring to draw his safety-booted feet through the leg-holes of a pair of fire-proof overalls.

It is likely that these misfortunes could have been attributed to the normal operation of fate in a hazardous job such as forestry, had it not been for the regrettable maiming of our Safety Officer himself only yesterday, who, when making out the Accident Report Forms and SGIO claim documents for McKay's mishap, simultaneously sprained his wrist and was impaled through the nostrils by the sharp end of his Biro which snapped as he was writing up the section on "unsafe conditions".

Can it be, I hear you cry (I'm so sorry, Madame) that there can still be some aspects of Accident Prevention not yet sufficiently covered in our extensive research and work on this subject?

Therefore Madame Minister, and assembled guests and men of the Division, although I am greatly honoured by your presence on this momentous occasion and, I am sure, speak on behalf of you all when I especially thank the Conservator and Mr Hill for the beautifully monogrammed ping-pong ball he has awarded each of us in recognition of our 17 year record, it seems appropriate that I close these remarks with a special note of warning and inspiration. To all of you I say "Safety First", "Beware of Complacency" and always "Look Before you Leap" because .... oops! .....AAAARRGHHHHHhhhh .....

(Codswollop trips over cord of microphone, stumbles on a ping-pong ball and crashes heavily from the rostrum, striking his forehead on the metal lid of a First Aid box, with a sickening crunch.

A greying Functional Leader moves across and lowers Award of Merit Flag to half-mast).

- CURTAIN -

SAFETY

We can build a safety program
  and show that safety pays,
We can organise for safety in a
  hundred different ways,
We can hang out safety posters
  far and wide in every place,
We can quote our regulations
  'till we're purple in the face,
We can hold our safety meetings
  every morning of the week,
And nod in bland agreement while
  the supervisors speak.
While these things contribute
  greatly to the goal we must achieve,
We'll never be completely safe
  until all hands believe:
That accident prevention holds a
  challenge for mankind,
That safety is an attitude,
  a healthy state of mind.
It's something you can't force
  upon a mind antagonistic,
Nor can you win a doubting soul
  by quoting a statistic.
But everyman must use it in the
  hectic daily grind
To guarantee security and give
  him peace of mind.
For safety isn't just a word -
  it's more a way of life;
It helps avoid the grief and woe,
  the care and doubt and strife,
That is the lot of some who scoff
  at accident prevention
And sometimes have to settle for
  a disability pension.
A whole new way of life is yours
  in safety consciousness,
And in its sphere there is no room
  for chance or thoughtfulness.
So join the safety movement,
  lift yourself above the throng.
As you set a good example,
  others then will go along.

- Anon.

Ex "The Chartered Engineer"
Vol.21, No. 10, May 1977, pg. 4.

ENVIRONMENTAL EDUCATION - Opportunity or Chore?

During the last decade, the general public and particularly educationists, have become more and more involved in evaluation and protection of the environment. The change of attitude has resulted from many factors, both sociological and physical.

The trend in Australia has followed that of the western world so closely that many people have become concerned with hazards that are really not important at our level of population or industrialisation.

In Western Australia some of the results have been

- creation of a Department of Conservation and Environment;
- rapid growth of the so-called "Conservation Movement";
- increased public use of non-competitive outdoor recreation facilities;
- re-direction of education towards more outdoor activities.

Interest in the environment is, in itself, not so new. The level of interest is the real measure of modern environmental awareness.

The accepted general term for outdoor educational programmes is Field Study Centre. In a general sense such centres have been used for many years at Primary School level, the best Western Australian example being the Forest Youth Camp at Pemberton, while on a day-visit basis, the Bickley Reservoir Valley has been the happy hunting ground for the Gould league for many years.

The concept of a more formal, field study centre arose from a major change in the geography curriculum for years 11 and 12 in the Secondary School system. In effect, geography has been taken out of the classroom and into the scrub.

The professional forester has always been interested in telling people about forest ecosystems but has rarely got beyond the occasional talk to individual school groups. The new curricula for Geography paved the way for direct liaison with the educationist and the first forest based Field Study Centre became a fact in July, 1976.

SELECTION CRITERIA

While it can be argued that environmental studies are feasible almost anywhere, application to the regimen of an educational system imposes certain constraints. Even though the current political view is that costs of education are out of control, the concept has been based on minimal cost by using existing facilities as much as possible.

Location is important from consideration of method and time of travel, while the proximity of a range of potential study areas is important for the same reasons. Similarly, there must be a pre-existing user group.

The Jarrahdale site was chosen because it fitted these criteria to a high degree: an empty house was available, within one hour's travel from a number of Perth metropolitan senior high schools, and had close access to virgin forest, bauxite mines, a perennial stream and orchards etc.

DEVELOPMENT

The building used to launch the Jarrahdale centre was an old forestry workers cottage with four rooms, electricity, water and little else. It provided space for storage of study materials and short period overnight accommodation during programme development. The programmes were developed in a manner which facilitates minimum time loss for day-visit groups. Work sheets and teacher notes were prepared such that, on arrival at the centre, work sheets are handed to students during a short briefing session and within 20 to 30 minutes the students can be in the field carrying out their projects. The existing programmes at Jarrahdale are:

* jarrah forest association transect
* granite succession
* physical features of a small stream
* field survey of jarrah dieback (Phytophthora cinnamomi) disease
* valley vegetation, soil and aspect study
* urban study of a village 100 years old
* bauxite mining
* rehabilitation of bauxite mine site

IN-SERVICE TRAINING

During the period of programme development, it was realised that in-service training in association with the professions involved would speed up the preparation of student activities. Several weekends in-service groups were used in this way, and the additional benefits that emerged were:

* a core of experienced "users" of the centre evolved
* liaison between teachers and professional advisers reached a high level

* the courses themselves had a publicity value for the centre

As a result of the thorough preparation of student programmes and the core of teachers who were involved in their development, the centre received heavy use immediately after the official opening in July, 1976 by the member for Dale, the Hon. Cyril Rushton.

By November, 1976 almost 1,000 students of year 11 and 12 had used the centre for either Geography or Biology exercises.

FUTURE DEVELOPMENT

The value of the Jarrahdale Field Study Centre has been proven by the level of its use.

It is however, far from adequate for student needs, even if confined to years 11 and 12 and to Biologists and Geographers.

The location is suitable for schools in the south and south-east metropolitan area, but is just too far away for those to the north and north-east of Perth. Similarly, there is great potential value in the addition of outdoor study areas for years 8, 9 and 10, as well as for the areas of social studies, general science, economics etc.

The immediate need is for a centre, similar to Jarrahdale but located conveniently for the north metropolitan senior high schools. The Mundaring and Gnangara centres are being examined to serve this demand and Mundaring Field Study Centre could be in use by mid-1977. The Gnangara area is better suited for biology students but has potential for other activity as well.

In the longer view there is seen to be a need for centres in areas more remote from Perth, not necessarily in forest areas alone.

The remote centres need to be associated with live-in accommodation of some kind and for forest studies a residential field study centre at Hamel (near Waroona) and at a later stage at Pemberton are under examination.

These additional centres are seen to complement work in non-forest study areas such as those in use at Cape Naturaliste and Narrogin. They retain the advantage of low capital needs, but, like the centres at Jarrahdale and Mundaring, can be put to optimal economic use only with the provision of specialised teaching staff - a provision which is sadly lacking to date.

NANNUP NEWS

C. Done

GRAZING IN FUEL REDUCED BUFFER AREAS

Nannup Division has been active in increasing the areas of grazing under pines in fuel reduced buffer areas. Recently a 100 ha block of P71 P. radiata was fenced and the introduction of 30 head of cattle has noticeably reduced the fuel availability in the four weeks that they have been in the area. This section of the plantation has proved popular with Nannup arsonists and it is hoped that the grazing will reduce damage from any future deliberately lit fires.

Two other areas are currently being fenced and tenders are being called for grazing about 180 ha of P74 P. radiata. These areas are expected to be keenly sought by local graziers since they are excellent pasture areas capable of carrying a good stocking of cattle or sheep.

The cost of fencing these areas to date has been high, and to try to reduce this an area will be fenced using electric fencing materials recently purchased.

It is anticipated that by summer 77/78 about 400 ha of plantation within the fuel reduced buffers will be grazed, giving a measure of protection to a much larger area of pines.

CONSTRUCTION OF DIEBACK WASHDOWN FACILITY

A new ramp of all squared log construction has recently been completed adjacent to our Nannup Workshop. The ramp allows drive on - drive off facility for even the largest log trucks used in the area and will make the tedious task of washing down large vehicles much easier.

SUNKLANDS SOIL DEMARCATION

This project has commenced and results to date are disappointing in that area available for planting appears to be consistently less than anticipated in all compartments checked so far. If this trend continues, as appears likely, the Sunklands planting proposals will need to be rethought to allow for the programmed area to be planted on schedule.

PINE PLANTING 1977

About 560 ha was planted to P. radiata in Ellis Creek and Dalgarup A this year.

The weather was kind to the planters with only a few of the cold, miserable wet days they have come to expect. 260 ha was planted by piecework at a cost (wages) of less than half of daywork planting.

Dayworkers planted 137 ha and the remainder was planted by machine (Quickwood and Lowther).

Problems have arisen with stock from neighbouring properties entering newly planted areas and sampling the pines. These problems are still occurring and it requires constant vigilance on the part of Forests Department staff to ensure that damage is kept to a minimum from this source.

CABLE LOGGING IN STEEP AREAS

Nannup's Skyline logging machine has been in "operation" since March this year and although it has had more than its fair share of teething problems the system has great potential and has impressed its many visitors by the speed at which it hauls logs up or down the steep slopes. There is minimal earth disturbance by the logs and damage to remaining stems has been slight, and is confined to those trees which have been used to anchor the tower and various cables.

Operations have to date been confined to first thinning areas and the material produced has been taken to the Dardanup Chip plant. Some balks and sawmill logs are now being harvested and will be supplied to Harvey Mill.

BUNBURY DIVISION

Regional Group is still housed in "No. 96" in Stirling Street. It is hoped that building of the new office in the relatively forested area on North Boyanup Road will commence later in this financial year.

The computer terminal has been installed and is ready for action. By time of going to press, the terminal will have been used daily for input of pine sawmilling data and extraction of some very useful and up to the minute information. Unfortunately the display is only programmed in black and white.

Miss Shelly Barrett transferred from Kalgoorlie office early in the year and put a golden gleam to the smile of our other girl Michelle Sorrell who is now happy that she almost has time to eat. Michelle has just returned from a trip to Malaysia looking 100% fit and has an even further slant to her smile after visiting her penfriend in Penang.

LAND USE PLANNING WITH TOPAZ

A computer model, TOPAZ-WA, has been adapted to assist in evaluating alternative land management strategies for the catchment of the Murray River, Western Australia. TOPAZ (technique for the Optimum Placement of Activities into Zones) is an optimising model based on a linear programming algorithm. It was originally developed by Brotchie and Sharpe to assist the planning of buildings and cities.

Evaluating the management strategies for the river and its 660,000 ha catchment is a complex task. Existing major land uses include forestry, agriculture and bauxite mining. The river and parts of the catchment are extensively used for recreational activities. Several areas have considerable value for the conservation of flora and fauna. The river is currently brackish (1000 mgl^{-1}) as the result of clearing by agriculture and is well above the W.H.O. recommended standards for water supply (500 mgl^{-1}). Despite this, the Murray is seen as a likely future source of water for the Perth Metropolitan Area. Strategies include partial desalination, mixing with fresher water from other sources, multiple dams to impound the fresh, smaller tributaries and a reduction in the river's salinity by replanting trees on parts of the cleared farmland.

Landform, climate and existing land use were used to divide the catchment into 43 "homogeneous" zones to which the model would allocate activities. Activities included bauxite mining, forestry (hardwood or conifer), agriculture (grazing, grain and grazing) agroforestry, (a combination of forestry with agriculture), National Parks, Fauna and Flora Reserves and Water Storage. Data on water yield, salt yield, recreational use, economic value and conservation were estimated for each combination of activity and zone.

The model was run testing several options : the "as is" solution; an unconstrained solution; runs which constrained the river to various salinity levels (500 mgl^{-1}, 750 mgl^{-1}), or conservation to specific sites of bauxite mining to the capacity of the refinery. One dam, two dam and multiple dam solutions were tested. Further, the effects of allocation criteria (B/C, B-C) or discount rates on land use changes were assessed. Sensitivity analyses (water and salt yields, recreational data, economic yields) have been undertaken to identify those land use changes which are "knife edged" decisions.

The final report is in its first draft stage. Several papers have been presented at conference and seminars.

MULTIPLE LAND USE PLANNING IN THE FORESTS OF W.A.

In January 1977, the State Government approved the General Working Plan No. 86 (1977), a plan which sets out the Forests Department's Multiple use objectives and the strategies to be used. Two documents were prepared. Part 1 describes the trends in demand and supply for the various products (timber, water, recreation, minor forest products, minerals, conservation reserves), sets Departmental objectives for each and then states the broad strategies which will be used to achieve the objectives. This is a public document, 400 copes were printed and distributed. Part 2 is a confidential document with restricted distribution and discusses aspects of the timber industry, especially the allocation of areas and volumes to various sawmilling companies.

Following the Working Plan, another document the "Perspective for Multiple Use Planning in the Northern Jarrah Forest" was prepared. The northern jarrah forest is located between the Preston River and Mundaring and has an area of 784,000 ha. The planning document reviews the environmental features, economic and legal constraints and current management and resource use within this region. The forest was then divided into six management zones, based on a combination of geomorphological and climatic features. These two factors are closely interrelated to soils, vegetation, water and salt yields and form suitable planning units. For each of these six zones, the Department's management strategy was outlined. This is a public document, 400 copies were printed.

The "Perspective" is a precursor to more detailed Land Use Management Plans (LUMP's). Each part of the northern forest has now been allocated to a Management Priority : e.g. conservation, recreation, catchment protection, water production, scientific, timber production, mining etc. For each Management Priority Area (M.P.A.) compatible secondary and tertiary land uses have been allocated. These may be pursued, but only as long as there is no conflict with the priority use for the area. For each M.P.A., prescriptions for each of the major activities (e.g. roading, prescribed burning, dieback rehabilitation, mining rehabilitation, silviculture etc.) have been prepared.

The LUMP's are available in first draft form. Extension of these proposals both within and outside the Department has required considerable time and effort. Over 20 organisations and 150 individuals have already had an opportunity for comment. Further comment is expected once the LUMP's are published.