Dwellingup Research Annual Report

1974-75

Annual Report

Research Activities - Dwellingup 1974-75

Introduction

Major emphasis has been placed on three areas during the past year - hydrology, Jarrah Dieback and bauxite mine rehabilitation. Long term silvicultural and fauna research programmes have been maintained but no new projects have been initiated. The initiation of dieback rehabilitation projects has been delayed pending the receipt of a survey of existing trials, and the assessment of the results of hydrological studies which will determine the species required for rehabilitation.

There has been a major increase in demand for extension services from the laboratory. Officer's have delivered lectures to a variety of organisations and on average the laboratory is visited once a week by either schools, scientists from other organisations or the general public. There has been a continued and increasing use of the photographic service provided by the laboratory. Coloured slides have been provided for lectures by Departmental Officer's and photographic prints have been supplied for reports and publications.

A number of research projects which involve co-operation with outside bodies have been initiated. The station is directly involved in 4 of the 7 major bauxite research projects which are supervised by an interdepartmental steering committee. Co-operative research projects have been undertaken with the C.S.I.R.O., W.A.I.T. and the W.A. University.

Two professional and two technical appointments have been made. These appointments were made to provide for the additional research on bauxite mining projects.

Forest Hydrology

Detailed research into fundamental aspects of the Jarrah Forest Hydrological cycle are being carried out by the C.S.I.R.O. in Wellington catchment. The Department's programme is aimed at developing practical catchment management programmes which will maximize water yield and minimize salt flow. Hence, the Departmental studies involve extensive monitoring and broadscale research.

(1). Broadscale Surface Salinity Surveys

The major factor affecting the type of management in a Jarrah Forest catchment is the quantity of salt in the profile. In non saline areas reduction of forest cover may be necessary to increase water yield. On these areas, provided that other deleterious effects such as erosion, sedimentation and turbidity can be prevented, alternative land use practices such as logging or bauxite mining may be carried out without a major threat to the water supply system. On saline areas disturbance of the vegetation could result in a significant discharge of saline water into the reservoirs. In these areas it will be necessary to maintain the existing forest cover or where dieback has already caused distruction of the forest, rehabilitate with high water consuming species.

Detection of the level of salinity in the soil profile is a difficult and expensive process. Sampling of the streams during the period immediately prior to cessation of flow (i.e. the base flow period) does, however, provide an estimate of the salinity of the ground water table and hence an estimate of the salinity of the extra water which would be yielded if the vegetative

cover in the catchment being sampled was disturbed. It is likely this approach will lead to an underestimate of salinity (see below) but it will, at least, lead to the definition of these areas which are saline.

Extensive surface salinity sampling has been carried out during the past 12 months in the Serpentine, North Dandalup, Little Dandalup, South Dandalup and Murray catchments. Data from this survey is still being analysed but there are marked variations in salinity within the catchments. There is a general increase in salinity with increasing distance from the Darling Scarp. For example, in the western parts of the catchments base flow salinity is less than 300 p.p.m. but in the eastern areas values in excess of 6,000 p.p.m. have been recorded. There are, however, disjunctions in this general gradient. Within the central zone of the forest there is a mosaic of saline and non saline areas. This variation cannot be explained in terms of rainfall variation or disturbance to vegetation.

(2). Yarragil Catchment Studies

The catchment of the Yarragil has been selected for intensive hydrological research. This catchment is located within the central forest zone which is an area of major land use conflict and is of considerable hydrological significance. This zone of the forest is a major source of fresh water but preliminary research indicates that disturbance in some areas may cause discharge of saline ground water. It is intended to use the catchment as a model for catchment management in the Northern Jarrah Forest.

The study has three phases -

I. Documentation of stream flow and yield characteristic of the catchment as a whole and the sub-catchments comprising the catchment.

II. Documentation of the physical and biological characteristic of the catchment and their relationship to stream flow and salinity.

III. Treatment of the catchment to a prescription aimed at maximizing water yield and minimizing salt flow.

I. The hydrological characteristic of the catchment are being monitored as follows. (Fig. 1).

(1). Measurement of Total Yield of Water and Dissolved Solids

A broad crested weir was established by the P.W.D. at the mouth of the catchment in 1951. Continuous flow records are available from this date. The stream, at this point, has been sampled weekly for total soluble salt content since 1973 and a total analysis of the nutrient content of these samples was commenced in 1975.

(2). Measurement of Flow Within the Catchment

Combination "V" notch weirs have been established on streams at the mouth of all sub-catchments and at intervals along the main stream channel. Flow is recorded 3 times weekly at all stations and continuously at 5 sites.

(3). Stream Salinity

Total soluble salt levels of stream samples taken from eastern weir sites are determined weekly. Stream sampling

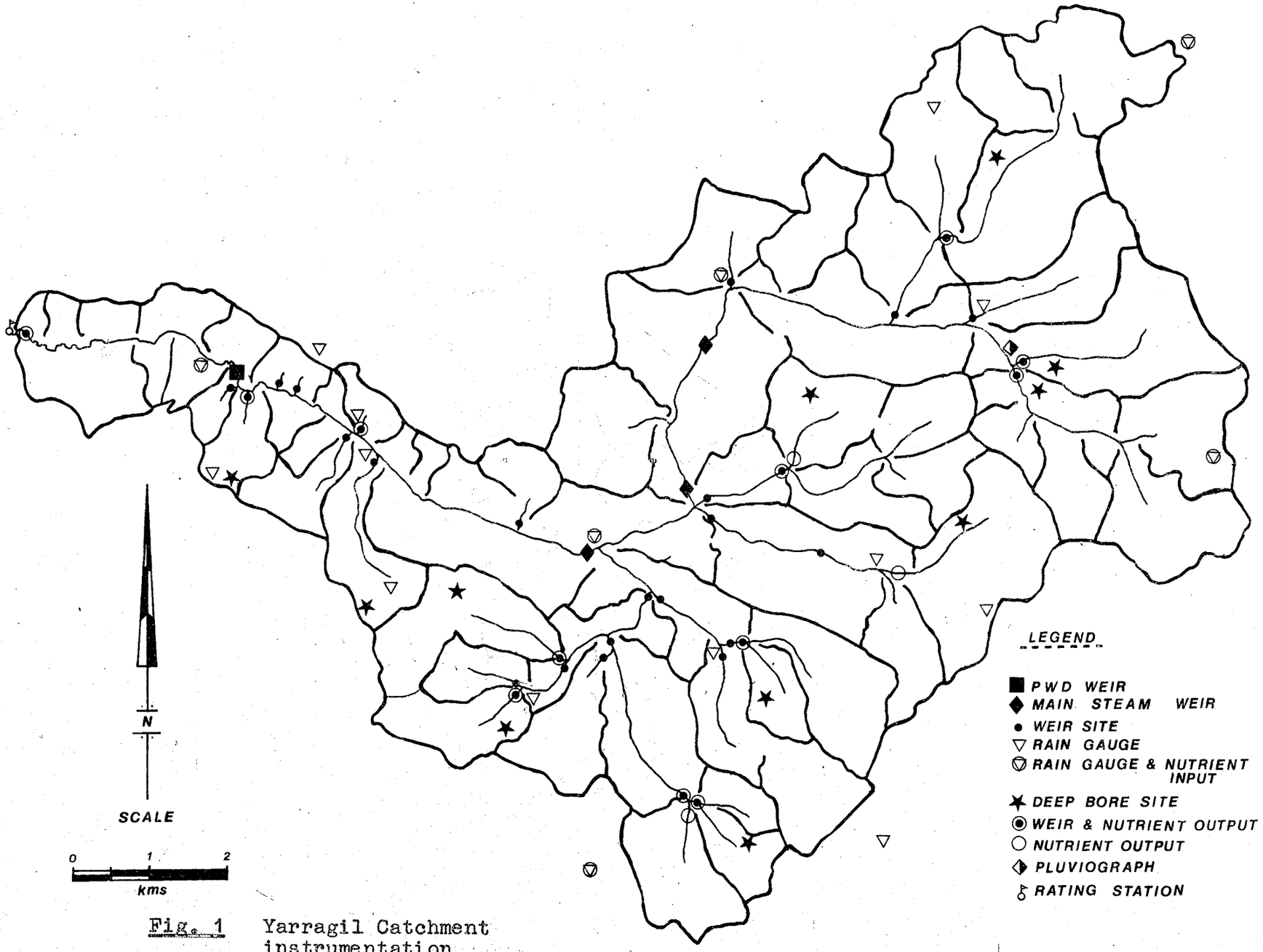


Fig. 1 Yarragil Catchment instrumentation

commenced in 1973.

During periods of peak, medium and base flows total soluble salt levels are determined from samples taken at ¼ mile intervals along all streams in the catchment.

(4). Rainfall

17 rain gauges have been located within the catchment. Rainfall is recorded 3 times weekly.

(5). Nutrient Input and Output

Total nutrient content in rainfall is recorded at 6 sites and from 17 stream sites.

(6). Total Soluble Salt Levels in the Soil Profile

27 continuously cored deep bore sites were established in the catchment in 1975: Bulk density, T.S.S. levels, pH, and M.C.% were determined at .7 metre intervals from the soil surface to a depth of 44 metres on the parent material.

(7). Ground water Monitoring

Ground water table depth and T.S.S. content are recorded in each bore site fortnightly.

II. Physical and Biological Characteristics of the Catchment

A detailed soil and ecological survey of the area was carried out in 1974-75.

Results

The study is long term and only preliminary results are available.

(a). Accuracy of Periodic Measurement of Stream Flow

Comparison of estimates of total annual stream flow based on periodic (3 times weekly) readings with those derived from continuous recordings indicate that the periodic measurements results in an underestimate of total annual stream flow of less than 5%.

(b). Stream Salinity

There is a considerable variation in stream salinity, particularly during periods of base flow, in the catchment. In Fig. 2 ground water salinity of sub-catchments within the catchment can be estimated from stream salinity during periods of base flow.

(c). Salt and Water Yield from Sub-catchments

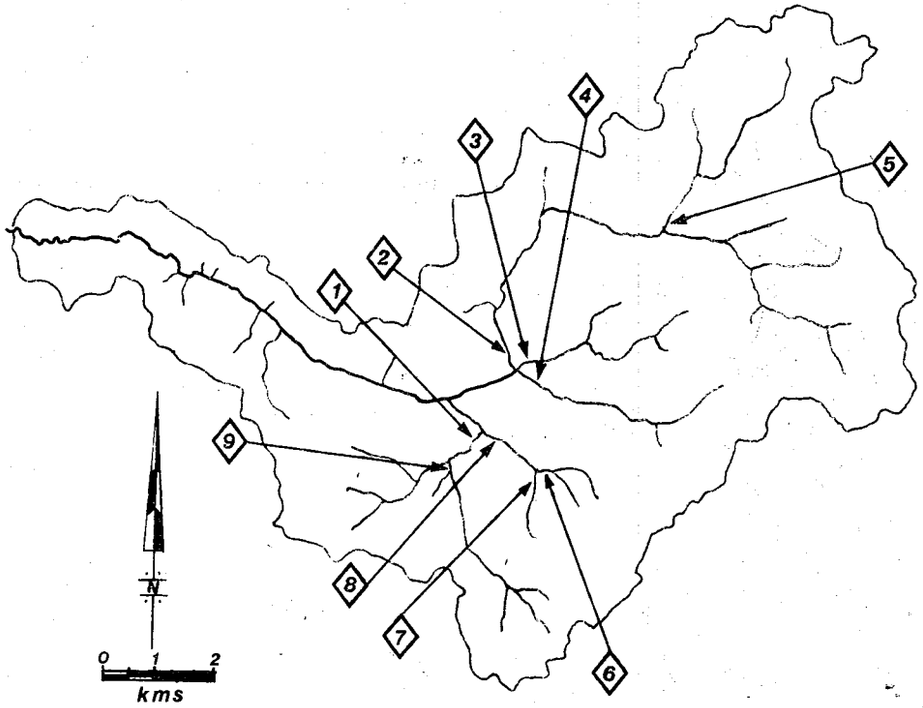
Data from measurements of water and salt yield from different sub-catchments during 1974 is shown in Fig. 2.

(d). T.S.S. Content of Salt Profile

Data from deep cores is currently being assessed. Preliminary results indicate -

(1). There is a marked variation in the total quantity of salts and the distribution of salts in the profiles of different sites. In some sites there is a distinct zone of salt

Fig. 2a Water and Salt yield from Yarragil sub-catchments during 1974



		1	2	3	4	5	6	7	8	9
WY	cm	18	6	7	9	7	10	12	10	18
SY	t/km^2	21	18	16	19	18	17	17	17	22
WAS	mg/l	116	308	225	216	260	167	144	166	122
BFS	mg/l	436	820	922	618	545	752	346	102	633

WY – WATER YIELD
SA – SALT YIELD
WAS – WEIGHTED AVERAGE SALINITY
BFS – BASE FLOW SALINITY

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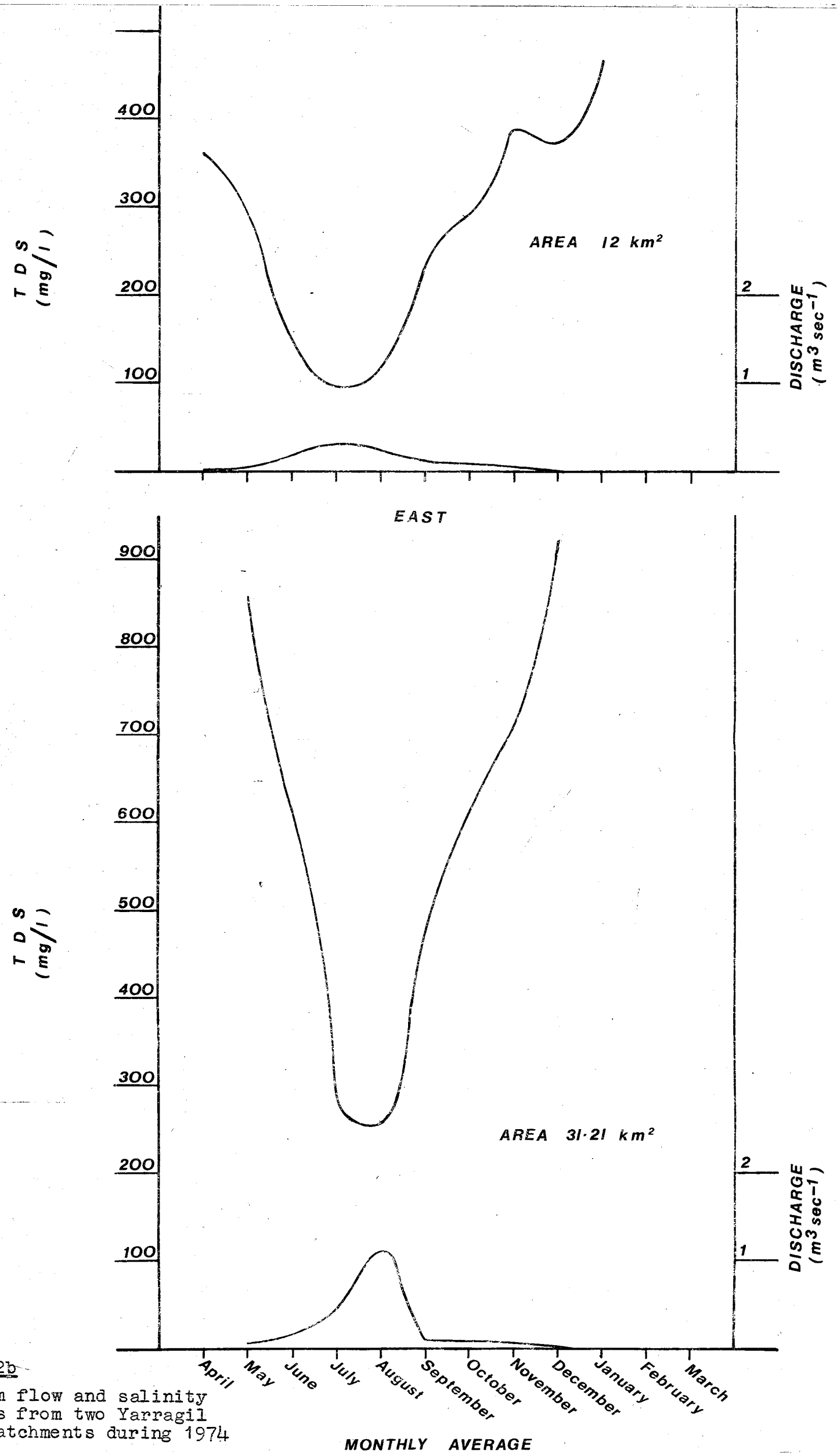


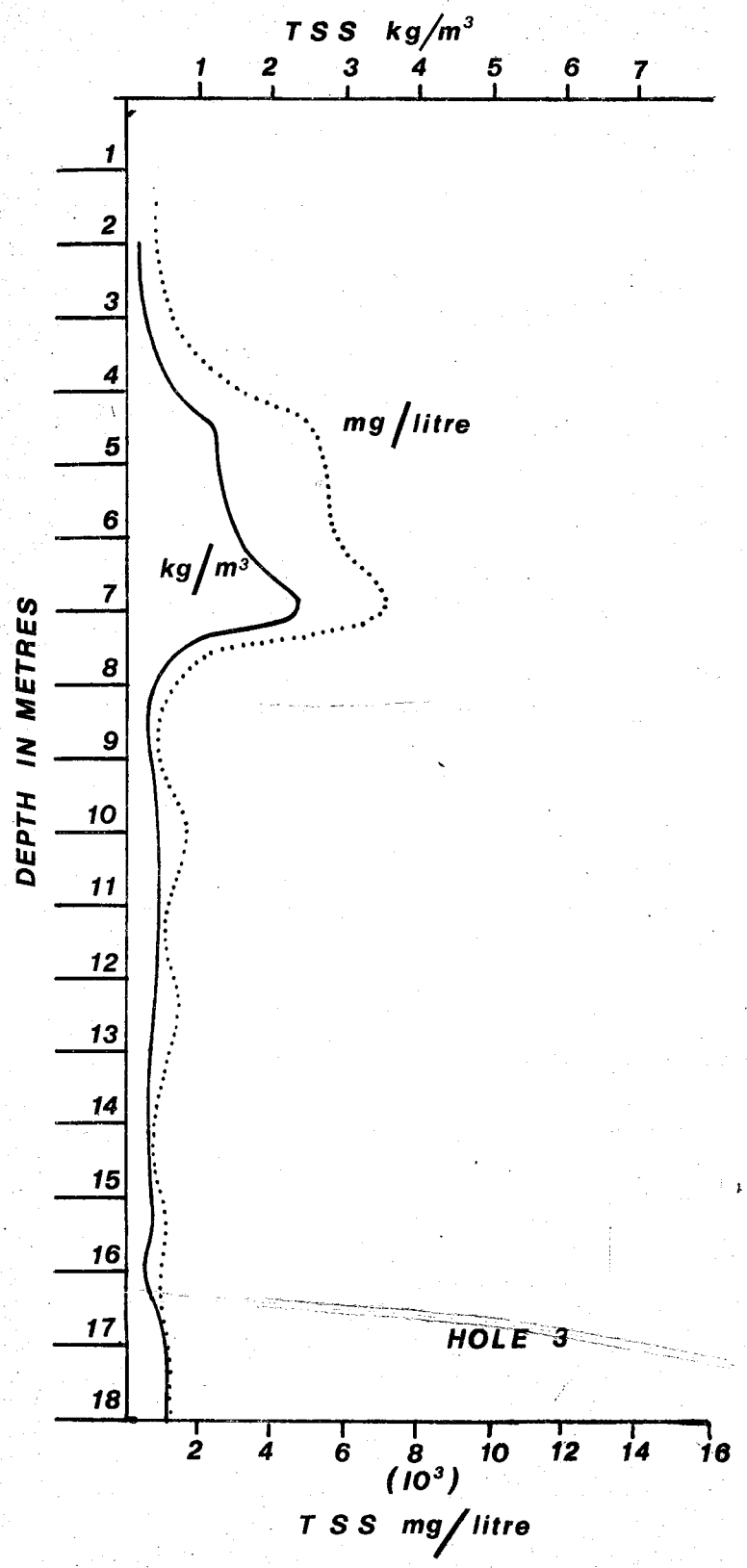
Fig. 2b

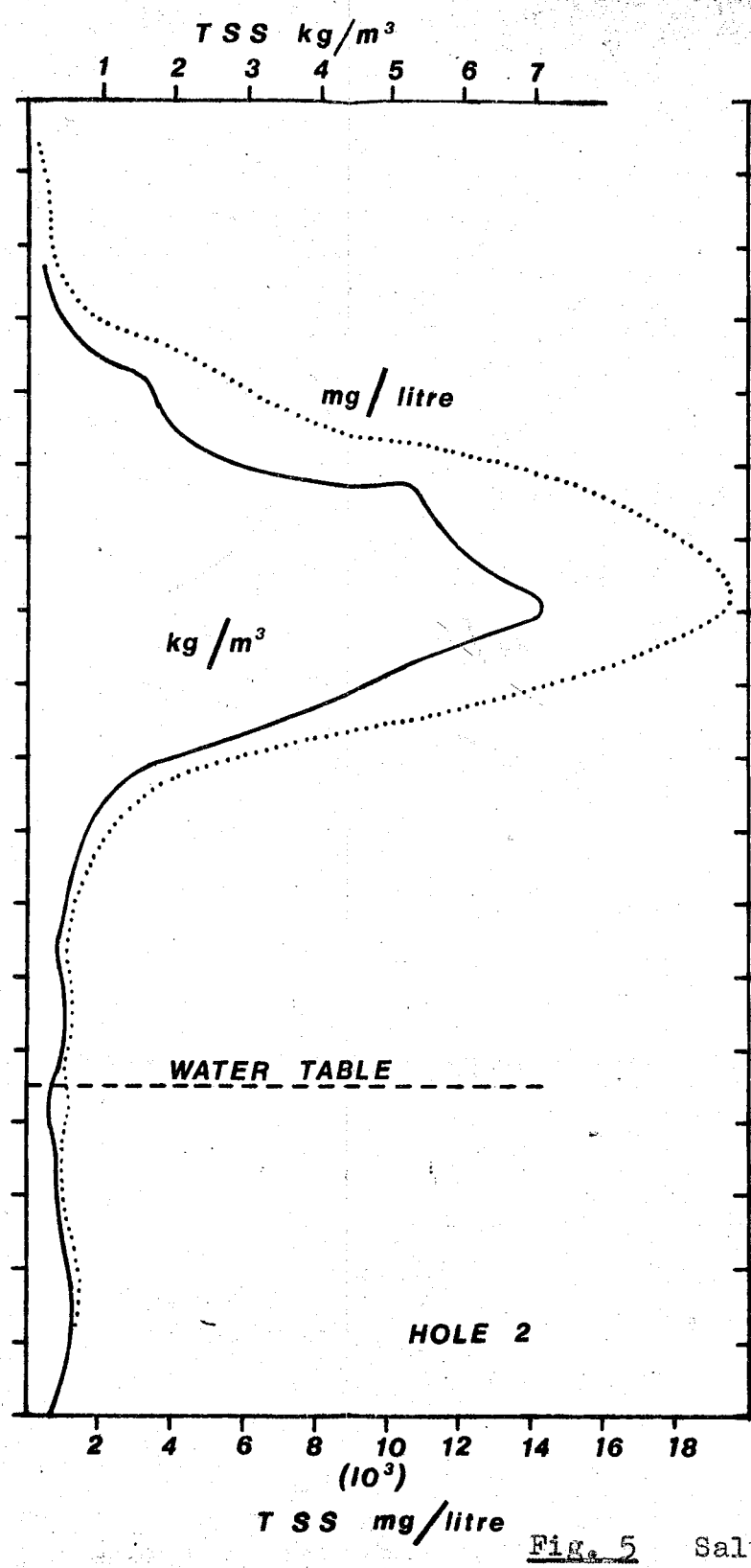
Stream flow and salinity levels from two Yarragil sub-catchments during 1974

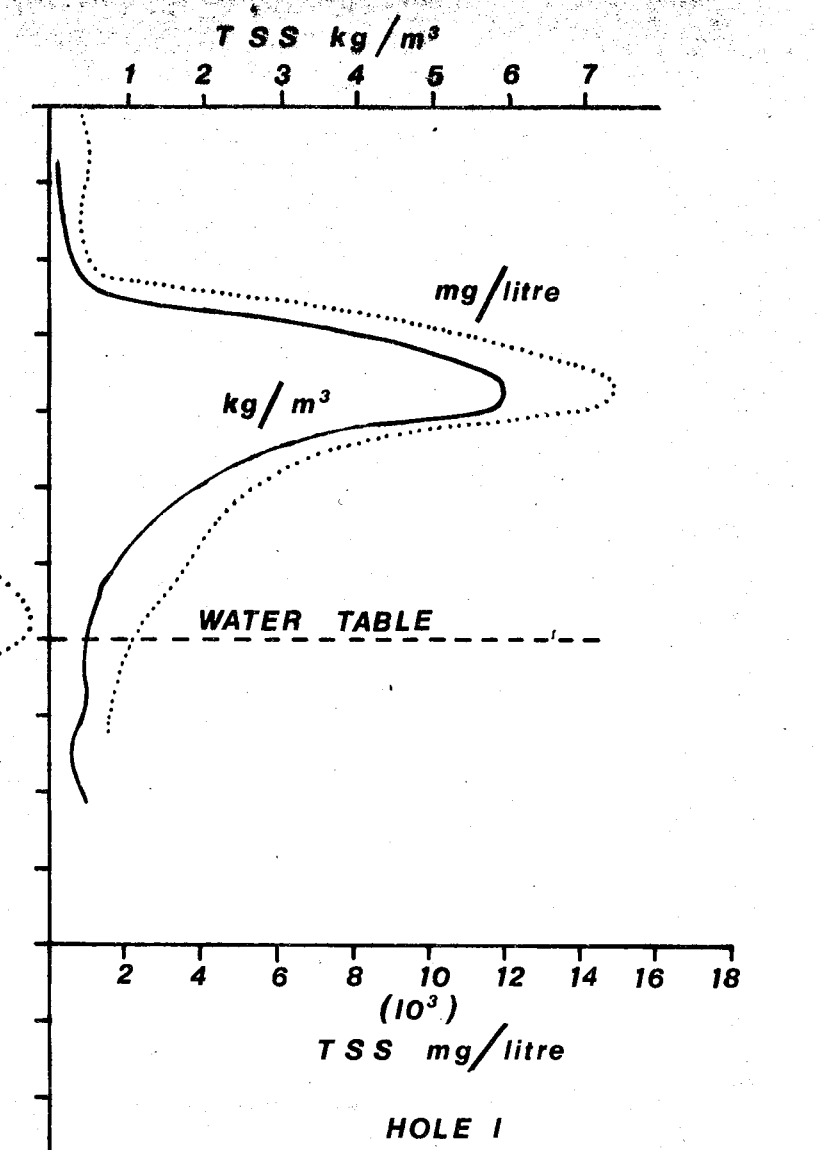
Fig. 3 Combination "V" notch weir constructed by Dwellingup gang.

Fig. 4

Drilling rig used to obtain cores for determination of salt profile.







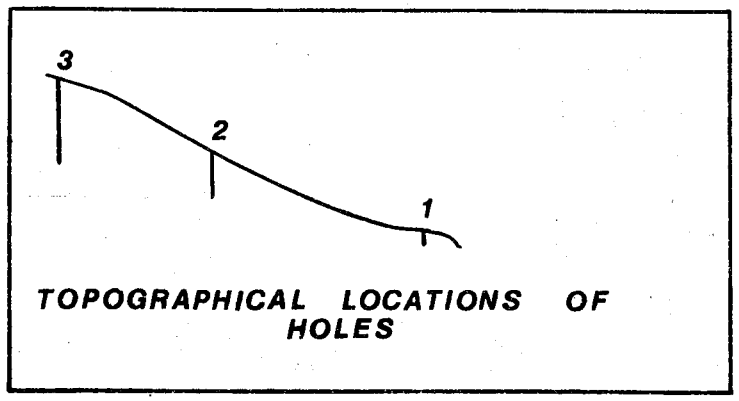


Fig. 5 Salt profiles in a Yarragil sub-catchment

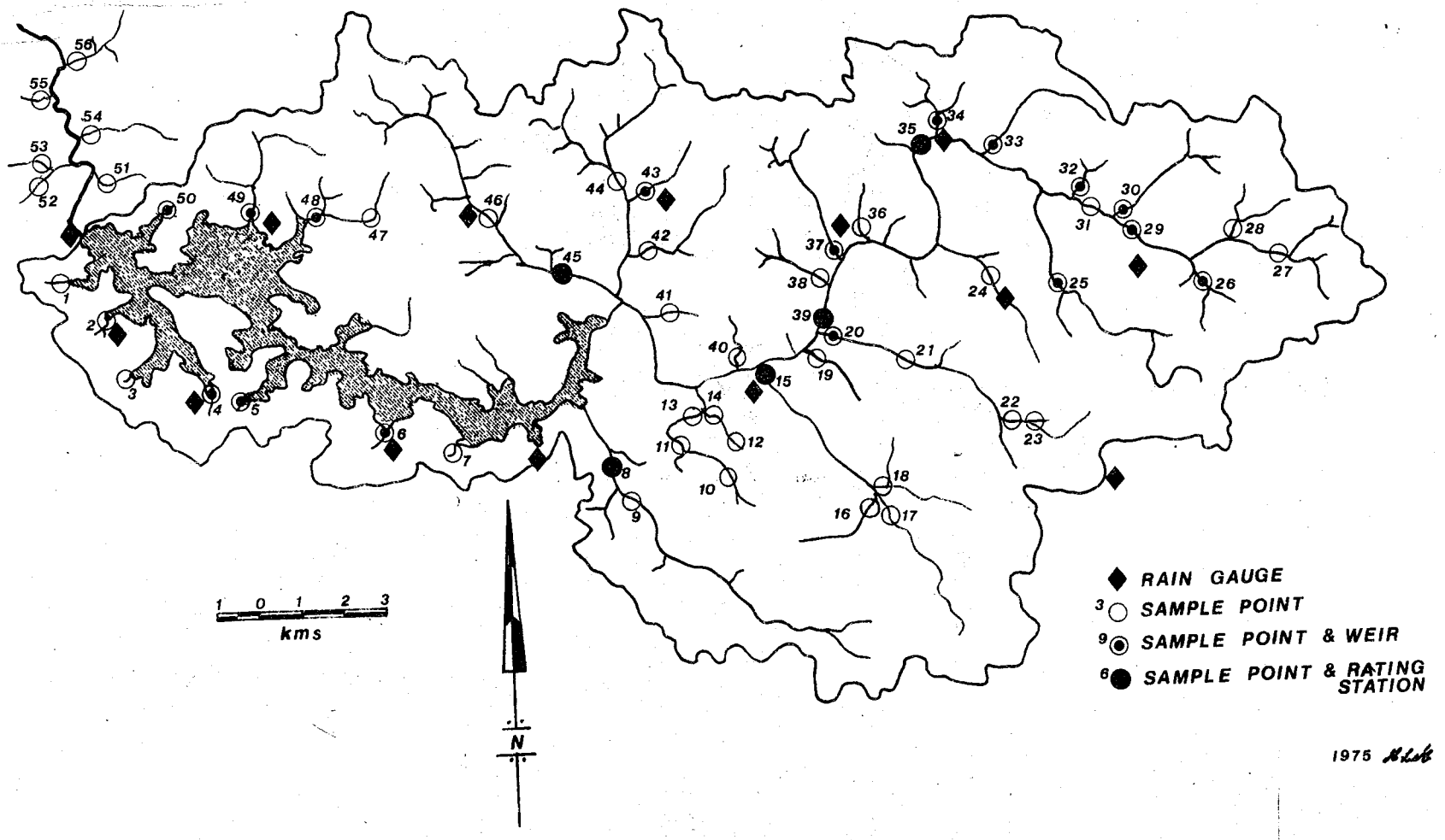


Fig. 6 South Dandalup catchment.
Stream and rainfall sampling points.

accumulation at depths of between 4 to 8 metres but in others the salt is uniformly distributed in the soil profile. This study suggests that there is a mosaic of saline and non saline areas within the catchments. This variation cannot be explained by differences in rainfall. Preliminary analysis suggests that the differences in salt content are correlated with differences in parent material.

(2). Ground water salinities were significantly higher than the base flow salinities of adjacent streams. Ground water salinity was between 1.8 and 5.8 times higher than base flow salinities. This would suggest, that areas of forest which have been considered relatively free of salt on the basis of low base flow salinity levels may, in fact, have significant accumulation of salt in the soil profile. Salt profiles in a sub-catchment of the Yarragil are shown in Fig. 5.

(3). South Dandalup Catchment

The South Dandalup catchment is an important unit in the Metropolitan Water Supply system. Surface salinity surveys indicated that there were marked variations in ground water salinity under the catchment. Fig. 6 and Table 1. The western section of the catchment has relatively low salinity levels but a large proportion of the catchment has high ground water salinities. Currently salinity levels in the reservoir are low (200 p.p.m.) but the structure of the catchment and the distribution of saline ground water suggests that relatively minor disturbance of the catchment could result in a significant deterioration in water quality. Maintenance of low salinities in the reservoir is dependent on the maintenance of a high proportion of yield from the western section of the catchment.

In order to determine the relative yield of salt and water from different sections of the catchment "V" notch weirs have been established on all major streams feeding into the reservoir. Flow is recorded three times weekly and water samples for T.D.S. content determination are taken weekly. Rainfall from gauges distributed throughout the catchment is recorded weekly.

These measurements will permit the construction of a total salt and water yield budget for an operation catchment and consequently will allow the evaluation of different land use practices to be made in the context of the total catchment.

(4). Root Distribution Studies of Native and Introduced Species

The maintenance of high quality water yield in forest areas which have salt stored in the soil profile is dependent on the stabilization of the ground water table by high water consumpting species. Preliminary research indicates that native forest species, in particular Jarrah, are able to maintain high rates of water use during the summer because of the presence of a deep root system. If water is to be maintained rehabilitation of forest in salt prone areas with deep rooted species will be necessary.

Studies have been initiated which are aimed at determining the rooting characteristics of native species and a variety of exotic species. These studies will permit the selection of species for rehabilitation which are most likely to have the same hydrological effects as Jarrah.

Excavation of the root systems of Wandoo, Jarrah, Marri, Banksia and Pinus radiata are being carried out.

Table 1

Stream Salinity During Periods of Base Flow

in the S. Dandalup Catchment

(See Fig. 6)

1	127.9	22	341.9
2	142.7	23	130.0
3	159.9	24	446.6
4	151.8	25	568.0
5	139.5	26	511.8
6	204.4	27	510.4
7	188.8	28	800.82
8	287.9	31	7246.0
9	376.7	32	1041.9
10	357.4	33	808.6
11	371.1	34	887.5
12	352.0	35	~~353.7~~ 2804.0
13	402.5	36	709.9
14	882.6	38	645.7
15	547.0	42	284.7
16	245.9	43	190.3
17	648.9	44	396.1
18	358.8	46	227.6
19	316.0	47	156.0
21	637.2	49	119.8

Jarrah Dieback Research

(1). Environmental Studies

(a). Field Studies

Detailed measurements of soil moisture and temperature levels under a dense legume stand and adjacent legume free forest have been carried out for a period of two years. The soil physical environment under the legume stand was only marginally suitable for P.cinnamomi. The results of this study indicates that it may be possible to protect upland Jarrah Forest sites from attack by P.cinnamomi by the promotion of dense legume stands.

(b). Pot Trial Studies

The data available on the soil moisture and soil temperature levels required for P.cinnamomi pathogenicity is imprecise. Laboratory studies aimed at defining these levels have been initiated using a technique which permits the maintenance of soil moisture at a static level during the duration of the trial.

(c). Inoculation of Legume and Non Legume Sites

(i). Jarrah and Banksia seedlings were planted under a Bossiaea aquifolium and in an adjacent non legume site. Inoculations were carried out in October 1973. Seedling mortality in both control and inoculated plots in legume and non legume sites was high, but there was a higher survival of inoculated seedlings under the legume site compared to the non legume sites.

	% Survival	
	Legume	Non Legume
Inoculated survivals expressed as a percentage of control survivals.	46	63

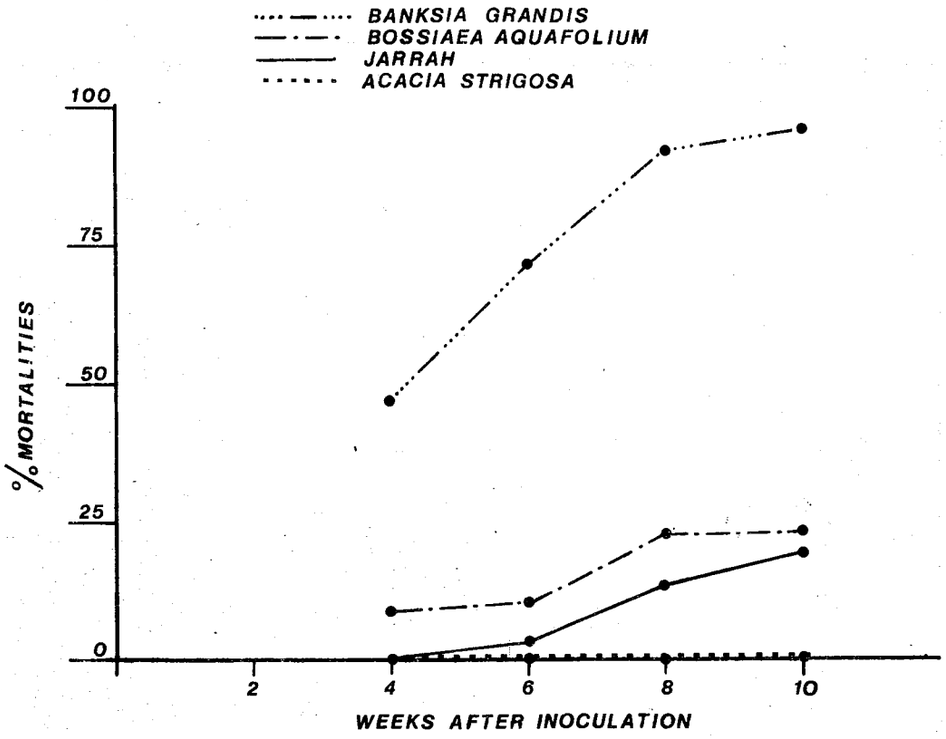
(ii). A series of field inoculation trials aimed at determining if jarrah and banksia seedlings and pole size jarrah can survive in the presence of P.cinnamomi when dense legume stands are present were initiated in 1974. The trials are continuing.

(2). Distribution of P.cinnamomi in Root Systems

The degree of invasion of the root system by P.cinnamomi of a susceptible species has a major influence on control. Where total invasion of the root occurs it is unlikely that the species can be protected.

(a). B.grandis. Intensive sampling of B.grandis root systems demonstrated that P.cinnamomi can totally invade the root system of this species. P.cinnamomi was recovered from roots from 3 mm to 75 mm in diameter.

B.grandis form specialized proteoid roots which frequently occur as a dense mat less than 1 cm below the soil surface. It is hypothesized that these roots are a major cause of P.cinnamomi



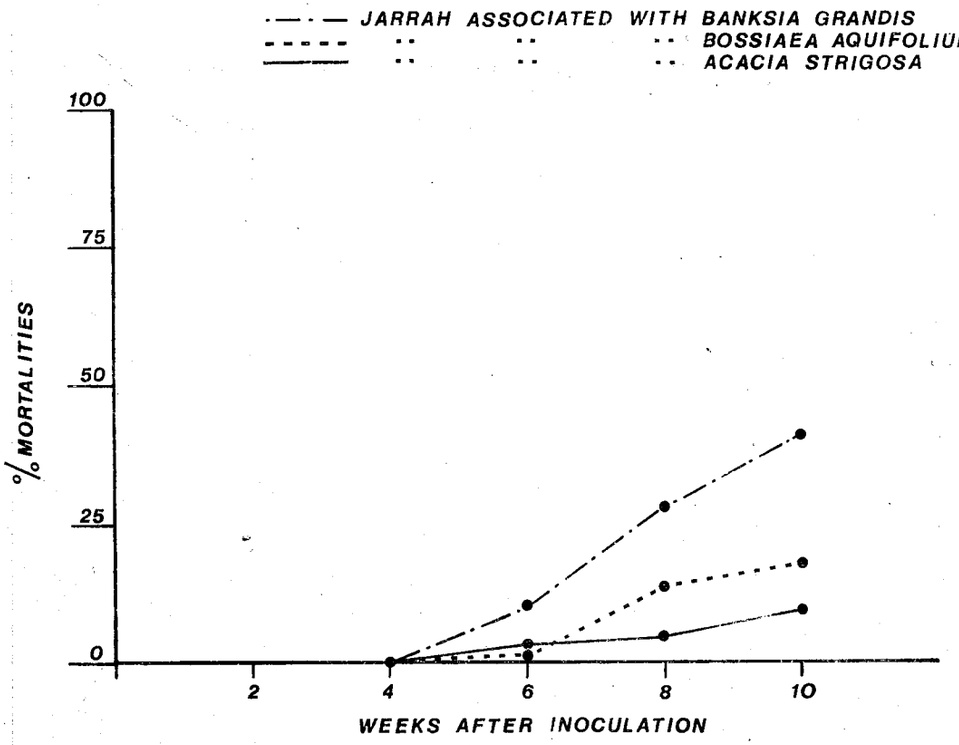


Fig. 8 Survival of B.grandis and E.marginata and legume species in the presence of P.cinnamomi.

spread. Detection of the fungus in proteoid roots in the field has proved difficult but it has been demonstrated that the fungus can completely invade these root structures.

(b). E.marginata. Intensive sampling of the root systems of Jarrah trees growing on freely drained sites exhibiting dieback symptoms failed to detect the fungus. The ability of the fungus to cause mortality when it is apparently only present in the soil at very low population levels is puzzling. It is possible that mortality of Jarrah is due to secondary factors which operate after P.cinnamomi attacks the root system.

The fungus was recovered extensively from one tree which was growing on the edge of the swamp on an active green line. Roots varying in diameter from 1 mm to 60 mm yielded the fungus. This tree exhibited unique dieback symptoms. The crown was dead but the foliage was retained indicating rapid mortality. The tree was located on the edge of a swamp on the green line.

From the studies conducted it is unlikely that the fungus is capable of invading suberized jarrah roots unless the tree is under stress or in sites which are particularly conducive to P.cinnamomi; however, further sampling is being carried out.

(c). E.marginata - specialized fine roots.

During excavation of Jarrah root systems specialized fine root structure was discovered. This root type occurs as a dense mass in the top 10 cm of the soil profile. It is hypothesized that the large root surface area of this root structure permits efficient nutrient uptake by Jarrah in the highly infertile laterite soils. It is possible that destruction of this root by P.cinnamomi is responsible for decline and eventual mortality of Jarrah. Investigations are continuing.

(3). Interaction between Native Legumes and P.cinnamomi

(These trials are being carried out in co-operation with Mr. N. Malajzcuk, C.S.I.R.O.)

(a). Susceptibility of Legumes to P.cinnamomi

A factorial pot trial to determine the susceptibility of A.pulchella, A.extensa, A.myrtifolia, B.aquifolium and M. dilatata was carried out. Pre-inoculation mortalities occurred in the B.aquifolium and M.dilatata pots and these were excluded from the trial. The remaining legumes survived in the presence of P.cinnamomi for a period of 4 months. Inoculation had no significant effect on height or dry matter production.

P.cinnamomi was recovered from the soil and roots of A.myrtifolia and A.strigosa but it was not recovered from the soil or roots of A.pulchella. The soil from one A.extensa pot yielded P.cinnamomi but there was no recoveries from the root systems or from the soil from the remaining pots.

This trial indicated that the legumes tested are relatively resistant to P.cinnamomi and hence could be used as an understory cover to ameliorate the physical soil environment. The low recovery rate from two legume species suggests that these legumes have suppressed the fungus.

(b). The Effect of P.cinnamomi on Jarrah Seedlings Grown in Association with Native Legumes

Following trial 3(a) a further trial to determine if legumes suppressed P.cinnamomi pathogenicity was carried out.

Jarrah was interplanted with a number of legume species and B.grandis.

Preliminary results indicate that Jarrah grown in association with legumes is less susceptible to P.cinnamomi. Fig. 8. These trials are continuing.

(c). The Effect of Rhizobium on Pathogenicity of P.cinnamomi to Native Legumes

It is possible that Rhizobium sp., the bacteria which forms a symbiotic association with legume species has an antagonistic effect on P.cinnamomi. A trial aimed to test this hypothesis was carried out.

The trial was a factorial and was designed to test the pathogenicity of P.cinnamomi with and without the presence of Rhizobium in sterile and unsterilized soil. Significantly higher mortalities were recorded in sterilized and unsterilized soil which were not inoculated with Rhizobium. This indicates that Rhizobium is reducing P.cinnamomi pathogenicity.

(d). The Capacity of Native Legumes to Fix Nitrogen

The control section of experiment 3(a) was used to determine the capacity of A.strigosa, A.pulchella, A.myrtifolia and A.extensa to fix nitrogen. The results indicate that some native legumes have the capacity to fix nitrogen at a relatively high rate.

It is difficult to explain the relatively high dry matter production of virgin jarrah in an ecosystem from which nitrogen must be continually withdrawn as a consequence of frequent controlled or wildfires without the presence of a mechanism for significant inputs of nitrogen. Periodic high intensity fires which result in the regeneration of dense stands of legumes may be the mechanism.

(4). Detection of P.cinnamomi Using B.grandis Leaves As A Bait

A P.cinnamomi detection technique using B.grandis leaves as bait material was devised. Young, fresh banksia leaves were as effective as E.sieberi cotyledons. Mature banksia leaves were unsatisfactory.

(5). The Effect of Soil Type on P.cinnamomi Pathogenicity and Survival

Observation of the intensity of diseases caused by P.cinnamomi on different site types within W.A. and in the eastern states suggests that there are unknown soil factors which have a major influence on the severity of the disease. Recent research has shown that ethylene production, antagonistic micro-organisms and nutrient levels in different soils may have a marked influence on P.cinnamomi activity. Precise identification of the factor responsible for variation in disease intensity may lead to a control method.

A trial aimed at investigating the relationship between a variety of soil factors and P.cinnamomi activity has been initiated in co-operation with the C.S.I.R.O.

Summary

The major factor frustrating progress in Jarrah Dieback Research is the long period required to field test possible control methods. However, during the last 12 months studies

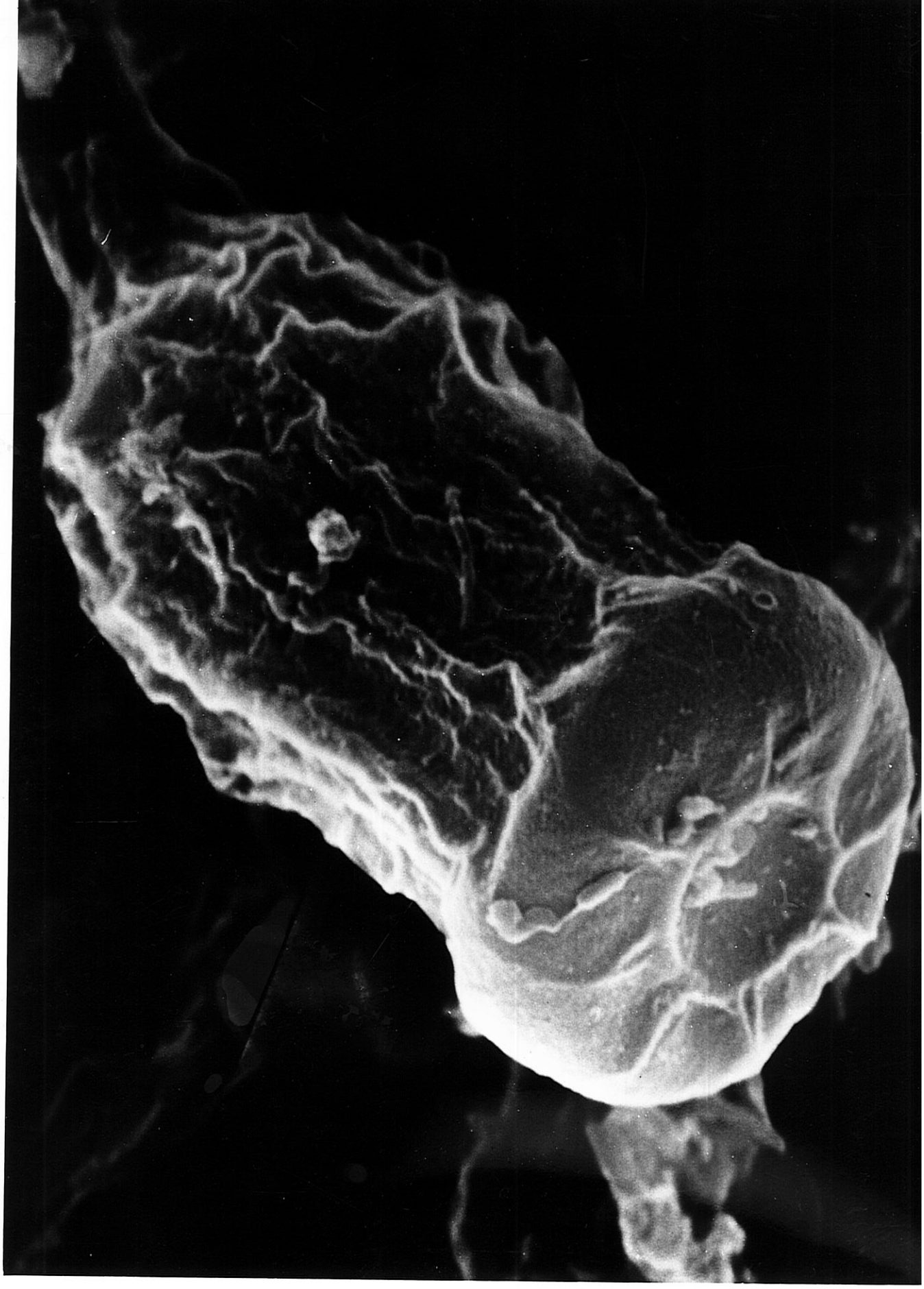


Fig. 7 Bacteria attacking P.cinnamomi sporangium. There is evidence that micro-organisms associated with legume roots are antagonistic to P.cinnamomi.

Photo: N. Malajczuk

involving the use of native legume species have produced very encouraging results.

Bauxite Mine Rehabilitation

Erosion on bauxite mine sites is severe and water running off mine sites has a high sediment load and is turbid. Hence, major emphasis has been placed on devising techniques to stabilize the mine floor surface.

Recolonization of mine sites by native shrub and understory species which are believed to play an important role in stabilizing the soil in "unmined" areas is minimal.

A series of direct seeding trials were conducted to evaluate the effect of native species and agricultural grasses on erosion and the effect of agriculture species on survival and growth of native species and trees.

(1). Survival and Growth

Twelve 90 metre square plots were direct seeded with a variety of jarrah forest native legume species, Woogenellup clover and Wimmera rye grass. All plots were fertilized at a rate of 1 tonne of superphosphate per hectare.

The growth of native legume species was variable but A.myrtifolia, A.extensa, and A.strigosa by the mid-summer 1974-5 had established a good cover. The clover germination was more rapid and grew more vigorously initially than the native species. Rye grass growth was poor. No species provided sufficient cover during the first winter to prevent erosion. However, by the second year in plots seeded with native species cover was complete and should result in stabilization of the soil.

Where agricultural species were mixed with native species survival and growth of native species was markedly reduced. Fig. 9.

(2). The Effect of Agricultural Species on Survival and Growth of Native Shrub Species and Tree Species

20 x 20 metre plots were sown with native and agriculture species singularly and in combination. In each plot 5 rows of eucalypt tree species, each row consisting of E.maculata, E.bicostata, E.saligna, E.camaldulensis, and E.propinqua, were planted.

In plots planted with clover the average tree height was reduced (19.1 cm vs 14.1 cm) and survival (92% vs 84%) was reduced.

Clover and rye grass significantly reduced survival and growth of native species (particularly wildflowers).

(3). Seed Application

A technique involving application of seed under pressure in a water based mix of fertilizer and paper pulp was tested. Two different treatments (with and without paper mulch) were applied to a steep mine floor surface and a steep bank. A mixture of native shrub and tree seed was applied.

Seed germination and distribution was excellent and did not vary significantly. The average number of plants per square metre which have survived to the 15/2/'75 are shown tabled below.

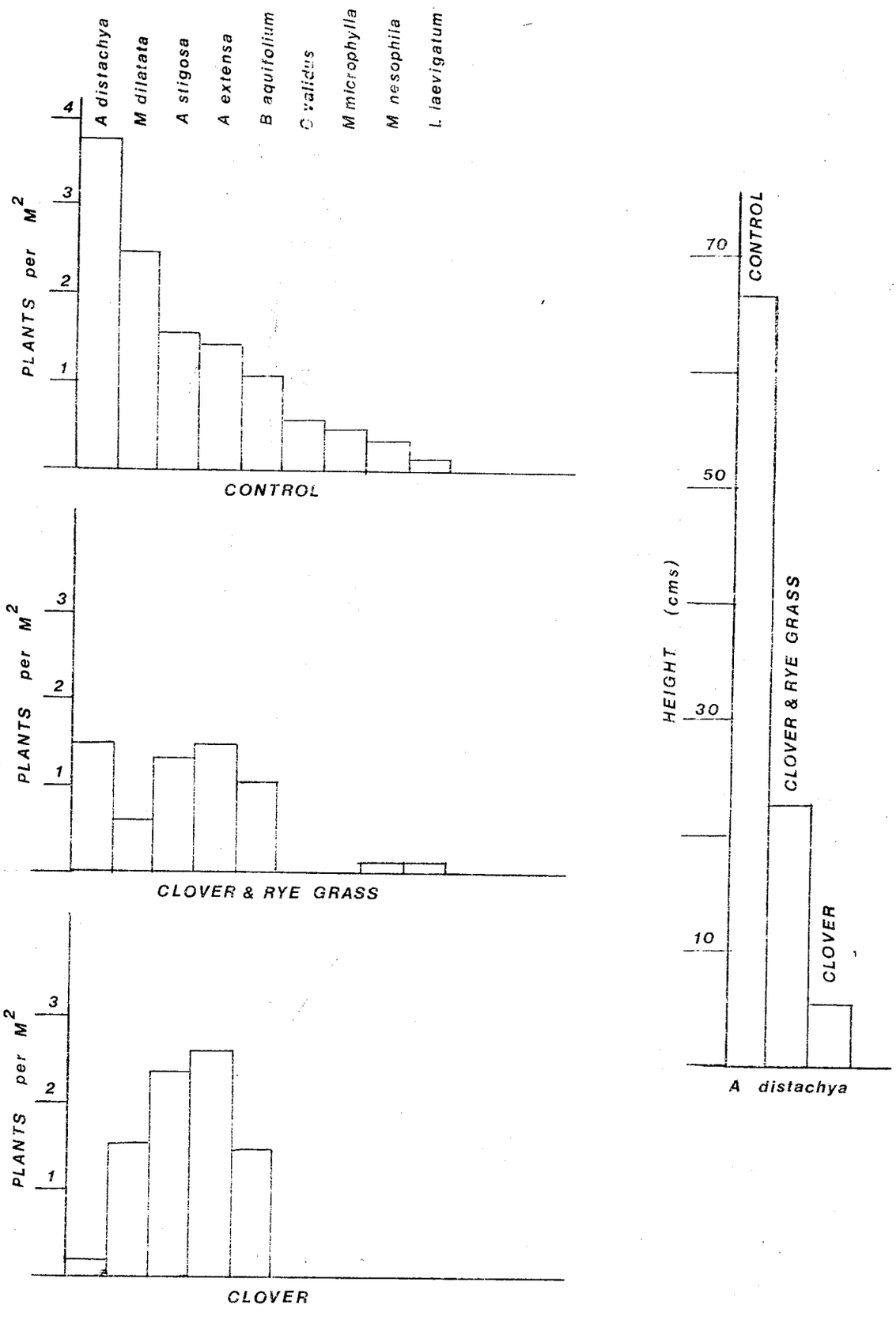


Fig. 9 The effect of clover on survival of direct seeded native species.

Fig. 10a Plot direct seeded with mixture of native species. Foreground untreated area.

Fig. 10b Plot direct seeded with native species and clover.

	Native Legumes	Native Non Legumes	Mixed Eucalypt Seed	Native Regeneration
Mine Floor	11.7	8.4	2.7	5.9
Bank	7.5	3.1	2.1	2.2

Where tree seed germinated adjacent to planted trees which had been fertilized the growth of the direct seeded trees frequently exceeded or equalled the growth of the planted trees.

Following the success of these initial trials a further series of experiments were set up in Autumn 1975.

(a). Broad Scale Trial

The amount of erosion occurring in a bauxite mine pit is a function of the hydrology of the whole pit. Hence, it is difficult to evaluate the capacity of different understory treatments to reduce erosion using small plot studies. A semi-operation trial involving treatment of four discrete mine pits (total area 4.6 hectares) was carried out. The following treatments were applied.

(i). Clover + rye grass (direct seeded)

(ii). Clover + rye grass + eucalypt tree species + native shrub species (direct seeded)

(iii). Clover + rye grass + wheat straw mulch

(iv). Eucalypt tree species + native shrub seed + wheat straw mulch.

(b). Detailed Plot Studies

Twelve self-contained plots which were located between two contour banks were seeded with native species and clover and rye grass singularly and in combination. Treatments were applied with and without straw mulching. Each treatment is replicated twice. As these plots are self-contained it should be possible to accurately qualify the effect of each treatment on erosion and the turbidity of water running off the plots.

(c). Monitoring of Water Quality

Water samples for determination of nutrient content and turbidity are taken weekly from water running off treatment plots, in streams below the mine site and in adjacent unmined forest.

Fire Ecology

(1). Plavins Trial

In this factorial trial which was established in 1971 the effect of intensity, frequency and season of burning on flora is being assessed. Forty six plots were assessed prior to the three year cycle burning being applied. Plot data is being processed for computer analysis. Preliminary analysis suggests that there are no significant differences between treatments. Cool, medium and hot burns were applied in November 1974 and April 1975.

(2). The Ecology of Ants in Jarrah Forests with Particular Reference to Their Relationship with the Jarrah Leaf Miner

This project is being carried out by Dr. J.D. Majer with assistance of the Dwellingup Station.

Ants have a major influence in forest ecosystems in both tropical and temperate regions. This is illustrated in West African cocoa farms where the composition of the cocoa fauna is largely determined by the species of ants which are present.

Their importance in Western Australian forest ecosystems has not, as yet, been investigated although the Entomology Division of C.S.I.R.O. in Perth have found that ants have a limiting effect on the Jarrah leaf miner. The larvae of the miner are predated by the ants when they drop to the ground and select pupating sites. In view of the paucity of information on ants in W.A. forest ecosystems and the involvement of ants in the biology of at least one major Jarrah pest, a study of the ecology of forest ants has been initiated.

The diversity of ants, their distribution patterns and their influence on the leaf miner is being investigated. In addition the inflence of hot and cool prescribed burns is being studied in order to elucidate the effects of fire on the ants and the limiting effect of the ants on the leaf miner. Three grids of pitfall traps have been set up in control, cool autumn burn and hot autumn burn plots of the Plavins Fire Ecology Field Trial area at Dwellingup. At least 44 species of ants occur in the area sampled. They are distributed in a patchwork manner and certain species are clearly numerically more important than others. This research is at present ongoing.

(3). Pindalup High Intensity Burn

(a). It is possible that the promotion of dense legume stands could reduce P.cinnamomi activity and increase N inputs into the Jarrah Forest ecosystem (see above). If legumes can be used to control Jarrah Dieback it would be necessary to modify burning techniques so that legume stands are protected.

In order to determine if it was possible and practical to promote legumes by burning at a high intensity, an experimental burning was carried out in 200 hectares on the 19th March 1975. Twelve continuous lines of fires were lit in a northerly direction. Burning commenced at 1300 and the area was burned out within two hours. Complete crown scorch was obtained throughout the area save for partial crown scorch on a few old Jarrah and Marri trees. Small, isolated areas of defoliation occurred in thick pole sapling stands where link-up of lines of fire took place. Charring of tree boles was complete.

Conditions during the burn were somewhat cloudy but a temperature of 30°C with a relative humidity of 23% persisted throughout the burn. The average recorded windspeed was 8.8 kilometres per hour. Strong inrush winds were felt close to the burn due to strong conversion current. A mean flame height of 3.7 metres was recorded with sporadic bursts of flame to 20 metres in fire link-up zones. The overall fire intensity was estimated to be 4,353 kilowatts per metres.

Soil temperatures at a depth of 2 cm exceeded 135°C and remained above 100°C for 30 minutes.

Fire damage caused by the 1961 wildfire was assessed prior to the burn. 95% of the trees assessed exhibited fire damage. No damage from the experimental burn was evident 14 days after the burn but it is expected there will be cambial damage.

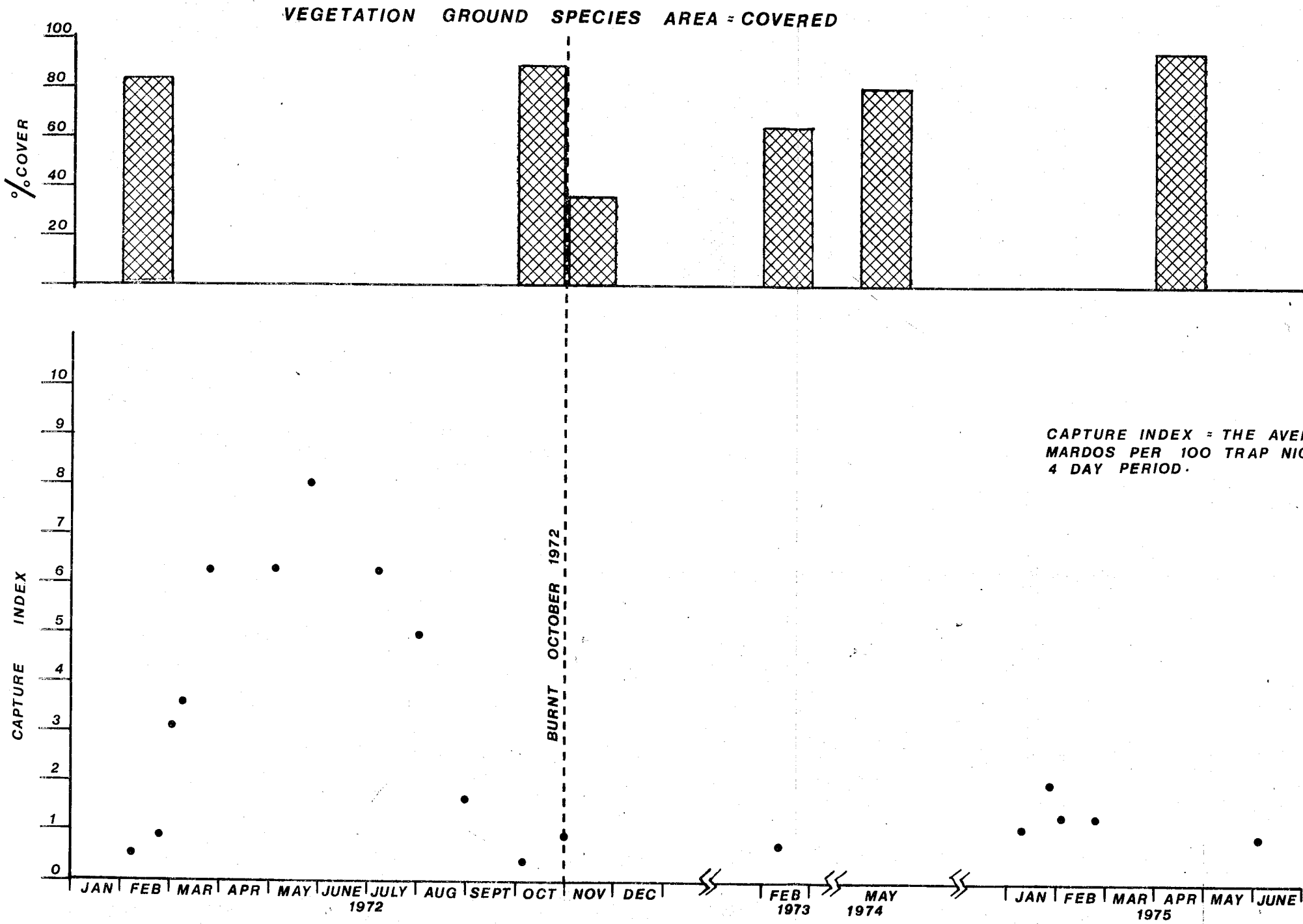


Fig. 11 Recaptures of Mardos pre and post burn.

Germination of legumes (A.pulchella and K.coccinea) commenced 14 days after the burn. In some areas wheatfield regeneration has occurred but in others legumes are absent. Assessments are continuing.

This trial demonstrates that it is possible to cause a radical change to the composition of the Jarrah Forest understory by burning. Further research is planned to determine burning procedures so that crown damage is minimized and legume germination maximized.

(b). The Effect of High Intensity Fire on Soil Fertility

C.S.I.R.O. research officers are using this experimental high intensity burn as part of the general study of nutrient cycling in the Jarrah Forest. Detailed monitoring of soil nutrient levels at locations within the experiment burn is being carried out.

Fauna Research

(1). The Effect of Intense Fire on Mardo (Antechinus flavipes)

A swamp containing a population of 23 mardo's was burnt in October 1972 following a pre-burn study of mardo numbers and movements using a rotational grid trapping system. One male mardo was caught in June 1974. Three male mardo's and two female mardo's were trapped in February 1975. These were subsequently recaptured suggesting that they have taken up permanent residence.

Vegetation cover has been recorded using the Levy point sampling method; 1 day, 3 months, 6 months, 1 year, 2 year and 3 year intervals since the burn. Data from this study is shown in Fig. 11.

(2). Comparison of Mardo Populations on Upland Jarrah Sites in Regularly Burnt and Unburnt (44 year) Areas

Trapping during periods of peak animal activity was continued during 1974-75. Recovery from unburnt forest continued to be higher. Sixty seven animals were recovered from the unburnt area compared to 7 animals from the regularly burnt forest (including recaptures).

Dieback Rehabilitation Trials

(1). Dieback Rehabilitation Costing Trial

A 73 hectare dieback site was totally chained and divided into six 12.1 hectare plots. Six pre-planting treatments were applied. Costing was as follows -

(a). Chained, windrowed and burnt.

Chaining	20.52	per hec.
Windrowing	38.58	" "
	$59.10	

(b). Chained, windrowed and burnt area between windrows ploughed at alternate 6' intervals.

Chaining	20.52	per hec.
Windrowing	38.58	" "
Ploughing	7.41	" "
	$66.51	

(c). Chained, windrowed and burnt. Total ploughing between windrows.

Chaining	20.52 per hec.
Windrowing	38.58 " "
Ploughing	11.11 " "
	$70.21

(d). Chained, windrowed, pushed up once while alight, totally ploughed.

Chaining	20.52 per hec.
Windrowing	38.58 " "
Ploughing	11.11 " "
Push up once	21.24 " "
	$91.45

(e). Chained, racked at 12' intervals. Rack to be totally ploughed. Single 12' racks found to be impracticable. Double racks used.

Chaining	20.52 per hec.
Racking	21.29 " "
Ploughing	7.41 " "
	$49.22

(f). Chained, racked at 12' intervals. Single 12' racks found impracticable. Double racks used.

Chaining	20.52 per hec.
Racking	21.29 " "
	$41.81

The area was planted with open rooted and jiffy pot stocks of E.globulus, E.resinifera, E.microcorys and E.saligna.

Preliminary assessments of this trial indicate that open rooted stock was not successful. E.globulus in jiffy pots has established successfully on all sites. Some trees 11 months after planting are in excess of 2.5 metres high.

(2). Direct Seeding Trials on Dieback Sites

Broadscale rehabilitation of dieback areas can only be achieved if low cost establishment techniques can be developed. In this trial growth and survival of direct seeded E.maculata and E.globulus sown over and N x P fertilizer placed at 20 cm was compared with jiffy pot planted and fertilized trees.

Preliminary results indicate excellent survival (75% stocking) and growth of fertilized direct seeded trees. In the absence of fertilizer survival of direct seeded trees was low (10%) and growth of survivors poor. Assessments continuing.

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D.F.O.

SRS:LRH
Dwellingup Research
7th July, 1975.