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MR. McENOY

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CONTENTS

AERIAL PHOTO INTERPRETATION OF DIEBACK AREAS

by

F. Batini and J. Williamson

INTRODUCTION

With any forest disease situation, one of the first needs is to map the extent and the location of the diseased areas. Foresters have used various methods for mapping fungal and insect damage. These include ground reconnaissance, aerial photo interpretation and surveys from aeroplanes and helicopters.

Errors are inherent to any of these methods and it is therefore desirable to obtain a numerical expression of accuracy. The areas mapped in the Northern Jarrah Forest have been field checked and the results obtained will be discussed in this report.

METHOD

The interpretation was carried out using pocket and mirror stereoscopes and the Pinjarra 1 : 40,000 black and white photographs (approximate scale 48 chains = 1 inch). The minimum area delineated was 5 acres and the following classes were separated.

A.	unaffected	type 1
B.	affected	type 2 (affected but green)
		type 3 (dead)
C.	swamp	type 4
D.	water surfaces, rocks and cleared areas.	

The typing errors can be analysed in two ways.

1. Errors in total area (usually expressed as a percent over or under estimate) and
2. Reliability of the map produced (expressed as the probability of a point, randomly selected on the type map and falling in the correct type when it is located in the field).

Field checks were carried out with strip lines half to one and a half miles in length selected so as to cross type boundaries. Each chain along the line, the field type was noted. This was subsequently compared with the map types and an estimate of reliability and area errors was obtained.

RESULTS

Errors in Total Area

Example 1 Area mapped = 84, 850 acres
Area field checked = 1, 456 chains
= 291 acres

Class	Estimated areas from Aerial Photo Interpretation (Acres)	Corrected Areas Based on Field Check Lines (Acres)
Unaffected	69, 040	69, 367
Affected	11, 370	11, 353
Swamp	4, 440	4, 130
Total	84, 850	84, 850

Example 2 Area mapped =180, 300 acres
Area field checked = 2, 965 chains
= 593 acres

Class	Estimated areas from Aerial Photo Interpretation (Acres)	Corrected Areas Based on Field Check Lines (Acres)
Unaffected	147, 630	148, 260
Affected	19, 410	20, 560
Swamp	11, 200	9, 420
Water Surfaces	2, 060	2, 060
Total	180, 300	180, 300

These area statements indicate that the extent of the disease has been accurately mapped. The larger error (1, 150 acres, or 6%) is accurate enough for management and planning purposes.

Reliability

Probability of a Random Point falling into the correct type.

Class	Example 1	Example 2
Unaffected	95%	96%
Affected	69%	73%
Swamp	81%	72%
Total	83%	86%

The reliability figures indicate that unaffected areas have been accurately located. Diseased areas and swamps have not been typed quite so accurately. These types have a relatively large perimeter for a smaller area. The width of the interpretation line on the photograph was two chains and the minimum area delineated was five acres. All of these factors contributed to this inaccuracy.

DISCUSSION

From the interpreted photographs, 40 chains to the inch plans have been prepared. These have been used for various purposes, including:-

1. The planning of overall hygiene strategy and the sub-division of forest areas into zones which indicate the severity of infection.
2. The planning of logging operations and of access routes on an individual permit basis.
3. As progress plans to record cutting within dieback areas.
4. As a stratification for inventory sampling.

Volume figures for these types have been made available by the Working Plans Branch. These indicate a considerable volume reduction with respect to jarrah (a susceptible species) but no difference with respect to marri (a resistant species).

Volume per Acre by Photo Types

Class	Marketable Jarrah >60" GBHOB (Loads)	Total Jarrah >12" GBHOB (Loads)	Total Marri >12" GBHOB (Loads)
Unaffected	10.3	21.6	5.6
Affected	4.2	10.6	5.2
Swamp	0.8	2.0	2.4

Small areas of diseased forest are impossible to delineate from aerial photographs of this scale. For the purposes of selecting road access, control of new infections within high quality forest units and detailed research work, ground reconnaissan and field surveys will still be necessary. Aerial photo interpretation is generally used in the broad planning stage. The tests described are far more stringent than those which would be applied by foresters using these maps. It is considered therefore that this interpretation has fulfilled its primary function - to define accurately the extent and the location of diseased areas within the northern jarrah forest of this State.

LARGE MARRI CAN BE KILLED BY DEEP INJECTIONS OF TORDON

by

C. W. Moore

Since the thinning of our prime Jarrah pole stands started, we have been faced with one difficult problem; killing the unmerchantable marri within these areas. In the main these marri are enormous in size and are taking up vast amounts of space and nutrients which should be put to a more economical use. In addition they have proved difficult to kill using the techniques which are satisfactory for jarrah.

For this reason the following two experiments were carried out.

The initial trial was made on 120 veteran marri ranging in girth class from 5' to 15'. Trees were grouped into 10 lots of 12 stems each.

12 combinations of treatments were used to test:-

1. Season of application;
2. distance apart of notches;
3. different doses of Tordon.

A modified miners pick was used to form the notches and a calibrated sheep drencher to inject the required amount of poison solution. Tordon 50D diluted with water was used.

Treatments were as follows:-

A. Notches 10" apart 0.1 gms of Tordon 50 per notch*

B. " 10" " 0.075 " " " " " "

C. " 5" " 0.050 " " " " " "

D. " 5" " 0.025 " " " " " "

Treatments were applied during the months of January -mid summer, June-mid winter, October-mid spring.

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* 0.1 gm is the quantity of Tordan contained in 2cc of Tordon 50D.

The seasonal effects which resulted were:-
June 10% deaths;
October 17.5% deaths;
January 5.0% deaths.

The best result was given by the October (spring) treatment, and the worst result by the January (summer) treatment.

Results for different notching distances and amounts of Tordon were:-

10"	at 0.10	gms	16.7% deaths
10"	" 0.075	"	6.7% "
5"	" 0.05	"	20.0% "
5"	" 0.025	"	0 "

From these results it is obvious that there was no significant difference in the distance apart of notches, but there was a considerable difference in the amount of Tordon used.

With these results to hand it was suspected that the results could have been effected by the gum which was exuded by the tree when punctured. Some of the solution might also have been washed out by rain because of unsatisfactory notching.

A second experiment involving 60 veteran marri was laid down on the 29th September, 1968.

Three treatments were used. Trees were tabulated in ascending girth order and then split into three groups of 20 so as to give equal girth representation for each treatment.

To enable the solution to be more readily absorbed it was decided that for two of the treatments holes should be drilled into the outer sapwood (xylem) for a depth of approximately two inches as the notching tool went in only as far as the cambium.

Treatments were as follows:-

1. Notches 10" apart with 0.15 gms of Tordon 50D
2. Drilled holes 10" apart with 0.15 gms of Tordon 50D per notch
3. Drilled holes 0" apart with 0.30 gms of Tordon 50D per notch

Eight months after the treatments were laid down the results were:-

1. Notches 10" apart 0.15 gms per notch - 50% dead
2. Drilled holes 10" apart 0.15 gms per hole - 90% dead
3. Drilled holes 20" apart 0.30 gms per hole - 85% dead.

It is quite obvious that the bored holes gave by far the better results and that the distance between holes had little effect on the results.

Further experiments are planned to find out just how far the distance between bored holes can be extended without losing killing efficiency.

OFFICER TRAINING

by

A. R. Gobby

Twenty one Forest Guards and Forest Rangers commenced the Field Staff Correspondence Course on October 27th. Over seventy applications were received so that acceptance for the course has been limited to Forest Guards and Forest Rangers in the general division, who have not recently done the Forest Field Cadet course. Officers in the Research and Working Plans sections may be able to use parts of the course which are useful to them under the guidance of the officers in charge of their section. Those who were not able to take the course this year will be invited to apply next year.

Officers taking the course will attend the first training day at Dwellingup or Manjimup just after Christmas when the Botany, Pathology and Surveying and Mapping sections will be covered. The programme for this day will include sessions for group discussion on each section, talks by specialist officers on important topics and practical field work. It is hoped that these days will provide a time for those taking the course to obtain answers to any problems they may be having with the course.

In view of the number of applicants to undertake this course and the number of enquiries about courses suitable for foresters which I have received since then, especially from research and specialist officers, the following information may be of interest to some people. Correspondence courses in Western Australia are conducted by two sections of the Education Department. The W. A. Correspondence School, Thomas Street, Subiaco offers courses in most junior and leaving subjects. The Technical Extension Service, 480 Newcastle Street, Perth, conducts courses in subjects at leaving level and of a more technical nature and it is suggested that the courses offered by this section would be most suitable. If you are considering doing a course next year which would help you in your work, write to both these sections and obtain a copy of the syllabus' of the courses that they offer. Units that may be particularly useful to foresters would be junior or leaving English, mathematics, biology, physics or chemistry and the Technical Extension Service courses, English expression, agricultural botany, nursery practise, soil science, plant pathology, geology, genetics or statistics.

Some officers are aware that promotion to higher field staff positions depends upon their ability to do the job. One way of improving your ability is

through correspondence courses. Unfortunately, there is no complete forestry course available at a level which would help officers train for higher field staff positions. The low level of interest in a course of this type written by the Queensland Technical Correspondence school which was advertised in the circular concerning the Field Staff Correspondence Course, sent to all officers is an indication that the demand for a training course for higher positions is not sufficient to warrant the time and expense of making it available. Had there been sufficient interest in this course, steps could have been taken to introduce a course at this higher level.

If you are interested in doing a subject by correspondence discuss with your senior officer the selection of a unit which will help you most in your job. I would be happy to answer any queries regarding courses available through the Technical Extension Service or to discuss with anyone training for higher field staff positions.

RECREATION - AN IMPORTANT ASPECT OF FORESTRY

by

W. B. Edgecombe

INTRODUCTION

During the term from January 26th until March 22nd I was fortunate to be able to attend my first of a possible seven, one month courses on Recreational Leadership. This programme is conducted at the National Fitness Council's training centre at Narrabeen N.S.W. As a result I have a greater awareness of the concept of recreation; how a recreation programme can be set up in a Forestry centre and the influence of the recreation needs of the people (in the South West) on future forest policy. Before discussing these items it is necessary to define what recreation is.

DEFINITION OF RECREATION AND LEISURE

Recreation when defined embraces a multitude of activities done by people usually during their leisure time, for some constructive purpose; without compulsion; for enjoyment; " and not consciously performed for the sake of reward beyond itself" (1). It serves as a balance to the increasing complexities and mental pressures of life and results essentially in "the refreshment of strength and spirit after toil" (2). Such a definition can be expanded by saying that "the purpose of recreation is not to fill in time but to fulfill life" (3).

Leisure refers to the time remaining after work has been accomplished, plus other obligations to the family, and to the community.

THE IMPORTANCE OF RECREATION

"At work, one is told what to do and how to spend one's time. Recreation implies voluntary use of time and thus denotes self-responsibility. A person who regularly engages in some form of recreation as a balance to his work enjoys a rich, full, and abundant life, and also performs better at his job" (3). Those who regard play as frivolous and hold a second job to keep "up with the Jones' " could miss the fulfillment of life and expose themselves to needless mental and physical pressure without any break. Mental illness often results from this common approach to life.

THE NEED FOR RECREATION LEADERSHIP

Leisure is increasing and unless we are taught to use it fully and effectively it could be the downfall of our present social system (compare the fate of the Roman Empire). "Therefore it is essential that education, as at present, is not just restricted to training for a career but also how to use our spare time productively" (4). "Learning how to live is as important as preparing oneself for a particular vocation of profession." (3). The training of professional leaders is the best approach as these people can go into the community (as do doctors, school teachers and policemen) and organise activities for all ages to keep people occupied during leisure. Experience in the U.S.A. which is more "advanced" socially than Australia, shows that the provision of facilities is not sufficient to ensure the success of community recreation (e.g. athletic tracks, gymnasiums, swimming pools.) Leadership is imperative to provide and vary programmes to retain interest, as people soon become bored if they are not stimulated with something new.

THE PRESSING NEED FOR RECREATION PLANNING

Australia probably has not reached its saturation point yet where recreation facilities have fallen disastrously behind the needs of the people. This has happened in the U.S.A. and is a major contributory factor to racial tension and riots. "In fact, suggestions indicate that riots are a twisted, malignant type of recreation caused by boredom, frustration and discrimination, coupled with ignorance and lack of understanding by the governing bodies" (5).

However, in Australia the major factors which will force the need for recreation planning are reduction in working hours, high wages and hence more disposable income, automation in industry and technological advances culminating in the taking over of office jobs by computer. A few examples both here and in the U.S.A. are:-

"(i) Dr. Brian Corrigan suggests that a twenty hour, four day working week is not far off, with six weeks annual leave and two hundred leisure-free days per year!

(ii) Automation in industry in the U.S.A. results in 50,000 jobs per week going out of existence resulting in retrenchment, retraining or early retirement on Government benefits!

(iii) America's annual supply of 800 million light bulbs could be made by 16 men!

(iv) An economic advisor to Senator Barry Goldwater suggested a negative form of income tax as it would be cheaper to pay men not to work than create work situations which are unnecessary!"(6).

If Australia develops along these lines, the time could conceivably arrive when many people do not work at all during their lives! Recreation would be the only way to enable these people to lead normal lives.

ESSENTIALS AND BENEFITS OF A SMALL TOWN RECREATION PROGRAMME

1. Basically a leader of a Recreation Programme must have some training and knowledge of the diverse activities which can be incorporated.

2. He must have the skill and perserverence to see his programme carried out.

3. He must be able to improvise and vary activities to suit ever-changing popularity.

4. He must make the goals meaningful to the participants via experiences that have direction and purpose. This is essential before monetary assistance can be provided by Government bodies and service organisations.

"Programmes must cover:-

1. Emotional and Physical Health
2. Character Development
3. Widening Interests
4. Citizenship
5. Skills - mental and physical
6. Social living
7. Economic values
8. Community stability

The tasks of the recreation leader are:-

1. Planning
2. Organising
3. Staffing
4. Directing
5. Co-ordinating

6. Observing
7. Reporting
8. Evaluating" (6)

The benefits of a successful recreation programme in a town such as a Mill and Forestry Settlement are:-

"1. Employees weld themselves into a more co-operative industrial family.

2. Artificial barriers between companies and between various levels of authority are largely eliminated - workers learn that supervisors are human.

3. They discover the company has interest beyond their jobs.

4. Off-hour habits have an important bearing on job performance - no programme of activities - off to the pub!

5. Employees experience morale-boosting experiences during recreation triggering loyalty and community pride.

6. Happy discussion on the previous nights or weekends activities replace gossip, rumour and often unjustified gripes.

7. Job monotony is combatted especially if regular programmes take advantage of before and after work and even during lunch periods"(9).

THE IMPORTANCE OF FOREST LAND FOR RECREATION

Besides recreation within a community there are a number of factors causing people to use the forests for recreation more than ever before.

Quoting from an article by K. W. Cremer(7):-

"the average Australian may enjoy recreation in the forest environment possibly thirty times per year (The O. R. R. R. C. (8) suggests 86 times in the U. S. A. for some one over 11 years of age but allowance is made here for the great popularity of beaches). That is, driving for pleasure 16 times, picnicing 6 times, walking 4 times, camping once and fishing or hunting once."

By extending Mr. Cremer's following paragraph where he suggests that each recreational experience may be worth 20 cents; for a population of 800,000 in our South West this would amount to $4,800,000 or a sum equivalent to our total forest revenue. Thus a tangible estimate of our priceless national heritage.

With people having more leisure they are sure to come to the forests more often.

Besides this, the frustrations of urbanisation, growth in population, ease of transport, improving roads will bring more people to our forests.

"One reason why camping has become such a popular leisure activity is that it provides a balance to the brick and concrete of urban living" (3).

"People can get along without wood but not without trees" (7).

"Real contact with nature should help remind man of his place and maintain proper perspectives" (7).

Forests are aesthetic, scenic, natural habitats of indigenous flora and fauna, catchment areas for purification and perpetuity of water supply; places for contemplation, hiking and natural phenomena unspoilt by man. With careful planning and foresight they can be established as a vast expanding recreational resource.

In 1962 the Outdoor Recreation Resources Review Commission studied recreation with the view to implementation of a permanent policy for U.S.A. Their findings were:-

"1. The simple activities are the most popular. Driving and walking for pleasure, swimming, and picnicking head the list, with driving for pleasure most popular, regardless of income, age, education, or occupation.

2. Outdoor opportunities are most urgently needed near metropolitan areas. Seventy five percent of the people will live in these areas by the turn of the century.

3. Across the country considerable land is now available for outdoor recreation, but it does not effectively meet the need. The land is where the people are not. The problem is not one of total acres but of effective acres.

4. Water is a focal point of outdoor recreation.

5. Outdoor recreation brings about economic benefits to the country"(8).

Although these are findings from an American investigation it appears that they can be easily applied here. Indications suggest that Australia is more like America than the people are willing to admit.

THE IMPORTANCE OF RECREATIONAL CONSIDERATIONS IN OUR FORESTS

To enlarge on the preceding paragraph it is interesting to discuss this subject under the headings of the O. R. R. R. C.

1. Our forest roading is very extensive for tourists and is constantly being upgraded. The very nature of our undulating timbered areas with gravel soils lend themselves easily to roading and ease of access compared with rugged forests in other countries. Our steeper areas, near the major rivers which cut the Darling Scarp, are (or will be) either well roaded for plantations or water catchment sites. All our major reservoirs have bitumen road access and are scenically landscaped.

2. Urban development is spreading. Most of the coastal plain has been cleared for farms and the remaining acres of natural forest and exotic conifers, which should be left as belts through our large cities, are gradually being swallowed up by the monstrous urban sprawl. People are still moving to the cities; 70% of the population of W. A. are in Perth; 85% are in the South West land division. Major towns spread around our forest, to the west along the coast and to the east in our open farming districts.

3. Our forest is not isolated. It is within easy reach of people from all the surrounding districts. It is in the middle of the most densely populated division of WA. It is also quite accessible, far from rugged and climatically favourable for most of the year. With the lack of timbered areas around our cities and farming districts there is little wonder that people go to our forests for a change.

4. "Water is the focal point of recreation". This is also so in Western Australia and the major rivers of the South West originate or flow through our forests. The statement that water will be the limiting factor in the development of W. A. is true (however much water is wasted).

Until cheaper methods can be found to readily extract pure water from the sea or ground, our forest catchment areas must supply the bulk of our states needs in the South and to the East.

Most major rivers in the Darling Ranges are ear-marked for one or more dams.

Perhaps a crisis will arise where pressure for recreational use of such vast areas of water will force a compromise on our present stringent catchment area laws?

5. The industry of sales of recreation equipment in U.S.A. with its 20 billion dollar per year turnover is something worth considering. It must be an important factor in top level government decisions of the importance of forest use. People like to camp, hunt, fish, boat and hike. To have a reasonable amount of success and comfort, equipment must be satisfactory and be renewed from time to time.

K. W. Cremer sums up the importance of the issue of recreation in forests in two sentences:-

"If the Australian forest services underestimate the demand for recreational use of their forests, they will be more pressured to relinquish control of some of their forests" (7).

"Conservation means wise use of resources and that conservation is for the sake of people not for the values conserved (wood, water, scenery, etc.)".

DISCUSSION

From all the evidence available it seems recreation is necessary for the well being of mankind. Australia must make haste to assess the growth and foster this vital social phenomena.

The people who live in our forested area must be educated and encouraged to realise the benefits of recreating effectively if they are to conserve this area in the interests of the bulk of the populus of W. A.

It would seem advisable that recreation aspects should be considered when planning forest management. Evidence suggests that interest is accelerating, but is it swift enough to control the changing scene in our forests?

Perhaps an inventory is necessary to zone our forest in various categories for diverse recreational use?

How important are the effects of reforestation, dieback, mining, water catchments, clearing for exotics, pollution and control burning as factors affecting the provision of adequate recreational opportunities for our people?

Should more of our natural forested areas be left for perpetuity and important ecological research?

Destruction of indigenous forests for quick returns must be weighed against the impossible task of returning them to their original state. The aesthetic value of large trees and scenic landforms are priceless. The destruction of such should not go unchecked and strong legislation is needed for their protection.

Our forests remained the same for many years, however, escalation of activity and perhaps apathy of people using them is a threat to their conservation.

It appears the time is ripe for an increase in the present consideration for recreation as more people than ever before are using their leisure productively in our timbered areas.

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PROMOTIONAL EXAMS 1969

Congratulations to the following officers who were successful in the 1969 Promotional Exams.

Technical Assistant (Grade 2)

Miss P. M. Collins	Manjimup
H. J. Kuhn	Wanneroo

Technical Assistant (Grade 1)

E. G. Popham	Como
P. R. Skinner	Manjimup
H. R. Annels	Manjimup

Forest Ranger

T. A. Backhouse	Grimwade
R. K. Burns	Dwellingup
B. F. Forster	Mundaring
B. W. Harris	Ludlow
J. C. McWhirter	Collie

Assistant Forester

T. J. Ashcroft	Lewana
D. J. Donnelly	Collie
A. Holland	Dwellingup
R. A. Kitson	Pemberton
N. Phelps	Nannup
T. H. Wood	Jarrahdale

Forest Assistant

J. H. Dorlandt	Shannon River

District Forester

A. Kesners	Wanneroo

ESTIMATES OF MERCHANTABLE VOLUME IN THE NORTHERN JARRAH FOREST

by

F. Batini

INTRODUCTION

The accurate assessment of merchantable volume of individual trees or plots is a difficult task which is subject to a number of errors. Not all of these sources of error (e. g. the accuracy of the volume table, the volume loss due to smashing) are under the assessor's direct control. There have been few investigations into this aspect of Forest Inventory. The results from 75 plots established in the Northern Jarrah Forest are discussed in this report.

METHOD

The plots were established in forests treemarked for felling. Each marked tree was inspected by the assessor, numbered, its girth breast height recorded and the merchantable bole length estimated by eye. After making due allowance for any visible defect, the volume was read off from the Abbreviated Volume Table, Jarrah, 1957.

The trees were then felled and crowned off by the mill faller in his normal operations. Prior to snigging, the prepared log or logs were measured (centre girth x log length), a girth correction for bark was subtracted and the volume calculated from the Cubic Contents of Logs Table.

RESULTS

A summary of the results is presented in the following table on the next page.

The results obtained by these assessors are not strongly biased and are quite precise. Over the 75 plots, an accurate and precise estimate of merchantable volume has been obtained.

Comparison of the Estimated Merchantable Volumes and the Volume removed in Trade Operations

Assessor	No. of Plots	Sum of the Estimated Merchantable Vols. (cub. ft.)	Sum of the Volume Removed (cub. ft)	Mean Difference per Plot		95% Confidence Limits of the Mean Difference per Plot	
				cub. ft.	%	cub. ft.	%
A	13	10,796	10,288	+39.1	+4.7	90.8	10.9
B	30	23,224	23,730	-16.9	-2.2	60.9	7.9
C	32	28,283	27,623	+20.6	+2.3	52.9	6.0
Total	75	62,303	61,641	+ 8.8	+1.1	35.6	4.3

THE CONCEPT OF DROUGHT INDEX IN WEST AUSTRALIAN FORESTS

by

G. B. Peet

INTRODUCTION

In 1968 Byram and Keetch (U.S. Forest Service) published the format for a drought index which expresses fuel dryness in forests. This index received favourable comment and is recognised in the Eastern States and U.S.A. as a valuable aid for planning of fire control. It is being tried experimentally at West Australian forest centres.

The first part of this article will review what the index means and its possible application in Western Australia.

The application of a drought index depends on the moisture fluctuations of fuel variables being comparable and of particular importance, that the different fuels are in phase. This consideration will be the basis of the second part of the article.

THE DROUGHT INDEX

Statements in this section are summaries of points in publications by Byram and Keetch (1) and by McArthur (2). More detailed explanations can be obtained by reading the publication listed at the end of this article.

The drought index is a number representing the nett effect of evapotranspiration and rainfall in producing a cumulative moisture deficiency in deep duff and upper soil layers. Primarily, drought index relates to the flammability of organic material in the ground.

This organic material includes humus, buried wood and heavy logs, all of which add to suppression problems when dry. The relative dryness of these fuels is a direct effect of drought because their drying is a much slower process than in flash fuels.

A prolonged drought affects fire intensity by making more fuel available for combustion. This increased intensity adds to the difficulty of holding fire-

lines, hence suppression.

The purpose of drought index is to provide managers with a continuous scale of reference for estimating deep drying in litter profiles.

The drought index is a scale of zero to 800. A zero index means saturated fuels where eight inches of water are available in the soil for transpiration. An index of 800 is the maximum drought possible with plants at wilting point. At any point on the scale the amount of nett rainfall (total less 20 points) in points is that required to reduce the index to zero, or saturation.

Additions and subtractions to the index depends on rainfall in the past 24 hours and on maximum temperature. Full explanation of these calculations are provided in the publications listed below:

Byram and Keetch's conclusions were:-

1. Droughts develop after extended periods of little or no rain when daily maximum temperatures exceed 50^{o}F.

2. Consistently high daily maximums exceeding 70^{o}F are required for appreciable drought development.

3. Drought has a variable significance depending on whether duff fuels are present in the area.

McArthur (2) defined the drought index as representing a cumulative moisture depletion in deep forest litter, heavy fuel components, living vegetation and the upper soil layers. Byram and Keetch suggested the foliar moisture content of chamise to vary with drought index.

McArthur suggested the drought index as a good indicator of quantity of fuel available for combustion. An index of 400 represented full fuel availability in P. radiata stands.

Controlled burning restrictions should be imposed when the drought index exceeded 100 in spring and not relaxed before it fell below 100 in autumn. These limits were intended as a broad guideline rather than as restrictions for particular forests.

THE DROUGHT INDEX CONCEPT

There seems little doubt that the drought index is a good concept for duff

and heavy wood fuels. These dry slowly and are likely to be in phase with a cumulative index of this type.

Heavy fuels add to suppression problems when they ignite. They usually burn behind the main fire front and for a considerable period. This adds heat to the convection column increasing the convective preheating of unburnt fuels and to the updraft carrying spot fires ahead.

These differences are quite evident in the difficulty of control of fires burning in early spring and similar spreading fires in late summer.

The significance of a drought index will depend on the presence of heavy fuels. Duff is being steadily reduced by controlled burning, not necessarily by the burn itself which usually leaves the duff intact, but by the accelerated decomposition which seems to accompany exposure of it. Measurements suggest that in regularly burnt jarrah the small depth of duff is of little significance as a fuel factor compared with pine plantations or karri.

In West Australian forests severe droughts on the Byram scale seem to be quite common during summer. For three seasons at Dwellingup (1962 - 1965) the drought index exceeded 700 in February and March. For five seasons at Pemberton (1964 to 1969) the index exceeded 600 in February and March.

In each of these seasons the rise of drought index was fairly regular, starting in September and rising to peak in February and March. Thereafter it fell steadily to zero in May or June. These trends are unlikely to represent 1969-70 where drought effects are already well known.

While drought index should represent rates of drying in the heavier fuels; trends in scrub need further investigation. Rates of litter drying are quite different in jarrah, karri and pine plantations each of which needs a separate definition to define fuel availability on the Byram scale.

FUELS

Several fuel components have been suggested as being affected by the drought index and these will be considered in turn.

Scrub

McCormick (3) showed foliar moisture content to be important in regulating rates of burning for scrub foliage. Fluctuation between seasons, species and diurnally were recorded. The amplitude of the seasonal fluctuation was much

greater than the diurnal one for most of the test species, suggesting seasonal differences in inflammability.

With the exception of ti-tree the test species showed high foliar moisture contents in spring, during the period of growth flush, and decreases in late summer and autumn starting about January. This suggests the test species were least inflammable in spring.

Foliar moisture content was in opposite phase to drought index until January, after which both were in phase. The "in phase" period was probably introduced by moisture stress and seemed to occur at an index exceeding 600.

Drought index may indicate the dryness of scrub foliage once it rises above 600. These species are adapted to drought however and their growth habit in spring precludes a relationship between rising index and foliar moisture content in these months.

Terminal leaves of jarrah were measured weekly over a 2-year period to record seasonal moisture changes. There was little significant change except during leaf replacement in summer, when the highest moisture contents were recorded. These trends were not "in phase" with drought index.

Litter Fuels

In both jarrah and karri trends in profile moisture contents of heavy litter fuel were studied for relationships with drought index.

For karri there was some correlation providing the fuel was heavy with thick duff. Lighter fuels in both jarrah and karri were influenced primarily by day to day weather and can be excluded as not representative of the drought index concept.

In karri a drought index of 50 in spring approximated a moisture content of 200%, or saturation, and 400 about 25%, or full availability (Van Didden, 4). There were marked fluctuations about these values due to the influence of daily weather. Unfortunately, duff was not measured separately which might have produced a better result.

The observations for karri were made at one site and variations on the above values could be expected in others.

At present the evidence suggests that jarrah litter dries faster under

forest conditions than does karri. This seems to be primarily an environmental control and drying curves for the two types are dissimilar in form. This poses some mathematical problems in interpretation of drought index.

It may be possible, site considerations aside, to fix points along the index scale at which karri and jarrah fuels become fully available. If the drying curves for the two types were parallel and similar to the drought index one, then simple corrections could be employed to describe relative dryness at any point on the scale. At present this does not seem possible for profile moisture content although duff may be quite different when treated as a separate component.

Whether the Byram scale presents any better measure of fuel availability than the karri A, B, C drought index in current use is doubtful for this forest type, although the question has yet to be resolved. Its structure makes it unlikely that it will describe fuel dryness in autumn any better than the present table.

Bark

Trends in the moisture content of outer dead bark on jarrah trees was plotted for one season. There was a seasonal trend with reasonably regular monthly decreases from spring to summer and rises after the autumn rain.

The period of inflammability appeared to lie above a drought index of 300.

Logs

As yet measurements of log moisture content have not extended sufficiently to comment. McArthurs suggestion that logs are dry at an index of 400 is the best indicator available.

DISCUSSION

The concept of drought index is a valuable one for planning fire control, particularly suppression. Its interpretation in practical terms is not so easy to conclude.

The main value of drought index appears to be in heavy duff fuels which follow a prolonged drying trend rather than in light litter which fluctuates with daily weather.

Drought index attempts to define the availability of additional fuels which chang the fire model. The burning of heavier fuels increases heat input into the con-

vection column. This adds to the convective preheating of unburnt fuel (as distinct from radiation), updraft and spot-fires. "Mop up" commitments are increased.

The Byram index suffers from extending a standard format for drying into a range of forest types where these rates are quite dissimilar. As such it is not possible to do other than identify points on the scale where certain fuels are likely to become available for burning. The range of scale behind that point may be quite inaccurate for defining relative dryness.

Some suggested points on the drought index scale were given for trial in the last section. One of these suggested an index exceeding 400 as representing full fuel dryness in deep karri litter. This does not mean necessarily that 200 represents half availability, as the form of the drying curve for litter may be quite different to the form of the drought index curve during the intermediate stages. This has yet to be investigated.

Drought index cannot be interpreted as a precise measure of fire behaviour. The ignition and spread of a fire is primarily influenced by the weather and fuel variables in fire danger ratings. What a drought index should do is indicate the likelihood of the fire model described by the danger rating changing to something more intense e. g. accelerated convectional activity and spot fires. Whether the Byram index will provide any better measure of this than the current karri drought index remains to be investigated.

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MARRI VOLUME TABLE

by

J. Williamson

A Marri volume table has just been produced by the Department. This is the first Marri volume table to be prepared and credit for it is due to Dr. Ferguson, who designed the original field work; to the Working Plans and field staff who measured and supervised the field measurements; and to Hugh Campbell who improved on the regression technique of Dr. Ferguson and who solved some other computational problems.

The table was prepared from accurate sectional measurements of over 200 trees in the Manjimup - Pemberton area, but will be suitable for assessment of all Marri, and there will be no need in future to use the Jarrah volume table for this purpose.

The major feature immediately apparent is that Marri generally tapers less than Jarrah, so that for the same girth and bole length, Marri has a bigger volume than Jarrah.

For example a tree with 8' girth and 40' bole length:

Jarrah = 2.3 loads

Marri = 2.7 loads.

In general, Marri and Jarrah volumes are found to be similar for trees of small girth but for trees over about 6' girth, Marri becomes about 15% greater in volume than Jarrah for the same bole length.

In practical terms of course, this means that there is a greater volume of Marri in the forest than we thought, and this has now been allowed for in all calculations affecting the Marri chipwood project.

COMPUTING THE ECONOMICS OF FORESTRY

by

C. Miller

In the June, 1969 issue of Forest Notes an article entitled "Economics of Forestry" by D. Spriggins compared estimated costs of production and possible returns from some typical forest crops. Many hours of tedious calculations must have gone into producing the figures quoted for each exercise.

The purpose of this article is to point out that a computer programme (called "FINTAB" for "Financial Tabulation") is available for that type of calculation. It could save aspiring economists a few hours of drudgery and produce a wider range of results with better precision and reliability.

A table of profit or loss values is produced for four interest rates and three levels of overheads; both interest and overhead rates may be varied to suit the exercise being computed. Appendix 1 shows an example of the output for a set of test data.

Recently Mr. Spriggins' four exercises were run by computer and the resulting tables are shown in appendices 2-5, together with his results for comparison. The extra levels of 30 and 60% overheads were used to fully utilize the capability of the computer programme.

There are only small differences between the manual and computed results; due probably to the following reasons:-

1. Human errors.

2. The manual calculations did not maintain as much precision as is possible in the computer.

Further calculations have proven the validity of the computed results and have shown where errors crept into the manual work.

Finally, the most noteworthy feature of this exercise was the little time required by the computer to produce the four sets of results. Feeding in the data and printing out results took four minutes, of which the actual computations only required 34 seconds.

APPENDIX 1

Example of Fintab Output Test Data for Program "FINTAB"

Statement of costs and returns used in the calculation of the profit values tabled below.

Initial Establishment costs of $100. /Acre
Subsequent cost of $10. /Acre incurred in Year 1.
Subsequent cost of $10. /Acre incurred in Year 2.
Subsequent cost of $10. /Acre incurred in Year 3.
Subsequent cost of $10. /Acre incurred in Year 4.
Subsequent cost of $10. /Acre incurred in Year 5.
Subsequent cost of $10. /Acre incurred in Year 10.
Subsequent cost of $10. /Acre incurred in Year 20.
Intermediate yield of $50. /Acre gained in Year 20.
Final yield of $500. /Acre at the end of Year 30.

Test Data For Program "FINTAB"

Net Profits, Discounted to the Year of Establishment, for Various Overhead and Interest Rates.

Overheads	Interest Rates			
	3.0%	4.0%	5.0%	6.0%
0.0	$ 74.90	$ 21.14	$-18.67	$ -48.18
50.0%	$ -4.48	$-56.78	$-95.27	$-123.59
100.0%	$-83.87	$-134.70	$-171.87	$-199.01

APPENDIX 2
Exercise 1(A) regrowing a crop of Jarrah.

Net Profits, Discounted to the Year of Establishment, for Various Overhead and Interest Rates.

Method	Overheads	Interest Rates			
		2.0%	3.0%	4.0%	5.0%
Computer	30.0%	$34.29	$2.99	-$6.03	-$8.10
Computer	60.0%	$27.43	-$1.76	-$9.56	-$10.86
Computer	40.0%	$32.00	$1.41	-$7.21	-$9.02
Manual	40.0%	$29.66	$0.82	-$6.44	-$9.02

APPENDIX 3

Exercise 1(B) Pinaster on former Jarrah site.

Net Profits, Discounted to the Year of Establishment, for Various Overhead and Interest Rates.

Method	Overheads	Interest Rates			
		2.0%	3.0%	4.0%	5.0%
Computer	30.0%	$101.57	$13.77	-$37.18	-$66.47
Computer	60.0%	$45.14	-$35.23	-$80.60	-$105.62
Computer	40.0%	$82.76	-$2.56	-$51.65	-$79.52
Manual	40.0%	$79.00	-$4.00	-$52.00	-$75.80

APPENDIX 4

Exercise 2 Pinaster Crop on the Swan Coastal Plain

Net Profits, Discounted to the Year of Establishment, for Various Overhead and Interest Rates.

Method	Overheads	Interest Rates			
		2.0%	3.0%	4.%	5.0%
Computer	30.0%	$212.47	$102.11	$35.98	-$3.82
Computer	60.0%	$163.15	$ 60.18	-$0.41	-$35.96
Computer	40.0%	$196.03	$88.13	$23.85	-$14.54
Manual	40.0%	$189.00	$87.00	$22.00	-$14.70

APPENDIX 5

Exercise 3 A Crop of Low Site Quality P. radiata.

Net Profits, Discounted to the Year of Establishment, for Various Overhead and Interest Rates.

Method	Overheads	Interest Rates			
		2.0%	3.0%	4.0%	5.0%
Computer	30.0%	$1087.33	$736.26	$489.19	$314.00
Computer	60.0%	$1021.12	$674.69	$431.33	$259.19
Computer	40.0%	$1065.26	$715.74	$469.90	$295.73
Manual	40.0%	$1001.00	$715.00	$470.00	$295.2

THE ROLE OF WATER BOMBING AIRCRAFT IN THE CONTROL OF FOREST FIRES IN AUSTRALIA

by

A. G. McArthur

SUMMARY AND CONCLUSIONS

a) Recent analysis of air tanker use by the U.S. Forest Service and Canadian Department of Forestry indicate that:-

(i) Air tanker use has increased sharply over the last decade and the U.S Forest Service alone has dropped 45 million gallons in the past ten years.

(ii) Around 70% of the drops are rated as being of "definite help" to the suppression crews or have had an appreciable effect in "reducing fire behaviour".

(iii) The use of plain water or short term fire retardants is decreasing and the use of long term retardants, especially diammonium phosphate has increased sharply, particularly in Canada.

(iv) Air tankers are, in general, most effective in the early stages of a fire.

(v) When used at wind speeds greater than 14 miles per hour, effectiveness drops off sharply.

(vi) A U.S. Forest Service evaluation finds that air tanker drops have provided substantial assistance to ground forces, but the assessment points up the necessity for using them on a selective planned basis for the utmost efficiency, since they are a relatively expensive fire suppression element.

(vii) In all cases the decision to use an air tanker must be based on a careful analysis of the particular situation. Fuels, weather, fire behaviour, topography, follow-up action and the difficulty the air tanker may have in hitting the target are all factors that have to be

considered in deciding whether the retardant drop is actually needed for control and the probability of achieving the desired results.

b) Despite the massive use of air tankers in the United States, fire damage has only decreased by 20% during the decade of their use. Improvements in fire prevention and increased efficiency in ground attack systems must account for a considerable proportion of this 20% overall reduction. One can only conclude that air tanker use has not significantly reduced forest fire damage in the United States over the last decade. It must follow that air tankers are used in many situations where they have little significant effect on the final size of the fire.

c) A survey of both Canadian and United States literature indicates that air tanker attack systems have been superimposed on the fire control system without a thorough evaluation of cost/benefit effectiveness.

d) Single purpose use of air tankers means that fire control must bear heavy capital costs and standby and maintenance charges during the entire fire season.

e) In Australia, the amount of finance available for fire control is limited, and of necessity, air tanker use will need to be gradually "phased in" over a number of years.

f) This will allow a careful evaluation of air tanker effectiveness under a wide range of fuel and weather conditions and covering the most suitable, readily available aircraft.

g) Due to the limited finance available for air tanker operation a system of dual purpose use appears to be a logical development in this country. Suitable agricultural aircraft types are available and research and operational use has already demonstrated that these aircraft can be effectively used in controlling and containing the spread of a fire in eucalypt forest burning under conditions of low to moderate fire danger.

h) Fortunately the agricultural demand for aircraft is minimal during the hotter and drier months of the year and air tanker operations on forest fires could provide an important alternative use for the industry during the summer months.

i) Extensive evaluation trials of a number of readily available agricultural aircraft types have commenced and a clear definition of the capabilities of the various aircraft should be available within six months.

j) With the guide lines established by this evaluation, forest fire authorities

can then "phase in" air tanker use as the situation warrants.

k) Air tankers can only be used to maximum effectiveness when an efficient ground system of fire control is in operation. The effectiveness of the ground attack system is still not sufficiently developed over many areas of Eastern Australia to warrant their use at the present time.

l) There are essential differences between the vegetative cover, climate and topography of the United States, Canada and Australia which preclude the adoption of a northern hemisphere air tanker system to Australian conditions. As would be expected, Australian fire control must develop a system best suited to its environment and stage of development.

m) Air tanker usage is only one aspect of a fire control system and in many circumstances, its use would have little significance in reducing fire damage. Large scale aerial control burning is one aspect which has an important bearing on whether air tanker attack systems are necessary, and in the case of Western Australia, would preclude any consideration of their use.

Reprinted by courtesy of Mr. A. G. McArthur of the Forestry and Timber Bureau, Canberra.

REGIONAL NOTES

METRO REGION

Staff Notes

New Appointments - Terry Arner who has previous experience in New Zealand plantations has been appointed as Technical Assistant (Work Study) and will initially be working on pine harvesting problems.

Promotional Exams - the results have at last been made available and congratulations are in order for:

Arthur Kesners	District Forester
Bevan Forster	Forest Ranger
Tom Wood	Assistant Forester

David Lejeune spent a week at Mt. Macedon Civil Defence School and a few days with A. P. M. Forests in mid-November.

Fire Control

Summer arrived early so far as Metropolitan Plantations were concerned and the first opportunity for practical trials with Phoscheck occurred on 1st November, 1969 at Sommerville. Results are still being evaluated but indications are very much in favour of Phoscheck.

Fire Education

Two officers from Como broke new ground in Primary School Fire Education on November 3rd. The film "Stop the Red Steer" was shown six times and six short talks delivered to a group of five primary schools and over 400 children in one day! Is it any wonder that they now find this film rather boring.

New Equipment

Early delivery is expected in the Wanneroo Division of a new type of utility. Although it is of a well known make this vehicle will have 4 on the floor, limited slip differential and wide pattern tyres (FATS in the vernacular). If the experiment proves successful it may be possible to make progressive economies in officer's transport in this Division by reducing the complement of 4 x 4 vehicles.

SOUTHERN REGION

Staff

F/G J. Brealey has transferred from Manjimup to Walpole.

F/G T. Maher has taken up his initial appointment at Pemberton.

A/F Jim "Stringer" Crawford retired on 30th October 1969 after 28 years of service with the Department. He will be missed by those who worked with him.

Forester Ernie Brown has transferred from Manjimup to Busselton. His duties as full-time Timber Inspector in the Manjimup Division have been taken over by Les Court.

Karri Seed

The bumper Karri Seed crop which has been delighting southern foresters for the last three summers has now tailed off and only very small amounts were available in Spring 1969-70. There are two crops of buds on the trees at the moment, one a "fat bud" crop which should flower in April-May 1970 and ripen by the summer of 1971-72, and the other still in the early pin-bud stage. It is felt that the under - average winter rainfall in 1969 and the very dry 1969-70 summer will affect the development of the next seed crop and results of the next regeneration burns may not be as highly successful as the last ones.

Building Projects

The shift of the Shannon River Settlement to Walpole is now, well underway.

The new Pine Sawmill being constructed at Pemberton is expected to be operating early in 1970. This mill replaces the unit at Pimelea which operated from 1954-1967.

Sawmill Record

What is thought to be a record days cutting occurred at Bunning's Karri Mill at Northcliffe during November. In a normal 8-hour day, 141 loads were put through the mill and 78 loads in the square produced; this represents a recovery of approximately 55%. The mill employs 28 men under the roof (including winch operators, saw filers, etc.) so the production per man-day was 2.8 loads.

The mill bush at the time was operating on "Super-Select" seed trees in an area cut-over and regenerated in 1968-69 in Boorara Block. The production was mainly in mine guides and some large dimension "specials" (45' x 16" x12", heart-free) for South Africa.