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CONTROL OF WILDFIRES AND PRESCRIBED BURNS IN WESTERN NEW SOUTH WALES.

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ABSTRACT

The pre-settlement fire regime had a major influence on vegetation. Pastoral activities significantly modified the fire regime by altering the vegetation, the suppression of wildfires and deliberate burning.

Except for the mallee country, significant fuel accumulation is ephemeral and occurs infrequently. However, high fuel loads can develop rapidly. Most fires in the area involve tall grass fuel.

Major fires in 1974-75 have resulted in the development of highly organised and equipped brigades.

There is a great deal of interest in prescribed burns to control scrub regrowth and improve pasture production. This activity results in hazard reduction and preparedness of brigades.

The logistics of fire control in arid areas revolve around the paucity of resources, particularly man-power. Thorough organisation is essential in such situations for all fire control.

Landscape has a major influence on the fuel type and fuel quantity which, in turn, affect fire behaviour. Landscape also affects access. The three main landscape factors are topography, soil type and the presence of timber

and scrub.

Fuel type factors that affect fire behaviour and fire fighting strategies are flammability, flame height, spotting and fuel moisture.

The weather influences fire behaviour and fire fighting strategies by the factors of temperature and humidity, cloud cover, wind velocity and direction and atmospheric instability.

Fire control techniques mainly involve dry fire fighting with earth moving equipment. Aircraft are very valuable in these areas.

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1. History of Wild Fire Occurrence

1.1 Prepastoral settlement

The records of the early explorers note the existence of fire started by Aborigines, who used fire extensively - this would have added significantly to the occurrence of fires caused by lightning alone. The frequency and distribution of fires caused by lightning and Aborigines meant that fire was an important factor in developing the landscape vegetation of western N.S.W.

1.2 Pastoral settlement

Pastoral settlement brought significant changes to the landscape, including changes to the fire regime, mainly as a result of livestock altering the vegetation and the direct suppression and control of fires by landholders. The spread of lightning ignited fires was significantly affected after settlement.

The decline in the number of Aborigines living off the land from the mid-1800's onwards meant that fires caused by their activities also decreased. The grazing of livestock reduced the vegetation which would otherwise have formed fuel for wildfires. Grazing also resulted in some vegetation types becoming more grass and herbage dominant and this resulted in a greater fire hazard. The reduced incidence of fire and the overgrazing by both livestock and rabbits have been contributing factors in the increase of scrub density in some areas. Where the scrub has depleted the pasture cover the fire hazard has generally been reduced.

Another factor in the change of the fire regime was the use of fire by graziers. Some were keen to use fire to produce a "green pick" or open up mallee-porcupine grass county. On the other hand, many landholders made every effort to reduce the risk of fire and to suppress any that did start.

1.3 Contemporary situation

Significant fuel loads develop infrequently because of the relatively low and variable rainfall in the area. Except for the accumulation of litter under mallee trees most fuel loads in western N.S.W. consist of annual or weakly perennial grass and herbage which accumulate over one or two seasons. However, in years of extended rainfall periods, high fuel loads can build up in a relatively short period, resulting in a very high fire hazard. Major fires in western N.S.W. mainly occur in such seasons (e.g., 1957, 1969, 1974-75). The probability of fire is naturally increased if, in seasons producing a high fuel load, dry lightning storms are common.

The infrequent occurrence of fires in western N.S.W. resulted in a lack of preparedness for the major fire outbreaks that occurred in 1974-75. Since that time brigades have been organised to cover the whole region. There is generally good liaison with interstate brigades when the need arises.

2. Prescribed Burns

Until quite recently, very few landholders would deliberately use fire as part of their management. However, studies into the causes and possible solutions to the major scrub and timber regrowth problem in western N.S.W. have resulted in a large amount of interest in using fire in the management of these rangelands (Leigh et al, 1981; Ralph, 1980). Organisations involved in research and co-operative programmes with landholders are CSIRO, Soil Conservation Service and the Western Lands Commission with strong support from the Bush Fire Council and the Forestry Commission. As a result of this, it is anticipated that fire

will become increasingly used by landholders as part of their regular management programme.

The increased use of controlled fire will have an obvious direct effect on the wildfire situation by hazard reduction and maintaining preparedness of brigades.

3. Fire Suppression and Control

Fire suppression in western N.S.W. is concerned mainly with grassland fires. However, many of the principles involved are common to grassland fires in other areas and to fire fighting in most situations.

In general, most large operations involve dry fire fighting techniques, i.e., burning back from fire breaks formed with earth moving equipment. Water is mainly used for protecting property improvements, small fires, 'mopping up' operations and personal safety.

The problems associated with fire fighting in the area can be divided into three categories: - logistics, landscape - fuel type and weather.

3.1 Logistics

In sparsely populated areas, such as western N.S.W., it requires thorough organisation and adequate pre-fire season preparation to ensure that available resources are deployed to best advantage.

The combination of lightning-caused ignitions and sparseness of population often means that fires may start to run either before brigades can attend or even before they are detected. In some seasons the large number of lightning-caused fires can place a great strain on fire fighting resources.

In a severe wildfire situation it may be necessary to set up a forward emergency control centre at a significant distance from any town.

3.2 Landscape and fuel type

Landscape has a large bearing on the type and quantity of fuel present. Fuel type and fuel quantity are the main factors affecting fire behaviour. The seasonal conditions preceding and during the fire season are the most important factors determining the fuel build-up. Tall grass, up to 60 to 90 cm high and sometimes up to 1.2 m high is by far the most abundant fuel type in western N.S.W. Landscape also has a significant effect on access for fire fighting equipment. There are 7 major landscape-fuel type categories in the Western Division (Condon 1975; Condon et al, 1980). Each category has its own particular problems in relation to fire fighting.

3.2.1 Landscape factors affecting fire behaviour and fire fighting strategies.

Experience with fires in the Western Division in recent years has shown that there are many landscape factors which influence fire behaviour and fire fighting strategy. These factors can be considered under topography, soil type and the presence of timber and scrub.

Topography

The rate of spread of a fire usually accelerates with increasing slope. However, in the arid areas, fuel volume usually decreases markedly with increasing slope above about 10^{o} and such areas would be unlikely to carry a fire - especially at night or if there are steep scarps or rocky areas present.

Once slopes become greater than 2 to 3^{o}, access becomes difficult because the country is often broken up by gullies. In the fire fighting situation air photo-maps or an aerial inspection will often reveal broad valley areas with gentle slopes which have a high proportion of bare areas which may be used to hold a fire.

Soil Type

Soil type has its main influence on the fuel type that develops. However, soil type, particularly in relation to topography, can also affect access for fire fighting equipment.

Timber and scrub

Timber and scrub affect fire behaviour and fire fighting strategies in several direct and indirect ways. These include effects on fuel type, access, visibility and fire behaviour.

In western N.S.W., increasing density of timber cover usually results in a reduction in fire hazard because grass fuels are usually absent or dominated by copperburrs of low flammability. In most cases dense timber cover, particularly belah and rosewood, make an effective firebreak. However, mulga does not compete strongly with grass for moisture and, if the trees are close enough and there is a heavy grass understory, mulga may carry a crown fire under extreme conditions.

In the more open areas timber and scrub cover creates an access problem because of logs and stumps hidden in tall grass areas. Visibility is often limited in timber and scrub areas.

3.2.2 Fuel type factors affecting fire behaviour and fire fighting strategies

Flammability

Western Division pastures will burn quite readily when only 60-70% cured, provided that there is sufficient dried material around the base of the grass tufts. Under mild conditions with winds of 5 km per hour or less, fire will only run through pasture stands where the plants are separated by no more than half the distance of the maximum diameter of the plant. Under higher fire danger conditions and with an increase in wind, fires can run more easily through sparser grass pastures.

A modified grasslands fire danger meter has been developed for measuring fire danger index and rate of spread for arid areas. The main modification to the conventional (McArthur) meter is that the "degree of curing" scale is substituted with a pasture height scale. (Condon, 1979; Condon et al, 1979).

Flame height

Flame height will increase with increase in pasture height which, in turn, brings about an increase in the Fire Danger Index.

Spotting

Some fuel types are prone to spotting, the process whereby burning embers are transported in updraughts ahead of the main fire front. Species and circumstances in which spotting may occur in western N.S.W. fuel types are:

Mallee country

Mallee country is characterised by closely spaced, low , many-stemmed Eucalypts, 3-5 metres in height, each with an accumulation of leaf and bark litter and fallen stems around the base of each, and with ribbon bark hanging from the upper branches. Normally there is little or no ground cover between the mallee clumps and it will not carry a fire. However, prolonged and heavy winter rains promote a tall dense growth of spear grass. Under these conditions, as has happened in 1957-58, 1969-70 and again in 1974-75, the mallee country becomes a major fire hazard with a high potential for spotting as the accumulation of leaf and bark litter on the ground can flare up into the hanging ribbon bark and carry burning embers off in the up-draft. The development of massive, thunderous convection columns is also a major problem in mallee fires. Because of its propensity for spotting, back burning becomes a very hazardous operation in mallee country.

Wildlife

Rabbits and kangaroos fleeing out of the flames with fur alight can be a means of the fire being carried across otherwise safe breaks.

Other

Other species and circumstance where spotting may occur include pine trees, old lignum plants, saffron thistle and recently fallen trees.

Fuel moisture

Fuel moisture for a particular pasture type is governed by two processes - (a) the curing pattern as determined by a combination of seasonal conditions and the particular curing process for the dominant pasture species; and (b) the diurnal variation in fuel moisture content.

The arrangements of fuel in a tall arid zone grassland is such that, once 60% of the plant material is cured, most species will burn quite readily. Some species, notably nigger heads or summer grass, woolly butt and spinifex, are more flammable at 70-80% cured than when fully cured.

In the fully cured state there is a marked variation in fuel moisture content as temperature and humidity changes throughout the day.

3.3 Weather

3.3.1 Temperature and humidity

Relative humidity has a much greater influence on fuel moisture content and hence flammability than air temperature. Fast spreading grass fires can occur under conditions of low temperature providing the air is dry and a strong wind is blowing.

3.3.2 Cloud cover

The presence of cloud tends to lower surface temperatures and raise fuel moisture contents, hence lowering the flammability of fuel. However, cumulus clouds can also indicate the presence of atmospheric instability.

3.3.3 Wind velocity and direction

Wind has the effect of leaning the flame into the unburnt fuel and pre-heating it (Luke, 1978). Grassland fuels are usually open to the full force of the wind and, what might be a slow fire, can become a raging inferno under the influence of a strong wind. The higher the wind speed the greater the risk of spotting.

Rates of spread varies approximately as the square of the wind velocity. Thus the rate of spread under a 30 km/h wind is four times the spread under a 15 km/h wind. (Luke, 1978).

Wind does not blow at a steady velocity and direction may vary by about 60^{o}. A gusty wind causes a fire to be erratic and unpredictable. In light winds, the movement of convection cells can cause sudden changes in fire behaviour.

Wind direction normally moves anti-clockwise with the passage of high and low pressure systems. Cold fronts may cause a sudden marked change in direction. In view of the expected wind shifts it is imperative that the northern and eastern flanks of a fire be brought firmly under control to avoid a massive breakaway on a wide front.

3.3.4 Atmospheric instability

Under conditionsof high instability, convection columns may form over major grass fires increasing the chances of long distance spotting.

The lee side of a hill will often create instability and initiate massive whirlwinds which may carry flames to 20-25 metres in height. This is a particularly dangerous area.

4. Fire Fighting Techniques - Equipment and Support

The general principles and practice of direct fire fighting apply to fire control in western N.S.W.

Dry fire fighting involves the use of equipment such as bulldozers, graders, tracotr blades and the Brompton Fire Rat to prepare breaks to hold a fire or, more commonly, for back burning. The Brompton Fire Rat, a tractor-drawn implement, cuts a vee-shaped groove whilst a burner ignites grass on one side of the groove (Wedd, 1978). It can be used to make features such as roads or sandy creeks more effective as firebreaks

and to create firebreaks in trackless country and protective areas around improvements. The "Rat" is ideally suited for control burn situations, but has also proved very valuable in wildfire suppression.

Direction finders which are very valuable in the rapid location of fires, are located at strategic points in some areas of the Western Division.

The scarceness of fire fighting resources means that "mopping up and patrol" operations are difficult to maintain but they are essential for efficient fire suppression.

The use of aircraft has always been of great value in the fire situation, particularly in reconaissance. In general, helicopters have proven more versatile than fixed-wing aircraft. However, the latter are usually more available. Aerial ignition, which has been used for control burns, may have potential for back-burning in a wildfire situation.

Experienced field officers from the State Government departments are available to assist brigade captains and fire control officers in the event of a serious fire situation.

References

Condon, R.W. (1975). Fire Behaviour and Fire Fighting in Relation to Landscape Types in the Western Division of N.S.W. Western Lands Commission technical note.

Condon, R.W. (1979). The Modified Grasslands Fire Danger Meter for Arid Zone Rangelands. Paper presented at Australian Rangelands Society Conference, Adelaide, May, 1979.

Condon, R.W. and Alchin B.M. (1979). The Modified Grasslands Fire Danger Meter. Western Lands Commission technical note, June, 1979.

Condon, R.W. and Alchin, B.M. (1980). Western Division Fire Suppression and Prevention. Western Lands Commission technical note.

Leigh, J.H. and Noble, J.C. (1981). The Role of Fire in the Management of Rangelands in Australia. In 'Fire in the Australian Biota'. (Ed. A.M. Gill, R.H. Groves and I.R. Noble), ANU Press, Canberra.

Luke, R.H. and McArthur, A.G. (1978). Bushfires in Australia. Australian Government Publishing Service, Canberra.

Ralph, W. (1980). Fire in Arid Rangelands. Rural Research 109:9-15.

Wedd, S. (1978). Bushfire Prevention with the 'Brompton Rat'. N.S.W. Agric.Gazette. 89 : 42-43.