Report on the CSIRO/FCNSW Seminar on Prescribed Burning in Young Regrowth Forests.

Mick Harewood. 1992

Introduction.

There are two major reasons why conservationists have been concerned with fire behaviour and control in the young regrowth that develops after intensive logging for woodchips. The high level of apparently unmanageable fuels in regrowth, increased access for ignitions and increased wind effect suggest that the risk of serous wildfire might be increased due to woodchipping. The 1980 Timbillica fire showed that access for suppression forces was of little or no value in severe fire weather.

The devastation caused by the Timbillica fire lead to the adoption of a comprehensive program of fuels management by prescribed burning. This in turn has raised the issue of the impact of such an ambitious burning regime on the long-term survival of flora and fauna and on soil and catchment values.

On 12th and 13th November 1992, the Forestry Commission of NSW held a seminar on the new prescribed burning guide for young regrowth forests developed by the C.S.I.R.O. Bushfire Research Unit. Regional forester Col Nicholson invited the South East Forest Conservation Council to send a representative and I was happy to attend in that role.

Fire Behaviour Model.

CSIRO researcher Jim Gould began by describing the experimental variables which went into developing the mathematical model of fire behaviour used to develop the burning prescription.

A preliminary survey of fuels showed that there was little variation in fuel loads between sites, perhaps because all sites carried around the equilibrium fine fuel load for the age studied (15-18 years). Fine fuels were divided into three layers based on distinct changes in bulk density; that is

- the very compact **surface litter**
- less compact **near surface fuels,** consisting of grasses, ferns and trailers and the litter caught up in this layer
- the relatively sparse **elevated fuels**, consisting of shrubs and saplings up to 2 meters.

For each experimental fire, the wind speed under the canopy (at 2 M height), slope in the direction of the prevailing wind, ambient temperature, drought indices, predominant understorey species (6 broad groupings) and near-surface fine fuel moisture content, height and % cover were quantified. Overall, 61 variable were examined.

As with other fire behaviour studies, fire rate-of-spread (and therefore intensity and flame height) increased with ambient temperature, wind speed and slope.

There was a highly significant **inverse** relationship between rate-of-spread and the **near-surface-dead-fuel moisture content.**

Rate-of –spread was also positively correlated to the near-surface fuel % cover and near-surface fuel height. Since this latter variable was easier to measure in the field and the two were related, only **near-surface fuel height** was included in the final model.

There was some suggestion in the data that the wire grass/bracken fern fuel type was most flammable and the Ghanias (cutting grass) the least flammable. This finding may have been due to chance because of the times when these fuel types happened to be burned in relation to antecedent rainfall.

Burning Prescription.

The burning guide is presented as a chart with four graphs which can be interconnected by straight lines. Thus, the temperature, slope, near-surface fuel height, near-surface dead fuel moisture content and in-forest wind speed can be used to predict rate-of-spread. A maximum rate-of-spread of 2.3 M/minute is recommended as the safe upper-limit for burning regrowth.

Other graphs are used to predict flame height and scorch height from rate-of-spread.

A separate study enabled the prediction of in-forest wind speed at 2M from the wind speed at 10M in the open.

A major finding of the study was that as near-surface dead-fuel moisture content falls below 12%, fire behaviour rapidly becomes more extreme. Similarly, if the near-surface fuel exceeds 1.2 M height, excessive flame height and canopy damage are likely to result.

Additional constraints on the burning prescription are that ambient temperature must be less than 25 degrees, relative humidity within the 50 to 80% range and average wind speed in the open at 10 M less than 15 kph.

Tree Damage.

Bushfire Research Unit Director Phil Cheney described a study by Malcolm Gill of tree damage from prescribed burning. Stem damage was related to tree diameter and height for different fire intensities.

For this study, trees were selected to cover a range of diameters and were specifically not close to large piles of debris from previous logging operations.

The study concluded that if fire intensity were limited to less than 759 KW/M (which corresponds to a rate-of-spread of 2.3M/minute) only 10% of the trees of 9cm diameter or smaller will suffer damage, and none over 12 cm in diameter will be severely damaged, provided the trees are over 12 M tall.

Crown Scorch.

Ian Knight described his study of the thermal environment above prescribed fires. The aim was to predict scorch height from various combinations of variables affecting leaf temperature and water loss. The theoretical model developed gave similar results to the empirical relationship between scorch height and rate-of-spread derived from all of the burning experiments. One interesting outcome was the advantage of having some wind in minimising crown scorch, provided fire intensity could be kept low.

FCNSW Practice.

District Forrester David Ridley reported on recent experience in prescribed burning in the local forests. He said in 1991 2000 Ha of post-logging burning had been carried out at $9 per Ha, 20,000 ha of broad-area burning had been carried out at $1.12 per ha and 11,000 Ha of burning under regrowth had been carried out at $2.90 per Ha. Of the regrowth burning, only about half had been considered successfully treated (defined as 25-40% of the areas covered with a maximum of 10% crown scorch) and half needed a second burn. He claimed that the regrowth east of the Princes Highway has been treated, at least with a first stage burn.

Ridley said that experience had shown that burning on cooler days was best (preferably less than 18 degrees) in dry conditions, with relative humidity 40 to 60% (compared to 50 to 80'% in the CSIRO prescription) and wind in the open less than 15 kph, with a caution to beware of afternoon sea breezes. He said he was somewhat unsure of what damage their prescribed fires had been doing to the crop trees.

I asked if, given the restrictions on humidity, temperature and wind speed, there would be a sufficient window of opportunity to carry out all the burning required? He replied that, once the backlog of burning from the past policy of excluding fire after logging had been cleared, there would be more opportunity to burn than required.

I asked, given the lower limits on stem diameter and tree height, what age classes could be safely burnt? Ridley replied that 10 year old post Timbillica fire stands had been treated (these have regenerated on advanced root-systems) and that stands as young as 12 years old have been treated where post-logging burning has been carried out. This answer is rather surprising given the growth rates reported in the 1982 Management Plan and may reflect a rather heavy toll of damage to the young crop trees.

I also asked whether, given that bracken fern and wire grass are pyrophiles, the prescribed burning regime might cause a species drift towards the worst fuel types. Ridley replied that he thought not because less than 50% of the areas are burned. I suppose that this means that a pyrophillic near-surface fuel type might develop on some areas and a different range of species may survive on other parts of the landscape.

Fuel load versus fuel structure.

After dinner, Phil Cheney presented some results from experimental fires in monsoonal grasslands in the Northern Territory, which question the findings of MacArthur that fire rate-of –spread is determined by surface fuel load. By using a forage harvester to manipulate fuel loads, Cheney showed that fuel height determined rate-of-spread and that, in a continuous fuel bed, fuel load had no effect (that is, the rate-of –spread was the same in areas where the grasses had been cut and removed from the site as in areas where the grass had been cut and left flat on the ground on the site).

Cheney then re-examined the data of McArthur and concluded that the relationship that McArthur found between rate-of-spread and fuel load may have been a consequence of the relationship between fuel load and fuel age (since the last fire) which in turn determines the height and continuity of near-surface fuel components.

Cheney suggested that the dryer, slightly elevated near-surface fuels determine the rapid propagation of fires and that the lower layers of surface litter tend to burn more slowly after the fire has passed, and may not contribute significantly to rate-of-spread.

Cheney further suggested that although Neuman had found that fine fuels in the Eden forests return to their equilibrium levels of around 10 tons per hectare in as little as 3 years or so, a much longer period of protection may be afforded by burning since near-surface fuels take longer to develop their maximum height, continuity and suspended dry-litter component.

Computer simulation.

John Coleman and Andrew Sullivan demonstrated a computer simulation of fire spread which uses data on topography and fuel types, mapped on a 500 meter grid, as well as weather forecasts, to predict the development of wildfires. Using this tool, about 10 minutes of simulation can be used to generate a picture of how a fire will spread in the next 3 hours or so.

Site Inspection.

The field trip on 13th November visited various experimental sites along Maxwell's Road, where the fuels sampling and damage studies were explained. At the Hanford Road site, I noticed plenty of rabbit scats and Guinea flower, 1 year after the fire.

Steve Roffey, the Eden district fire protection forester, outlined the results of prescribed burning in regrowth obtained in recent seasons. He said that burns were assessed from a helicopter, with a note every 15 seconds whether the forest below was burnt, unburnt or scorched, while flying in a grid pattern. The fire perimeter is not mapped.

Tony Howe asked Phil Cheney whether he thought 25-40% cover was adequate to protect against wildfire. Cheney replied that if the areas treated were scattered at random across the landscape, there would be little effect on a large running fire since large fires integrate the range of fuels encountered. However, if fuel hazards were reduced in strategic strips, wide enough to absorb most spot fires, wildfire damage could be limited.

A forester from Conservation, forests and Lands in Victoria said their policy is to achieve 80-90% cover in strategic areas.

Conclusions.

These studies have advanced the science of fuels management in regrowth considerably. However, further work is needed on the drying patterns of fuels in order to optimise the organisation of prescribed burning throughout the season.

Conservation concerns about the fire risk posed by regrowth and the environmental impacts of prescribed burning are somewhat contradictory. If public pressure over wildfire risk is brought to bear, a more intensive and severe fuel hazard reduction program may be implemented. If public concerns over the impact of prescribed burning on flora and fauna, air quality (must they burn over Easter?) soil fertility and water catchment values are given higher priority, the area treated to reduce fuel may be minimised.

Given that these opposing concerns need to be carefully balanced, it seems a pity that so little interest seemed to be shown by forest managers in the computer simulation of fire spread.

Serious doubts were expressed about the adequacy of the 25 to 40% cover of prescribed burns achieved in regrowth. If these areas were accurately mapped and the dater computerised, at least a fire controller would be able to contain full value from these.