

An overview of fire management in New Zealand forestry*

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Abstract

Since exotic plantations were first established in New Zealand, fire protection has been an important consideration for forest managers. During the last 60-70 years, over 40,000 ha of exotic plantation forest has been burned. Developments in fire control legislation have generally followed disastrous wildfire events, and changes in plantation ownership have led to changes in forest management practices including fire protection. New Zealand forest managers continue to view fire protection as an essential part of management responsibilities, and outlay considerable expenditure on fire prevention and readiness activities. This paper presents a brief summary of the history of forest fire management in New Zealand, culminating in a recent survey of NZ Forest Owners Association members on forest fire management practices and expenditures. Survey results reinforce the key role forest owners play in rural fire management and provide insights into issues such as forest insurance and risk management strategies, as well as fire prevention activities and expenditure.

New Zealand Fire History

New Zealand has always experienced infrequent wildfire events as a result of natural fire causes, such as lightning and volcanic activity. Evidence from carbon records shows occasional landscape-scale fires in New Zealand from as early as 40,000 years before present (B.P.) (Ogden *et al.* 1998). After the climate dried around 1,800 years B.P., more frequent natural fires removed tall woody vegetation and allowed tussock grasslands to expand in area. This was particularly the case in the South Island (Burrows and Russell 1990), but similar patterns of disturbance have been recorded in other parts of New Zealand (Bussell 1988, Enright *et al.* 1988). Despite such early occurrences of fire, New Zealand native ecosystems consist of species that are not specifically adapted to fire (McGlone and Webb 1981). However, the combined influences of climatic fluctuations and tectonic activity with fire have influenced the distribution of some plant species and communities (Cowan and McGlone 1991).

Polynesian burning in the last 1,000 years further removed forest vegetation, with Maori purported to have reduced the forest cover from about 80% of the country when they first arrived in New Zealand to around 50% by the time Europeans arrived (Ogden *et al.* 1998). Most fires were probably accidental, but other reasons for burning included encouraging growth of bracken fern (for its edible roots), clearing land for agriculture (e.g., kumara plantings) and moa hunting, and as a by-product of warfare (Cameron 1964). Forest clearance continued following European settlement (Wardle 1985), when fire was a primary agent for land clearing, and some large wildfires caused extensive damage to forest and rural environments of New Zealand. Particular fires of note include the 1878 Waimate fires in South Canterbury, and 1918 Raetihi fires in the central North Island (McLean 1992).

Fire continues to be widely used as a land management tool today, to clear weeds and unwanted vegetation, reduce residues such as logging slash and crop stubble, and improve grazing land and access for livestock. Unlike many other countries, fire is not widely used for fuel reduction or ecological purposes. However, fire use is likely to continue to play a major role in shaping and maintaining the vegetation cover of New Zealand.

Fire in Commercial Plantations

Establishment of exotic conifer plantations in New Zealand began over a century ago (Cooper 1980, Familton 1990) in response to the rapid depletion of New Zealand's natural lowland forests, mostly by burning. The area of plantation forests currently amounts to about 1.8M hectares (ha) or 7% of the country's land mass (NZFOA 2008), with radiata pine (*Pinus radiata*) comprising nearly 90% of this total. These plantation forests form the basis of important forest-based industries, as well as providing a range of social and environmental benefits. Safeguarding these areas from wildfires was a major concern of the former New Zealand Forest Service and forest industry almost from the first plantings. Many advances in fire control technology and management have occurred since these plantations were established (Cooper 1980). Fire is still a major risk facing forest owners and, due to the value of the asset being protected, fire protection remains an important consideration for New Zealand forest managers.

During the last 60-70 years, fires have resulted in over 40,000 ha of exotic plantation forest being burned (with a conservative value in excess of \$300M), at an annual loss of around 570 ha (or 0.12% of the planted estate) (Figure 1). The average annual loss over much of the last two decades is somewhat lower (just under 400 ha/annum or 0.03% of the plantation estate), but current plantation fire statistics are unreliable due to poor reporting and confidentiality issues (Cameron *et al.* 2007, Doherty *et al.* 2008).

Although New Zealand's fire climate is not as severe as other parts of the world due to its maritime position, periods

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Fires and forests

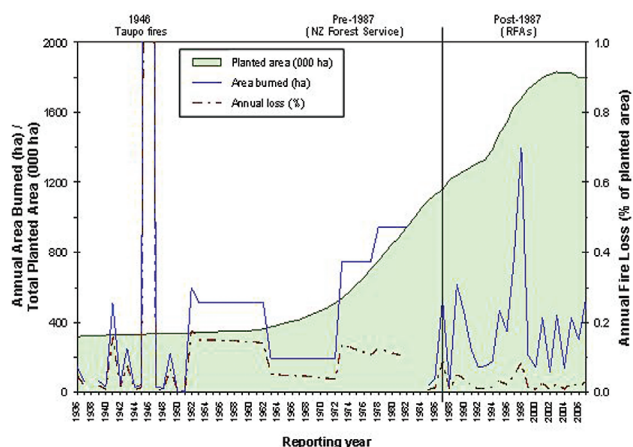


Figure 1. New Zealand plantation fires losses. Losses during the NZ Forest Service era (pre-1987) are contrasted with the post-1987 period where fire protection is provided by Rural Fire Authorities (RFAs) (after Cameron *et al.* 2007). Points of note include the lack of fire loss data for the period 1983-1984, and the impact of large fire events (such as the 1946 Taupo fires and 1997/98 fire season) on total area burned and annual loss (%).

of high and extreme fire danger do occur in many parts of the country each year (Pearce *et al.* 2003; Pearce and Clifford 2008). These periods of high regional fire danger coincide with a source of ignition that results in major plantation fires generally about once per decade (Pearce and Alexander 1994, Pearce *et al.* 2000). The 1945/46 fire season is the worst on record, with the 1946 Taupo fires burning about 13,000 hectares of planted forest (plus a further 17,000 of native forests) in the central North Island; Canterbury also experienced major plantation fires in 1955, 1973, 1976 and 1988. However, since 1955 only one plantation fire (Hira in 1981) has burned over 500 hectares of plantation forest (Pearce and Alexander 1994, Pearce *et al.* 2000). This is due to a number of reasons, particularly improvements in fire management.

The principal causes of fires in plantation forests are arson, escaped burns, forestry operations, spontaneous combustion, vehicles and campfires (Cameron *et al.* 2007). Fires originating outside of forests on adjacent land present considerable (and often the predominant) risk to plantation forests, with nearly twice as many fires and six times the area burnt reported outside of forest areas as within forests (Cameron *et al.* 2007).

Little is known on the risk to New Zealand's native forests as historic fire statistics do not distinguish between

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exotic and indigenous forest losses, and this continues to be the case in modern fire reporting systems. However, native beech and podocarp forests are generally less flammable than exotic forest species.

Rural Fire Legislation and Management

Major changes in New Zealand's rural fire legislation have typically been associated with significant wildfire events. The first piece of legislation dedicated wholly to rural fire (the Forest and Rural Fires Act 1947) was passed in reaction to the fires that devastated 240,000 ha in the central and northern North Island during the 1945/46 fire season. This Act extended the jurisdiction of rural fire authorities beyond State areas, and brought in the concept of restricted fire seasons, fire officers and specific regulations. After the Balmoral Forest fire of 1955, the Forest and Rural Fires Act (1955) brought all aspects of rural fire legislation together for the first time under NZ Forest Service responsibility.

For the next few decades, the NZ Forest Service assumed the fire protection responsibility for all forest and rural areas, and its demise in 1987 initiated significant changes in fire management. The Forest Service had a well-organised and well-funded system to protect state-owned forests and neighbouring rural lands. After 1987, new and existing forestry companies maintained the protection of production forests, but many experienced people left the forest industry. The Department of Conservation was formed and the management and protection of indigenous flora and fauna was given a higher priority than ever before. However, perhaps the greatest change occurred on private rural lands, where territorial authorities were obliged to meet their legal fire protection commitments.

Under changes made to the forest and rural fires legislation in 1977 and 1990, rural fire management is now the responsibility of Rural Fire Authorities, which may be the Department of Conservation, the Ministry of Defence, a territorial local authority or a specially-gazetted Rural Fire District administered by a committee made up of rural land owners and other agencies, particularly forest owners. Hensley (1990) reviewed the state of the rural fire sector following the fire-prone summer of 1988/89, and this led to an amendment of the 1975 Fire Service Act. The NZ Fire Service Commission, in addition to its role of a national urban fire service, was given a new role as the National Rural Fire Authority (NRFA). This new role saw the Commission, as the NRFA, responsible for national coordination of rural fire management and ensuring the effective and efficient functioning of Rural Fire Authorities. The advent of other legislation (e.g., Local Government Act 2002) and the definition of fire as a 'natural hazard' under the Resource Management Act (1991) and as an emergency in the Civil Defence and Emergency Management Act (2002), means that there is now a wide range of legislation pertaining to rural fire. Significant improvements have been made to the governance of the rural fire sector and the effectiveness of rural fire management since 1990.



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Cost recovery is also permitted under the legislation. Rural fire managers are able to recover costs from those responsible for wildfires, whether the responsibility is for ignition or stems from ownership of the land from which a fire spreads. Currently, many forest owners choose to insure their forests against loss from fire. However, in some cases, forest owners elect to “self-insure” by maintaining a fire protection capability that includes trained personnel and fire suppression equipment. Private and corporate plantation owners also have the option to rely on the local fire authority (usually a territorial local authority) to provide fire protection services, or to establish and manage their own Rural Fire District to provide their own fire protection.

NZ Forest Owners Association Forest Fire Management Survey 2005

In 2005, the NZ Forest Owners Association (NZFOA) carried out a survey of its members to gain a better understanding of the nature and extent of rural fire control activities undertaken by New Zealand plantation forest owners (Cameron *et al.* 2007). Results from the survey also provided insights into issues such as forest insurance and risk management strategies, as well as forest owner fire prevention and preparedness activities and expenditure.

The survey responses covered about two thirds of the total forest estate and a range of small and large forest owners from all parts of the country, and showed that forest owners spend in the order of \$8M to \$10M per annum on fire protection for the 1.8M ha plantation forestry estate. The majority of these costs were for fire administration, prevention and preparedness. While this amount includes suppression costs for the majority of minor fire events, it excludes suppression costs and damages for major fires (≥ 200 ha) where suppression costs can exceed \$1M per fire.

This compares with annual amounts of approximately \$6-8M for local government, \$9-10M for the Department of Conservation, \$4M for the NZ Defence Force, and \$3M for the National Rural Fire Authority. Forest owners contribute significantly to the rural fire sector in terms of manpower and equipment, providing the equivalent of some 60 full-time positions in fire control and more than 1600 trained staff, contractors and volunteers, and more than 130 firefighting vehicles. The sector is also a major financial contributor to national activities, such as the national fire prevention campaign and rural fire research, and through in-kind activities such as national working groups/committees, wildfire incident management teams and international firefighter deployments. Based on the total area being protected, the forestry sector (7% of New Zealand's land area) therefore provides above average levels of protection, which can be attributed to the value of the asset being protected.

Current costs for forest owners vary greatly in terms

of both total annual expenditure and cost per hectare protected (Cameron *et al.* 2007). On a cost per net stocked area basis, total fire management costs average \$15.50/ha (range \$0.05-\$130/ha), equivalent to \$12.40/ha (\$0-\$90/ha) for the total area being protected. Fire protection costs (on a per hectare basis) are greater for small forest owners ($< 5,000$ ha) and lowest for very large owners ($> 50,000$ ha), due to higher administrative, fire prevention and planning costs. Suppression costs are also greatest for small and medium owners, and damage costs highest for medium-sized (5000-20,000 ha) owners. Local government-owned forests have the greatest overall protection costs, due to having the highest fire administration costs; however, this is probably as a result of total fire authority costs (including non-forest areas) being allocated to only the forest area. Forest partnerships (high fire administration costs) and central government (high fire suppression costs and damages) have the next highest costs, while public companies and individuals have the lowest overall costs. In the latter case, this is likely due to smaller forest holdings, less personnel and suppression equipment, and reduced prevention activities.

In terms of relative risk, forest owners were also asked to rank fire, wind and health threats to forests (both currently established and non-established). The risk from non-established pathogens and insects was ranked highest, with the risks from wind, fire, other abiotic factors and established pathogens and insects ranked in descending order (Cameron *et al.* 2007). Fire was qualitatively ranked as a lower risk than wind, and this is supported by loss information (e.g., Pearce *et al.* 2000). Despite more widespread damage and significant economic losses, current established forest health risks were ranked well below wind, fire and other abiotic risks to forests (Cameron *et al.* 2007).

The future

Issues facing commercial forest managers that will impact on future rural fire management in New Zealand include:

- Significant changes in the forestry estate as a result of land conversion from forestry to dairying, urban subdivision and other land uses;
- Potential for increases in the threat of fire from climate change (Pearce *et al.* 2005);
- Poor forest fire reporting systems and statistics. Data collection systems for recording key data on plantation losses through wildfires need to be improved;
- Increasing planted area as a result of the demand for wood as a sustainable and renewable resource and need for forests as carbon sinks and a potential biofuel source;
- Valuing the benefits of protecting indigenous biodiversity and recreation opportunities as a part of defining the economic benefit of fire protection.

Conclusions

Since exotic forests were first established in New Zealand, plantation forestry has formed a significant part of the country's economy and its rural fire management. The value of forest assets is such that fire protection has always formed an integral part of forest fire management. The study by the NZ Forest Owners Association has demonstrated that, due to the high value of the asset being protected, forest owners contribute well beyond the level expected for the area being protected. The study also presented details of forest owners' expenditures for various fire management activities, and illustrated significant differences depending on forest size, region, ownership and Rural Fire Authority type. The risk of fire to plantation forests has declined since the NZ Forest Service era as a result of a number of factors, including improved fire management. However, there are several significant issues facing New Zealand forest owners that will present challenges for the future.

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