Wildfire Research Update

SCION FORESTS ▪ PRODUCTS ▪ INNOVATION

August 2024 ▪ Issue 20 ▪ ISSN 1178-7775

Spontaneous combustion of debris piles at skid sites

Woody debris piles at forest harvest landings or 'skid' sites can spontaneously combust, resulting in fires which are difficult and costly to suppress, and which can pose a serious threat to near-by forests and property.

Changes in forestry practices, particularly more whole-tree processing on the skid, may be creating conditions which increase the risk of spontaneous combustion in debris piles. A study by Scion for Fire and Emergency New Zealand (FENZ) sought to understand the key factors that cause debris piles to spontaneously combust, identify debris management practices which influence the risk of this happening, and gather information on effective fire suppression techniques for debris pile fires.

Key findings

- Causes of spontaneous combustion, and the risk factors leading to debris piles spontaneously combusting, are reasonably well-understood. Forest managers and harvesting crews can adapt debris management practices to reduce fire risk.
- Weather plays a role in stimulating spontaneous combustion, but debris pile location, composition and construction are key risk factors which can be controlled.
- Debris management to reduce fire risk starts with pre-harvest planning and continues well beyond the completion of harvest in certain high-risk circumstances.
- Fires in debris piles can be suppressed in several ways: the approach needs to be flexible depending on the fire itself, the local environment, social considerations and resource availability.

Photo: Peter Houston

Introduction

In recent years, there have been several recorded instances of skid-site debris piles 'birds' nests' spontaneously combusting. Debris-pile fires can be difficult, time consuming and costly to bring under control. Anecdotal evidence suggests these fires are becoming more common, and some forestry companies are pro-actively managing the risk by introducing new debris management practices.

Our study aimed to investigate the causes of spontaneous combustion in debris piles on forestry skid sites. We also wanted to better understand how debris management practices can influence the risk of spontaneous combustion and to learn how best to suppress debris pile fires, based on the experience of practitioners.

Our research included reviewing the international literature, analysing incident reports and interviewing forest managers and fire professionals about debris management and fire suppression practices.

How do debris piles spontaneously combust?

Spontaneous combustion of debris is defined as a sub-surface fire, where heat has built up within the pile sufficient to cause ignition of the woody material. The heat is generated by the decomposition of organic material within the pile.

Factors increasing the risk of spontaneous combustion

We found some common pre-disposing factors associated with spontaneous combustion of debris. The composition of the debris, debris pile size, underlying terrain and location, and the weather, can all play a part.

Factors found to increase the risk of spontaneous combustion include:

- **Fine material** – a large proportion of fine material (e.g. small branches, needles) in debris is a key factor encouraging heat generation
- **Deep/large debris piles** – piling debris to heights or depths over one metre increases risk
- **Debris moisture content over 20%** (i.e. green debris), and new debris piled on top of old debris
- **Soil mixed into debris piles** – soil harbours bacteria which decompose the debris and generate heat; soil also promotes prolonged smouldering
- **Porous debris piles** allow moisture and wind (oxygen) to permeate through the pile, but requires sufficient depth and compaction to provide an insulating layer to trap generating heat
- **Piles on north and west-facing aspects**, especially if also facing the prevailing wind

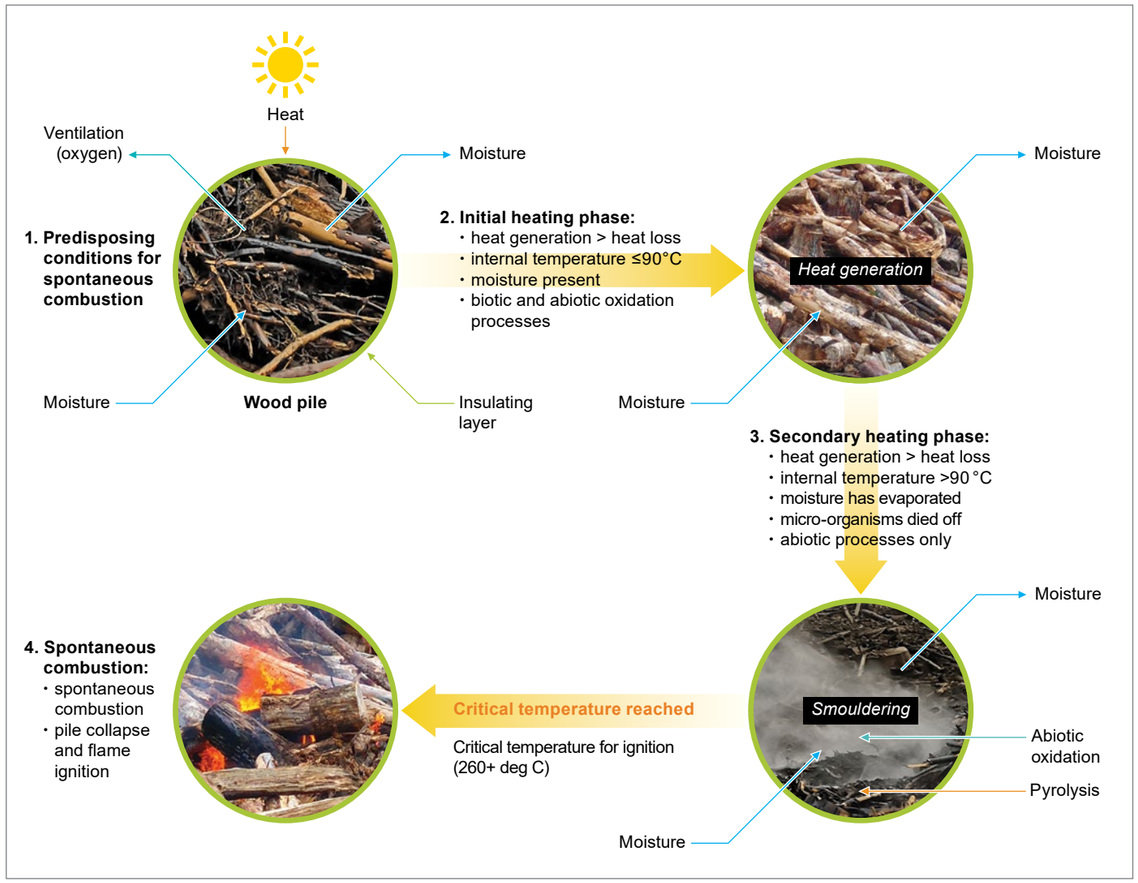

Figure 1. Outline of the spontaneous combustion (SC) process in a debris pile.

- **Foreign objects** – e.g. pieces of metal/wire rope or oily rags left in the pile can stimulate ignition
- **Warm, humid weather** plus wind increases the risk. Especially after a period of rain followed by hot, dry weather. Warm air temperatures reduce the heat loss from the pile, aiding the build-up of internal temperatures.

Managing debris to reduce the risk of spontaneous combustion

The consensus from the literature review, survey responses and interview findings enabled us to draw some conclusions on best-practice debris management. Once the main factors which cause debris piles to spontaneously combust are understood, debris management practices can be adapted to minimise risks. Good debris management starts at the harvest planning phase and continues through harvesting into the post-harvest period.

Harvesting systems that bring the whole tree to the skid for de-limbing and processing result in large quantities of small branches and fine material being incorporated into debris piles. Ideally de-limbing would be done in the cut-over, but the capacity to do this will depend on the harvesting machinery operating on any given site.

PLANNING

- develop a debris management plan (consider minimising the amount of debris on the skid)
- identify sites for debris pile in stable areas
- avoid steep gullies and north or west facing slopes
- construct benches and trenches to reduce debris movement
- construct a 10m fire-break around the skid site.

HARVESTING/PROCESSING

- keep debris piles less than 3m deep/high
- limit the amount of fine material in the pile
- minimise the amount of soil mixed with debris
- allow green material to dry/cure before adding to debris
- avoid compaction of debris piles
- ensure water does not drain into debris piles
- avoid any foreign objects in debris piles.

AFTER HARVEST

- identify debris piles that are at risk of spontaneous combustion
- monitor debris piles regularly including internal temperature
- deconstruct large piles into smaller piles (ideally < 1 metre high/deep) or spread debris over the skid site
- drag debris that has been pushed over the edge back up onto the landing
- open compacted piles to aid drying and reduce bacterial activity
- avoid putting new debris on old piles
- where safe, burn debris completely.

Figure 2. Summary of best practice debris management.

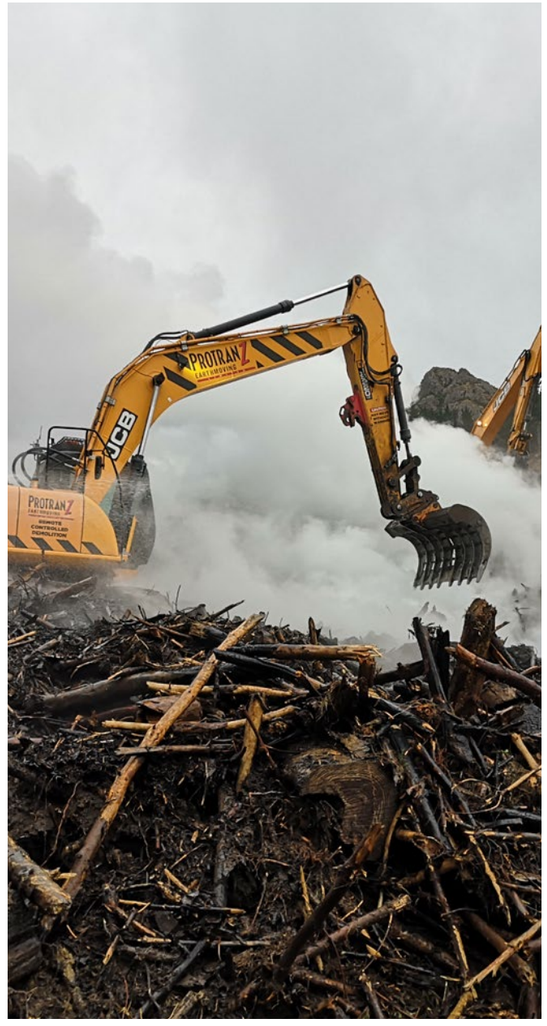

Photo: Bruce Janes, FENZ

Suppressing fires in debris piles

This part of the study included debris pile fires started by both spontaneous combustion and by other means. Our survey and interviews with forest managers and fire personnel revealed that there is no such thing as a 'typical' skid site fire, and actions applied at one fire cannot always be directly applied to another. A flexible approach is needed, with due consideration given to local environmental and social factors.

We found various approaches are used to deal with debris fires, depending on factors such as the scale and location of the fire in relation to surrounding vegetation and property, the weather forecast, the time of year, and the resources available (e.g., people, machines and water). Suppression techniques successfully used include:

- Open the pile up and dampen down with water/foam (or water additive)
- Open the pile and spread material out over landing site and extinguish with water/foam (or water additive)
- Cap and leave to burn out
- Burn the pile until there is no combustible fuel remaining
- Do nothing and monitor, if safe to do so (e.g. based on sufficient clearance from adjacent fuels or forecast weather

Photo: Clinton Lyall, FENZ

In summary

Debris management practices significantly influence the risk of debris pile fires. We have clarified the processes which combine to cause spontaneous combustion in debris piles, and how debris-pile location, composition and construction can create high-risk conditions. This information can be communicated via forest managers to harvesting crews, and measures from pre-harvest planning through to post-harvest management can be taken to reduce the risk of debris-pile fires.

Our research indicates that spontaneous combustion of debris piles is most likely to occur when fire weather conditions are moderate rather than extreme. Rain followed by warm, humid weather appears to create conditions conducive to spontaneous combustion. Armed with this knowledge, forest managers can increase monitoring activities, especially if they are aware of debris piles that may already be high-risk, if these weather conditions occur.

Finally, if a fire does occur in a debris pile, then the response will need to be flexible, and dependent on local factors, resources and expertise. Various suppression techniques, ranging from directly extinguishing the fire with water and foam to letting it itself burn out, can be considered: there is no one best technique but our full report summarises the approaches that have been used by forest managers and fire personnel in New Zealand forests.

Acknowledgements

Our thanks to all the forest companies, forestry managers, contractors and fire managers, Fire and Emergency New Zealand staff, NZ Forest Owners Association, and international scientists who contributed to this study.

Further information

Clifford, V. R., Bayne, K. M., Melnik, K., Yao, R. T., Baillie, B. R., Parker, R. J., & Pearce, H. G. (2020). Factors contributing to spontaneous combustion of debris at skid sites. (Report No. 182). Scion Rotorua, NZ: Fire and Emergency New Zealand.

Factors contributing to spontaneous combustion of debris at skid sites: full report available here.

Funding for Scion Wildfire Research was provided by the Ministry of Business, Innovation and Employment (MBIE) along with direct funding and significant in-kind support from NZ Rural Fire Sector organisations (Fire and Emergency New Zealand, Forest Growers Levy Trust Inc, Department of Conservation, members of Local Government NZ, NZ Defence Force and Federated Farmers of NZ Inc).

Prosperity from trees *Mai i te ngahere oranga*

Contact information

For more information on the project, contact:

Veronica Clifford veronica.clifford@scionresearch.com

Karen Bayne karen.bayne@scionresearch.com

Richard Parker richard.parker@scionresearch.com

10 Kyle Street
PO Box 29237, Riccarton
Christchurch 8440,
New Zealand

Telephone +64 3 364 2949
Email enquiries@scionresearch.com
www.scionresearch.com/fire

SCION™
FORESTS ▪ PRODUCTS ▪ INNOVATION

August 24