Fire science in action in New Zealand: Pigeon Valley fire

THE 2019 Pigeon Valley wildfire was New Zealand's largest forest fire in more than 60 years, burned more than 2300 hectares and caused the evacuation of more than 3000 people from Wakefield.

Pigeon Valley is near Nelson in the north of New Zealand's South Island. A spark from a tractor working in a field was all that was needed to start an extreme fire just after lunch on a hot, dry and windy February day. The fire spread rapidly up steep land into planted forest that ranged from recent cutovers and re-planting to intermediate and mature stands.

The fire spread very rapidly and showed 'extreme fire' behaviour, producing flames up to 30 metres high, and throwing embers 500 metres ahead of the spreading flame front. At these levels of intensity, the fire was unstoppable using any of the fire-fighting methods available, so the fire control strategy was a defensive one, evacuating people, protecting properties, and attempting to limit the spread of the fire around its boundaries.

Predicting fire behaviour

Fire scientist Veronica Clifford from Scion embedded in the Fire and Emergency New Zealand (FENZ) incident management team coordinating the fire response. Scion is a Government-funded research institute that specialises in research supporting New Zealand's forestry, wood products and biomaterial sectors. The Rural Fire Research group, established in 1992, focuses on developing the science and technology needed to protect life and property, and manage fire in the landscape (www.ruralfireresearch.co.nz). Scion's fire scientists regularly join the incident management teams during major wildfire events.

Veronica used tools developed by Scion and collaborators to help support fire operations, including the fire growth prediction model Prometheus, and the BlueSky smoke modelling framework originally developed by the US Forest Service. Using the Prometheus model, together with data on hot spots collected by drones, the potential for fire flare-ups and escapes could be predicted. This information was critical to decisions on evacuation and road closures, and the process for re-entry of evacuated properties.

The Scion team also ran the BlueSky model frequently to produce smoke predictions that were used by fire, civil defence and public health agencies to inform the public of potential health concerns.

Near real-time prediction

Being part of the operational team during fires allows Scion's fire research team to test their models under real conditions, as well as collecting more data to validate and improve their models. Back at their Christchurch base, the team reconstructs fires after the event to help them get a better understanding of what happened, and why.

● Some of the damage from the Pigeon Valley fire.

The fire research team's aim is near real-time prediction of fire spread and effects thorough the linking of fire detection, fire growth prediction and smoke models with high-resolution weather forecast data. The research team is confident that soon, when a new fire starts anywhere in the country, it will be automatically detected using thermal infrared satellites. Information on the new fire will then be linked to the latest weather data which, in turn, will feed into the Prometheus fire behaviour prediction model to produce estimates of fire size that are then used by the BlueSky smoke model to predict emissions concentrations and smoke spread direction. Predictions of where the fire and smoke are likely to go and how fast they will spread, can be used to mobilise fire-fighting resources much more rapidly and effectively than in the past, and to warn the public of impending threats. Scion hopes to have a prototype ready to trial with FENZ by 2020. This work is also part of the Extreme Fire research programme.