Scion challenging accepted extreme fire science

by Michelle Harnett of Scion

Dangerous, demanding and dirty, rural firefighting is not going to get any easier with climate scientists predicting extreme weather and extreme fire conditions.

While New Zealand might not experience bush and forest fires on the scale and intensity seen in Australia or North America, any fire has the potential to turn into an extreme fire at any time. Fires in Marlborough and Canterbury in the last couple of years have been intense and moved at alarming speeds, hinting that extreme fires are already here.

Extreme fires present new firefighting challenges. They are so intense they cannot be attacked directly. Often blowing up suddenly, they are erratic and unpredictable, spread rapidly, throw embers and other particles ahead of the fire front (spotting), generate fire whirls and tornados and tall, violent convection columns.

Recognising that current fire management strategies cannot suppress these fires, Scion's Rural Fire Research Group has proposed a research programme to develop new methods, decision support and models for extreme fires. The programme – Preparing New Zealand for Extreme Fire – has recently received funding of $8.75 million grant over five years from MBIE's Endeavour Fund.

Fire Research Leader Dr Tara Strand says the research will challenge the current understanding of the way wildfires spread. Instead of growing through the radiation of heat from the flame front to unburned fuels, fires seem to flow in waves produced by the fire's convection. If this theory is validated in real-world conditions in New Zealand, it will change global wildfire science and drive innovation in community readiness and resilience, fire prevention, prediction and control.

Grant Pearce, a fire scientist with 20 years' experience, is leading the project. With current fire behaviour models unable to predict extreme fire behaviour, the work will focus on gathering new information on when extreme fires are likely to occur, such as what atmospheric conditions cause a fire to escalate, and the effect of fuel type and loads.

Scion's Grant Pearce observing the Aoraki trial burns.

More experimental burns are planned, similar to those carried out in wilding conifer fuels last summer and autumn. The burns will look at large-scale effects, such as how long a fire takes to spread, and also what is happening on a small scale, within the flame front itself. The researchers plan to capture data on how the fire spreads from one fuel element to another within the fire, using high-speed video and infrared cameras, drones and other specialist equipment.

Carrying out experimental fires in New Zealand is less complicated that in many other parts of the world, and the strong relationship the Scion team has with landowners and rural firefighters supports and facilitates the work. This real-world laboratory is also attracting collaborators from around the world. The Scion team will work with researchers from the University of Canterbury and Lincoln University, plus the US Forest Service's Missoula Fire Science Laboratory, University of New South Wales, San Jose State University and the US Forest Service Pacific Northwest Station's AirFire research team.

Another aim of the work is improving the speed at which new fires are detected. Satellites already monitor and track fires, but there can be delays in getting the information. It is hoped that a system can be developed that can spot a

fire starting and raise the alarm in close to real time, as well as track and provide updates on the fire's progress.

Alongside helping prepare for extreme fire, the Scion team will continue to work with the Resilience to Nature's Challenges National Science Challenge to strengthen community resilience to wildfires and other natural hazards. Human factors research will also be important – looking at how firefighters cope with stress, possibilities for keeping firefighters out of harm's way with more remote firefighting, and increasing use of drones to monitor fires and hotspots.

The natural environment, primary production, vulnerable communities, our taonga species and rural fire stakeholders will all benefit from the improved ability to identify, mitigate and adapt to the threat of extreme fires.

A wildfire building strength near Hamner earlier this year. Photo: *Gavin Martin*

Climate change ramping up U.S. wildfires

Climate change has already doubled the number of forest fires in the western USA since the 1980s – and it is a trend that will continue to increase, according to new research.

The rise in temperatures and aridity sucks the moisture out of the plants, trees, dead vegetation on the ground and the soil, and is part of a world-wide trend of ever-increasing wildfires. Scientists from Columbia University pin the blame firmly on human-induced climate change – a significant statement in a country where many Republican supporters still refuse to accept that the burning of fossil fuels is causing global warming. The scientists want to settle the argument.

"No matter how hard we try, the fires are going to keep getting bigger, and the reason is really clear," says bioclimatologist Park Williams. "Climate is really running the show in terms of what burns. We should be getting ready for bigger fire years than those familiar to previous generations."

Forest fires in western USA began increasing in the 1980s (as measured by area burned, the number of large fires, and length of the fire season). The increases have continued, and, while there are a number of contributing factors, the study concludes that at least 55% of the increase is due to man-made climate change.

"A lot of people are throwing around the words 'climate change' and 'fire' – specifically, fire chiefs and the governor of California last year started calling this the 'new normal', " said University of Idaho's John Abatzoglou. "We wanted to put some numbers on it."

Since 1984, temperatures in the forests of western USA have increased 1.5°C (2.7°F), and resulting aridity has caused forest fires to spread across an additional 41,000 square km than they otherwise would have – an area larger than the states of Massachusetts and Connecticut combined.

Other factors

Williams and Abatzoglou say their research does not take into account some factors that could be offshoots of climate warming, and thus they may be understating the effect. These include millions of trees killed in recent years by beetles that prefer warmer weather, and declines in spring soil moisture brought on by earlier snowmelt. There is also evidence that lightning – the usual initial spark of forest fires – may increase with global warming.

The overall increase in forest fires since the 1980s is considerably more than the researchers attribute solely to climate change; the rest is due to other factors, for example, a long-term natural climate oscillation over the Pacific Ocean that has steered storms away from the western USA. Another is firefighting itself. By constantly putting out fires, authorities have allowed areas they 'saved' to build up more dry fuel, which later ignites and causes ever more catastrophic blazes.

Carbon released to the air adds to the burden of greenhouse gases already there, thus producing even more warming. And soot settling on snow and ice causes them to absorb more heat and melt faster.