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## Quick response report: Tathra bushfires

### Mapping the area of Tathra fires to study how Mechanical Fuel Load Reduction can save houses

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## CONTENTS

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<b>ABSTRACT</b> .....	<b>3</b>
<b>INTRODUCTION</b> .....	<b>4</b>
<b>BACKGROUND</b> .....	<b>6</b>
MECHANICAL FUEL LOAD REDUCTION .....	8
MECHANICAL THINNING: A CASE STUDY .....	9
<hr/>	
<b>RESEARCH METHODS</b> .....	<b>12</b>
<b>FINDINGS</b> .....	<b>13</b>
MAPPING TATHRA FIRES USING GIS TECHNOLOGY. ....	13
THOMSON DRIVE PROPERTIES .....	13
TATHRA PROPERTIES .....	14
MAPPING TATHRA REGION FOR MFLR. ....	15
<hr/>	
<b>DISCUSSION</b> .....	<b>19</b>
<b>CONCLUSION AND FUTURE RECOMMENDATIONS</b> .....	<b>20</b>
<b>REFERENCES</b> .....	<b>21</b>



## ABSTRACT

Australia is one of the most fire prone continents in the world. The driest winter of 2017 lead to high forest fuel accumulation in Far South Coast (FSC) NSW, and resulted in a series of bushfires in that region. Among them, the worst bushfire occurred on 18<sup>th</sup> March 2018, known as “Tathra bushfire”, or “Reedy Swamp Fire” according to RFS. It started from the bank of Bega River next to Thomson drive area and then spread down towards Tathra. The speed and ferocity of bushfire did not let residents defend their homes. Many residents fled their homes and sought refuge at Bega evacuation centre. Although most of the houses were saved with the help of water bombing and volunteer RFS crews almost 1/5 of houses were damaged or destroyed.

The purpose of this “Quick Response” project was to explore the impacts of Tathra bushfires and map the bushfire affected area to understand whether Mechanical Fuel Load Reduction (MFLR) could have diminished the risks of property losses and fire spread, if it was used. Mapping was done using a GIS app and coordinates of each destroyed property were sampled in QGIS. This report focuses on the extent to which MFLR implementation with HRB in Tathra might provide an alternative to help saving houses in the future. Our analysis consists of a number of factors including implementation of MFLR, mapping of Tathra region, access options, weather conditions of the area, public perceptions, fire behaviour and future recommendations.

We have also used this visit as an opportunity to interview local residents to provide data for the on-going research at UTS on public perceptions of various hazard reduction techniques, with the results to be further analysed and reported elsewhere.



## INTRODUCTION

This Quick response BFCRC funded research was conducted as part of a UTS sponsored Blue Sky Research Project. The UTS project explores alternatives for hazard reduction burning and social attitudes and preferences regarding these alternatives. We hypothesize that in some cases biomass may be collected for bioenergy production. This should also reduce impacts on air quality and improve human health and wellbeing. In most cases, bioenergy production and other alternatives are assessed with regard to economics, health, ecological, and fire risk reduction impacts. In the UTS project, in addition, we are exploring how social media can be used to understand public preferences and perceptions on these issues and to explore ways of educating people about the alternatives. In this joint project with BFCRC we are also to focus on an area recently exposed to fire to see whether there has been a possibility of implementing Mechanical Fuel Load Reduction (MFLR) for bioenergy production there. The study delivers key findings on bushfire managements and will be used to provide more effective bushfire management information to land managers, RFS and researchers. We also used this opportunity to learn about local residents' perception to fuel load strategies and fire warnings.

Extreme weather and natural disasters, i.e. cyclones, bushfires, floods and earthquakes are common in Australia. Australia is also one of the most fire prone countries/continents in the world and bushfires are the most frequent natural hazards in Australia. Bushfires are an important part of Australian ecology especially in eucalypt forests. Australia has almost 125 million hectares of forests which cover around 16% of its land area or 3% of the world forest area (ABARE 2013). In 2006-2011, almost 31.2% of the Australian forests were exposed to fires (ASFR 2013). Due to climate change, occurrence of bushfires has been increasing at an alarming rate of more than 40% annually, over the last five years (Dutta et al. 2016). Fires are becoming a growing concern due to climatic conditions which impose more threat of frequent wildfire to dry Australian forests. Millions of dollars are spent every year to control and recover from wildfires. Although fires play an important role in maintaining ecological integrity in many Australian ecosystems, but bushfires also pose a risk to human lives, property and economy. These bushfire threats can be reduced using fuel reduction techniques.

The primary fuel reduction technique is Hazard Reduction Burning (HRB), also known as prescribed burning, or controlled burning. It has been used as a hazard reduction method in Australia for many years. It is a cheap and widely used method to reduce the risk from bushfires. Australian Bushfire Management (AFM) policy applies prescribed burning in cooler months or off the season to reduce forest fuel and save properties from wildfires (Penman et al., 2008; rfs.nsw.gov.au, 2018). Prescribed burning may have many adverse effects including health problems, risk of fire escape, impaired visibility, water quality, ash deposits. They may affect wildlife and plants regeneration or reproduction, especially when administered at a wrong time, or with incorrect frequency. There are also high economic costs associated with conducting HRB.

MFLR is another tool for reduction of forest fuel load. Using MFLR, we can address risks and concerns associated with HRB as well as extract some revenue from the process if collected biomass is used energy production or other commercial purposes. In USA, large areas are already managed using MFLR to control bushfires and 40% of the cost is covered by selling timber (Grindlay 2015). Researchers and scientists are working on experimental trials and effectiveness of MFLR in Australian forests under National Bushfire Mitigation Programme (NBFP).



FSC region is historically affected by large bushfires. Our research trip was initiated after a high unexpected bushfire blaze (more than 1000-hectare fire) hit Tathra town. According to RFS, 93 fuel reduction activities in form of prescribed burnings took place in the area from 2006 to 2017. Despite that, Tathra fire was so intense and behaved so sporadically that it burnt 69 houses completely and had high financial and social impacts. Fire was driven by wind and embers flew several hundred meters from the boundary of forest fire. This suggests that prescribed burning alone may not be always enough especially since it is not possible in areas in close proximity to properties. We need more effective fuel reduction strategy.

Tathra has a significant forest area (with high loads of fuel) which is close to accessible roads and private properties. This makes Tathra a promising area to implement MFLR. Using Tathra fires as a case study, this research trip evaluates the potential of MFLR in Tathra area. In this report we describe the results of the trip, map the study area of Tathra, and explore how MFLR along with prescribed burning could save houses (in the future) in Tathra, NSW.

## BACKGROUND

Tathra is a small town on the Sapphire Coast in the Far South Coast region, New South Wales, Australia. It has an estimated population of 1600 residents. The dry winter of 2017 (driest year since 2006<sup>1</sup>) increased the risk of bushfire in that region. The fire started on March 18th 2018 (Sunday) after midday due to a malfunction in electrical infrastructure in the area of Tarranganda and then crossed the Bega river. From Bega river, it spread to the properties on Thomson drive and moved down to Tathra. The speed, ferocity and sporadic pattern of this bushfire made it difficult for residents to defend their homes. 25% Tathra residents were directly affected. Many residents fled their homes and sought refuge at Bega evacuation centre. Although most of the houses were saved with the help of water bombing and volunteer RFS crews almost 1/5 of houses were damaged or destroyed<sup>2</sup>.

Russell-Smith et al. (2007) identified Tathra region as an area where bushfires occur once every 3 years, mostly in spring and summer. Tathra has high annual rainfall of 908 to 1000 mm (Climate Data Org), which provides for higher than average forest growth rate. Remote sensing data show that regional areas with high rainfall have more frequent (2 to 3 years) and large fires (>1000 km<sup>2</sup>) (Yates et al. 2008).

Bushfires are directly affected by the amount of moisture that the atmosphere and forest fuel can hold. Studying the humidity patterns (1976-2005) of Far South Coast, Figure 1 shows that the region has the lowest humidity in December and March (Bureau of Meteorology). This low humidity will extract moisture from surface fuel, increasing dryness. Increasing dryness increases the chances of wildfires in forest (Bradstock, 2010). Temperature also has a positive correlation with wildfires. 1% increase in temperature during a wildfire season results in 2.34% increase in wildfire size (Dallas Wayne 2017).

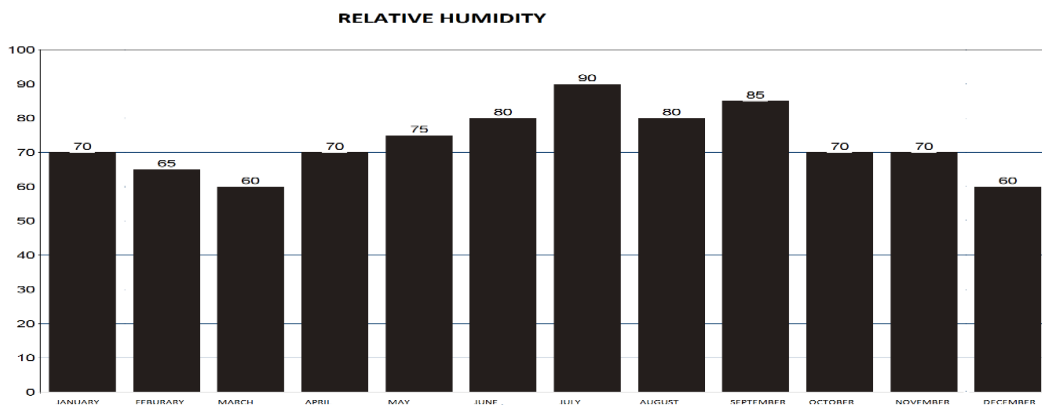


Figure 1: Average relative humidity of Far South Coast (1976-2005), source: Australia's bushfire seasons Bureau of Meteorology 2018.

As forests dry during December to March, southeast Australia becomes more sensitive to risk of bushfires.

<sup>1</sup> <http://www.bom.gov.au/climate/current/month/nsw/archive/201803.summary.shtml>

<sup>2</sup> [https://www.rfs.nsw.gov.au/\\_data/assets/pdf\\_file/0009/78354/20180319-Tathra-Damage-Assessment-1.pdf](https://www.rfs.nsw.gov.au/_data/assets/pdf_file/0009/78354/20180319-Tathra-Damage-Assessment-1.pdf)

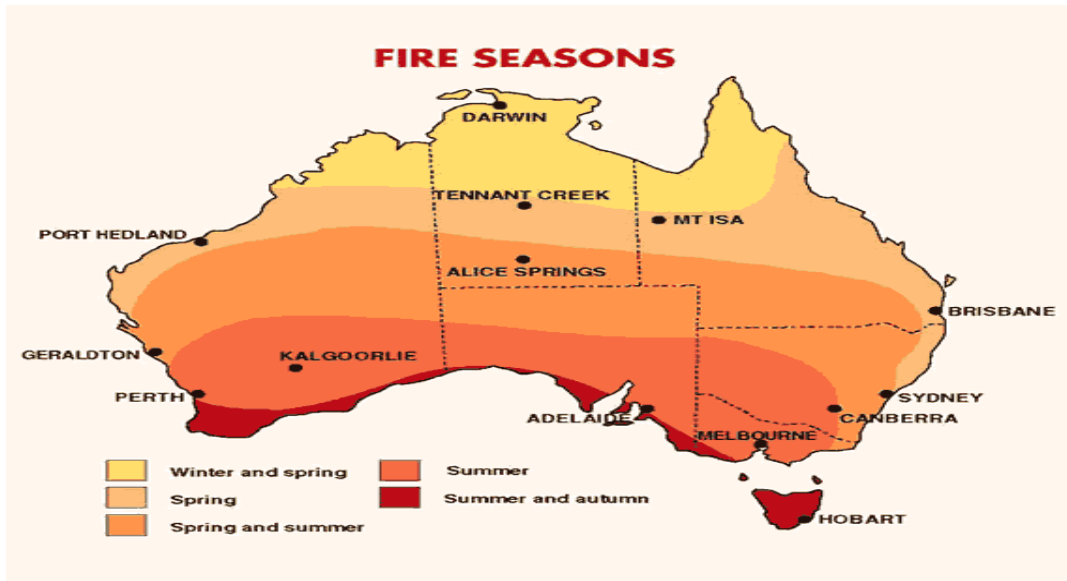


Figure 2: Fire seasons in Australian forests, source: Bureau of Meteorology.

Weather that mostly drives bushfires in Australia, works different across different regions of Australia. In hot and dry summer, Southern Australia is vulnerable to bushfires while in dry season northern Australia becomes more susceptible. Analysing meteorological conditions and geographic information, we find that FSC lies in one of the most fire prone areas and probability of wildfire is high in Summer, especially from December to March (Figure 2) (Fernandes 2001, Castro et. al 2003, Andrews 1986).

Another key factor which determines forest fires is Fuel moisture content (FMC). FMC is the amount of water per dry mass in forest fuel. FMC is a critical parameter in determining ignition, intensity and rate of spread. Remote sensing data (MODIS satellite data) is mostly used to determine FMC. Australian Flammability Monitoring System (AFMS) helps to visualize national scale data on flammability, FMC and soil moisture<sup>3</sup>.

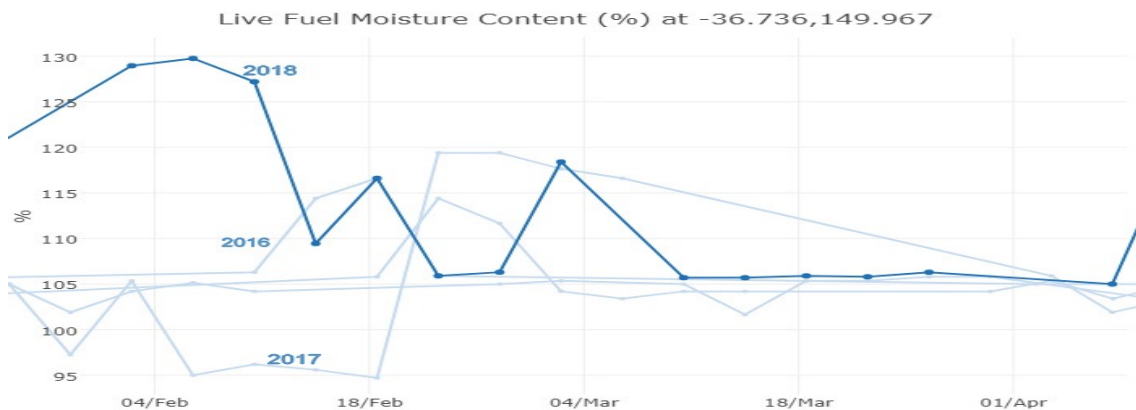


Figure 3: Live forest moisture content (AFMS 2018)

3 [http://wenfo.org/afms/#/\\_lvmc\\_mean/gfe\\_fire\\_weather/-36.79/149.78/11/20/4/2018/-36.722,149.963](http://wenfo.org/afms/#/_lvmc_mean/gfe_fire_weather/-36.79/149.78/11/20/4/2018/-36.722,149.963)



Figure 3 shows that FMC in FSC started decreasing from late Feb 2018 till March 2018 which may be due to evaporation of water moisture from forest fuel. Schoenberg et al. (2003) found that fire chances and burnt areas increase drastically when FMC decreases to around 90%.

It is very difficult to predict wildfire behaviour. Richard (1983) suggests that it can be predicted if we have the following inputs:

1. Geographical location of the area (slope, distance between vertical fuel groups);
2. Forest fuel quality & quantity, its bulk density and moisture;
3. Relative humidity and wind measurements (speed and direction).

Several fire simulators, including Phoenix Rapid-fire (developed by BNHCRC) and Spark (developed by CSIRO) are routinely used to model and predict bushfire behavior in Australia. These fire simulators integrate complex fire mechanism between fire and fuel distribution to provide planning, response and evacuation applications.

To prevent bushfire various techniques are used, usually striving to reduce the amount of fuel available in forest. Fuel reduction treatment modifies the forest fuel structure, load, distribution and moisture content to such a level that if a bushfire occurs it will spread slowly and is easy to control. Prescribed burning is one of the widely implemented fuel reduction technique in Australia since 1950's. Prescribed burning have a range of benefits including bushfire reduction, biodiversity management, managing population of insects, some native plants need heat to regenerate, recycle nutrients and low implementation cost.

Many fire prone areas which are highly biodiverse coexist with human developments. Prescribed burning in these areas is difficult to implement as there is a risk of fire escape and strict limitations on weather conditions have to be followed. Also prescribed burning has serious negative consequences for human health and may cause wildlife habitat destruction. It produces dust and smoke, impacts visibility and water quality. There is always a risk of fire escape. All this also impacts social acceptance of prescribed burning, which needs further investigation. With current changing climate, fire authorities have become more concerned about the effectiveness of existing fuel reduction treatments. Other fuel reduction techniques should be explored considering the ecological and social specifics of Australian ecosystems and communities.

### Mechanical fuel load reduction

One such potential alternative is Mechanical fuel load reduction (MFLR) often known as mechanical thinning. Mechanical thinning is considered a potential tool for reducing forest fires (Volkova et al. 2017; Fernandes et al. 2018).

Mechanical thinning is an agricultural term that refers to removal of plants or portions of plants by using various mechanical tools. One of the primary ecological objectives of thinning is to decrease the canopy and improve tree growth and health (by improving tree spacing). Mechanical thinning removes inferior trees to leave the resources to healthy (dominated) trees so that they can grow more quickly (faster height and diameter). Thus, thinning allows removal of a tree which is struggling to grow. There are two broad categories of thinning commercial and non-commercial thinning. When applied to fire hazard reduction, MFLR assumes collecting a part of biomass, primarily the dead organic material but not only, from the standing crop and the underlayer. As a result the most easily combustible parts are to be collected, reducing the risk of fires, as well as intensity if they still do occur.



Figure 4: Before mechanical thinning and after mechanical thinning (L. Kapoor, 2017)

Volkova et al. (2017) studied the impacts of mechanical thinning in south east Australia and found that thinning not only improves forest health, but also decreases the flammability of forests.

There are many possible benefits of implementing mechanical thinning which are:

- Low risk: Suitable for areas close to human developments.
- Addressing community concerns on prescribed burning.
- Environmentally friendly with no health concerns.

In addition to mechanical thinning, MFLR includes collection of the understory biomass using various shredding, mowing and compacting devices.

MFLR can involve heavy mechanical machinery which is of significant cost. In USA, only 40% of the cost of implementing mechanical thinning is offset by selling biomass (Grindlay 2015). Some concerns of MFLR are soil damage, high implementation cost, effect on forest and wildlife, water quality, biomass supply chain issues and facility geographical location. There is also a debate on when and how much biomass should be extracted. According to (Fried and Barbour, 2009) biomass processing facilities below 15 megawatts are not cost competitive.

### Mechanical Thinning: a case study

Forest managers in USA have been so strongly concerned with social and environmental issues that prescribed burning is relatively rare there, especially in western forests. Forest thinning is a more attractive and common practice, as they can improve stand structure along with forest management objectives and wildfire management goals. In some forests forest thinning not only helps in achieving firefighting goals, but also helps in ground water storage. Trees use a lot of water for photosynthesis. They suck ground water and evaporate it as vapour in a process known as evapotranspiration. This water becomes again accessible when it falls back to Earth as rain, so overall this is an important process to maintain water balance over large territories. However locally it may be huge loss. From 1990 to 2008, forest thinning saved 3.7 billion gallons of water



annually in California's Kings River Basin and 17 billion gallons in American river basin (nsf.gov, 2018). In California approximately two third of the water comes from Sierra Nevada forest which includes drinking water for 23 million population.

Although, mechanical thinning is implemented on a large scale in California. Still, mechanical thinning is a dividing issue in California's forest management and politics. President Trump's tweet (on 5 Aug 2018) shows that his administration wants to expand the logging and timber industry in western California (Sahagun, 2018). Some environmental organizations (also involving opposition political parties) are opposing this idea of logging forest at such massive scale and are filing a lawsuit against the government. US government officials (Department of Interior) referred to them as "Environmental Terrorist groups" who are not letting authorities to implement forest management policy on 80 million acres of forest to stop wild fires (Starr 2018). On the other side environmental groups claim that assuming that a logged area is at no risk of forest fire is not true. The brush and saplings that grow in cleared forests have higher probability to ignite and burn much easier than bigger trees. Environmentalists also claim that small branches and leaves which remain on the surface increase fire probability. Besides this, implementation of heavy machinery destroys the soil, causes erosion and damages plants and environment.



Figure 5: Heavy machinery may be involved in implementation of heavy thinning (Cart 2018)

In 2018, California faced the worst summer fire in a decade and claims from this fire event were for more than \$845 million (Insurance Journal, 2018). According to Kasler (2018) the volume of hectares that were consumed by wild fire by the end of this century will be 77% more than at present. In order to address this challenge California State is proposing a new legislation, which will help landowners to cut larger trees and build temporary roads in the forest for logging purposes. Forest agencies in California also offer a \$10 permit to help people cut Christmas trees in overly dense stands. There are specific guidelines in the permit for cutting, which actually helps in thinning the forest to prevent wildfires. Without these permits, the forest would have to be



thinned by forest agencies (Brunell, 2017). California government is also initiating \$1 billion grant for fire department, cities and non-profit organizations to implement forest thinning in coming five years (Rogers 2018).

Light thinning implies cutting the dead branches and clearing surface fuel (final canopy  $\geq 75\%$ ) while heavy thinning assumes removal of dead branches and trees (final canopy  $\geq 50\%$ ). In heavy thinning trees that are logged mostly include under growth trees so that rest of the trees can grow healthier.



Figure 6: Different scenarios of thinning (Piqué and Domènech, 2018)

Mechanical thinning removes crowding around tree crowns which decreases branch mortality and increases elongation, provides better photosynthetic process, helps tree diameter growth and enhances environment. Thinning followed by lop and scatter increase the surface fuel and thus probability of wild fires remains. Thinning followed by prescribed burning decreases the forest fuel. Piqué and Domènech (2018) found that if burning is conducted after thinning then it makes no difference for the risk of fire whether it is light or heavy.



## RESEARCH METHODS

During this trip, we focused on two things:

- mapping the fire affected region of Tathra using GIS technology and
- exploring potential sites for MFLR implementation.

For mapping, we used an Android app “Village GIS”<sup>4</sup> to collect the geographical location of each property destroyed by bushfires. Village GIS is an open source app which allows users to collect exact location information, geographical features like roads or slopes supporting both raster and vector layers. Vector data are stored either in point, line or polygon formats. All recorded points were further analyzed in QGIS<sup>5</sup>. QGIS is an open source software which supports multiple plugins to analyze spatial information. We used it to analyze our information and publish it on Google maps.

We have also used this opportunity to interview residents and collect data to further explore the social acceptance of MFLR.

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<sup>4</sup> <http://mspaceapps.in/~nagesh/VillageGIS/index.html>

<sup>5</sup> <https://qgis.org/en/site/>

## FINDINGS

### Mapping Tathra Fires using GIS Technology.

The fire which was caused by a malfunction in electrical infrastructure on Reedy Swamp Road in FSC forests near the bank of Bega River on 18th March 2018<sup>6</sup>, was so intense that it crossed the river and moved sporadically towards Thomson drive properties. Some Thomson drive properties which were right in the middle of the forest were completely destroyed. The fire spread down from Thomson drive towards Tathra. The properties locations, fire pattern and its direction of spread were reconstructed and mapped using GIS app.

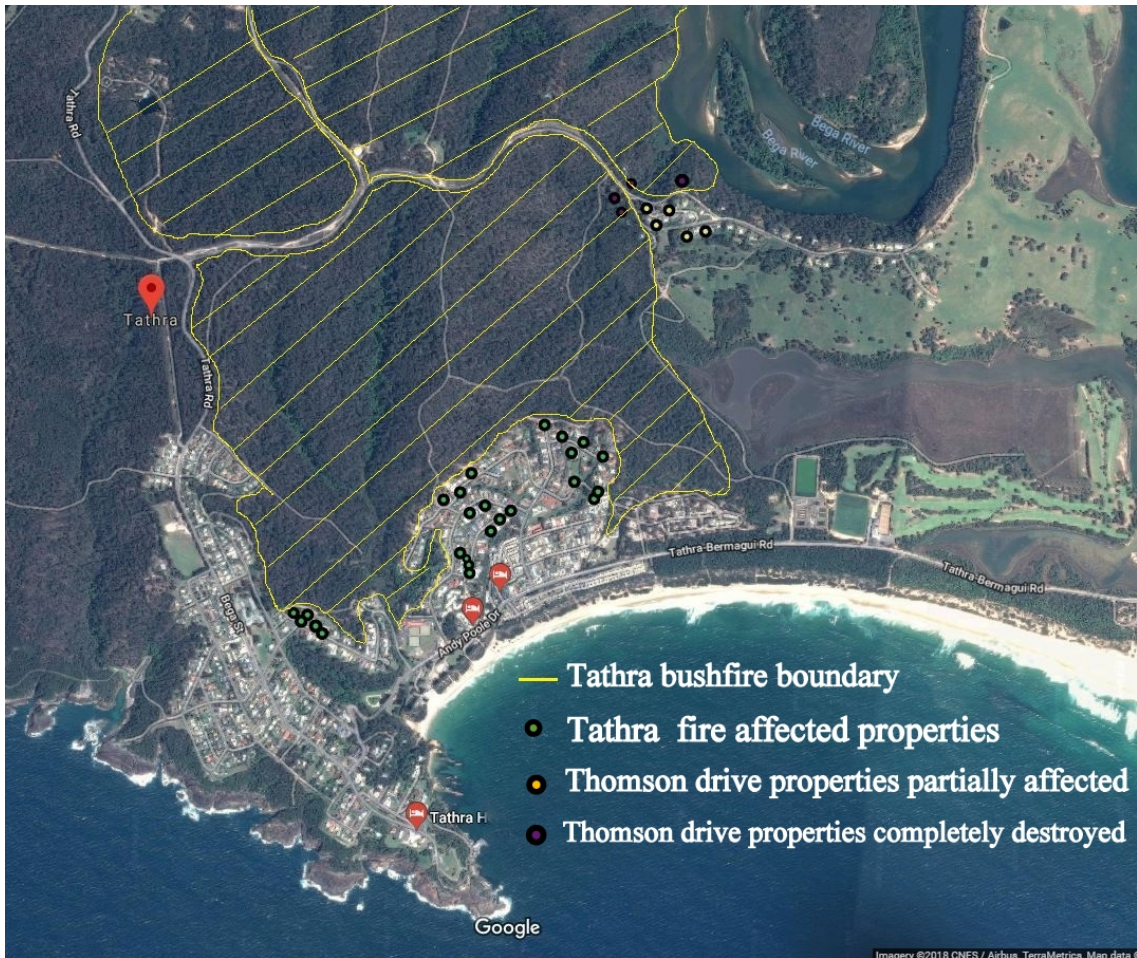


Figure 7: Mapping Tathra bushfires using QGIS

### Thomson Drive Properties

Fire first affected the cluster of properties in Thomson drive. More than 60% of the properties of Thomson drive were affected directly or indirectly. The data points were recorded on 28<sup>th</sup> March 2018. The red line in Figure 8 shows the Thomson drive area.

<sup>6</sup> <https://www.rfs.nsw.gov.au/news-and-media/media-releases/tathra-fire-investigation>

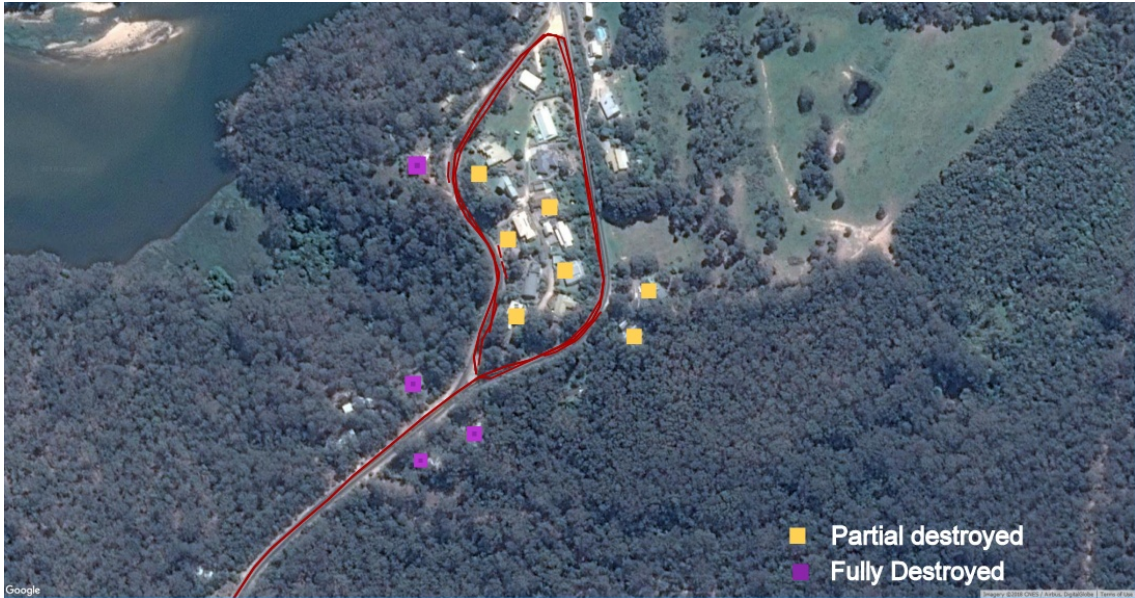


Figure 8: Bushfire affected properties of Thomson drive (data recorded 28 March, 2018)

### Tathra Properties

Fire moved further down from Thomson drive towards Tathra residential area. The embers flew with immense heat and smoke, they attacked random locations in Tathra, which caused damage to some of the properties.

Handmer (2005) found that most Australian houses are burnt due to ember attacks. Houses which have highly flammable external roof materials are more vulnerable to them. Small fires start and eventually lead to large fires if residents or fire services are not able to extinguish them, which burn whole houses or cause major damage to properties.



Figure 9: Tathra properties affected by bushfires.

The majority of destroyed Tathra houses were affected by ember attack, and most of them were not even close to forest. Residents described it as “a hail of fire, embers coming” (Gleeson, 2018).



Figure 9 shows that most of the fire affected houses are right in the middle of the town. Damage from ember attack depends on a number of factors which include quality and quantity of the embers, structure of the property, vegetation type around the property, surface fuel around the property, prevailing weather conditions (i.e. wind speed and direction), suppression activities during and after ember attack (Leonard & Bowditch 2003).

#### Mapping Tathra region for MFLR.

MFLR along with other techniques can be used as a fuel reduction technique, but with no smoke and less impacts on environment. Also it can be done closer to communities in areas and vegetation where prescribed burning is not possible. Cost of MFLR can be offset by using the biomass collected for timber or energy generation. It is very efficient for small-moderate sized areas, close to settlements, relatively flat-undulating terrain and no seasonal limits. Collection of forest fuel (dead fuel and surface fuel) can decrease the intensity, size and probability of wildfire (Regos et al. 2016).

Areas close to roads (transportation access) and areas that are populated (where implementing HRB is especially risky) should be preferred for MFLR, while areas with difficult access and remote areas are easier to treat with HRB. Areas, which we identified as more suitable for MFLR are marked with blue in Fig.6. The assessment was made based on location information, access difficulties and slope. These areas were selected after onsite analysis, using expert opinion and GIS data analysis.

The area close to Thomson drive properties is easily accessible from the road, thus we suggest to implement MFLR from Tathra road down to Thomson drive properties. The area provides quick and easy access for harvest machinery. Further life cycle analysis needs to be performed before implementation of MFLR.

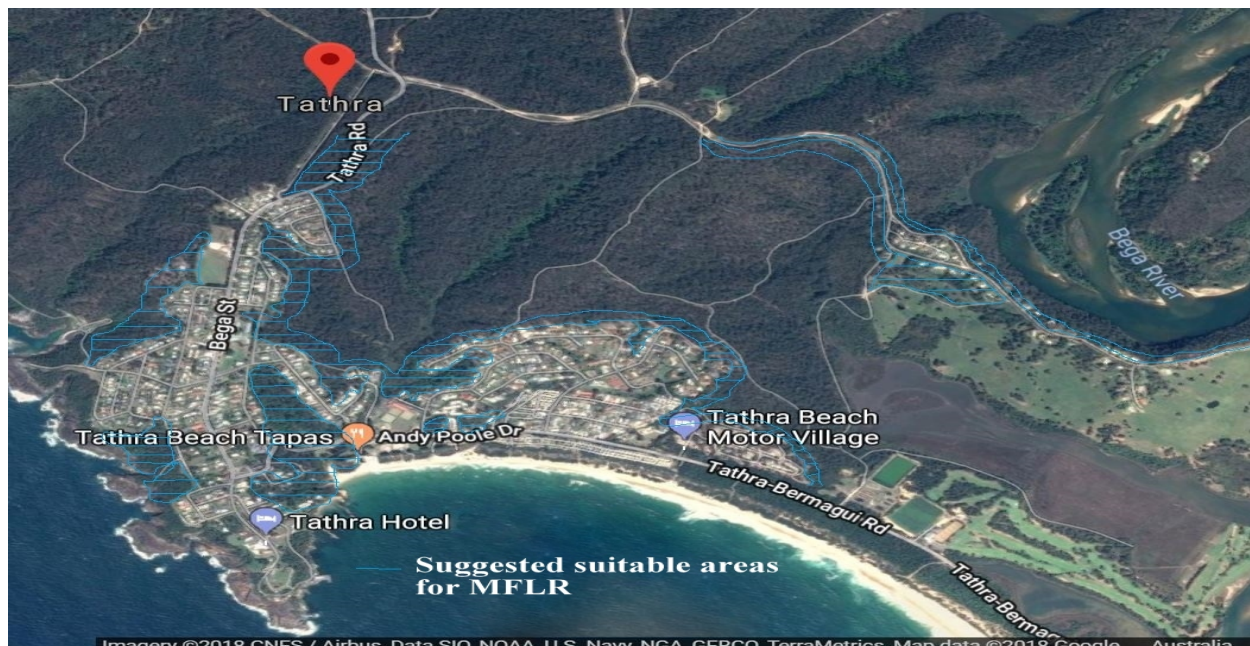


Figure 10: Suggested areas for MFLR in Tathra



Risk of bushfire endangers many Australian communities and developments. Property loss is greater in peri-urban developments, and quantifying bushfire risk is important for developing rational planning regulations and fuel reduction policies. Developments in bushfire areas mostly require the implementation of a safe distance from the vegetation. This is mostly known as asset protection zone (APZ) or fire protection zone. The asset protection zone is further classified into inner protection zone (IPZ) and outer protection zone (OPZ). The methodology is defined in Planning for bush fire protection 2006<sup>7</sup>. The IPZ should be located immediately next to an asset. In Figure 11, we can see that the IPZ and OPZ were not implemented in these two properties in Tathra. Burning IPZ (around 100m) every 1-4 years can save assets from bushfire except in the event of extreme weather conditions (Bradstock et al., 1998).



Figure 11: High vegetation fuel around properties affected by bushfire in Tathra.

In our visit, we also found that some properties were right in the middle of the forest (see figure 12). These properties were surrounded by high forest fuel load along with slope. The slope angle also contribute as a major factor in rapid fire spread to these properties. Fire tends to increase as slope increases. This is because bushfire can easily reach unburnt fuel sources and can pre heat them. Increase in slope also increases the speed and intensity of bush fire. With every 10 degree increase in slope the bushfire rate of spread doubles (Country Fire Authority, 2018). Fire tends to move slowly when slope decreases. As slope increases from Bega river towards Thomson drive properties and Tathra, fire started to move much quicker with the support of wind as well.

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<sup>7</sup>[https://www.rfs.nsw.gov.au/\\_data/assets/pdf\\_file/0008/4400/Complete-Planning-for-Bush-Fire-Protection-2006.pdf](https://www.rfs.nsw.gov.au/_data/assets/pdf_file/0008/4400/Complete-Planning-for-Bush-Fire-Protection-2006.pdf)



Figure 12: Properties in the middle of forest with high fuel load.

In our trip we explored the possible sites suitable for mechanical thinning. One of such possible sites is Thomson drive, which is easily accessible from road and has high loads of forest fuel (see figure 13). The extracted biomass can be easily transported to nearest facility for bioenergy production on a small scale or may be useful for local residents as a fuel source.



Figure 13: Possible sites for implementing MFLR.

According to (Parker, 2016) clearing of bush (waste biomass or live/dead fuel) around properties in fire prone areas is the most effective solution of bush fire mitigation. He also proposed a way out of implementing community funded biomass clearance and collection process and the valorisation of this biomass. We found that some of the local residents collect waste biomass (dead fuel) from surrounding of their assets and may later utilize this biomass as a fossil fuel alternative.



Figure 14: Tathra residents collecting biomass around their properties.



## DISCUSSION

Bushfire is a natural complex landscape process which is driven by forest fuel load, heterogeneity in vegetation, weather conditions, moisture content, timing and frequency of previous fuel reduction treatments (Collins et al., 2010; Barbour et al., 2007). Bushfires are an important aspect of many Australian ecosystems and indigenous culture from an estimated 60 million years (Matsypura et al. 2018). Bushfire are the most occurring natural disaster in Australia. According to (Ashe et al. 2009) bush fire causes almost 100 deaths and 3000 injuries every year. Over the last 30 years, more than nine million Australians have been directly or indirectly impacted by natural disaster mostly from bushfire (IAG 2017).

Before implementing mechanical thinning, life cycle assessment is needed to be explore the whole process and assess its profitability with current practices. When comparing to existing practices we should account for the costs of firefighting, asset protection, impacts on human health, payments for carbon emissions and ecological impacts. Monetary estimates of some of these factors can be quite difficult.

While implementing MFLR, there are a number of factors which need to be considered such as access difficulties, suitable mechanical harvest system, costs, and social acceptability. Access difficulties include slope of the area (slope must be less than 20 degrees), obstacles to operate machinery, rocks and uneven land, type of soil, e.g. wet or soft soil, and transportation accessibility of biomass from MFLR facility (Ximenes et al. 2017). However, little is known about the effectiveness of implementing MFLR (alone) in Australian forests. Most likely a hybrid system can be developed that will include a combination of both MFLR and HRB. We suggest that bush fire characteristics (surface fuel load, crown height and density) must be included in silvicultural treatment guidelines along with bushfire management goals and ecological challenges. This would help in determining the most suitable treatment for each fuel type and forest structure.

Our scoping survey has found that people living in bushfire prone areas have a positive attitude (63%) towards prescribed fires. When asked about the MFLR, we found that the majority (58%) of the respondents have no knowledge about MFLR techniques. People who reported prior knowledge of MFLR, indicate that it has limited application due to geographical access, ecological impacts and cost. Limited location application is the main issue reported by majority of respondents (with prior MFLR knowledge). People also reported that there will be loss of natural habitat for native wildlife that are supported by the presence of biomass

Yet it appears that there is good acceptance of MFLR among those respondents who have prior knowledge about MFLR. The fact that local residents have different opinions about different fuel reduction treatments is not surprising. Some of these groups may know about MFLR, while other have no prior knowledge. People who support prescribed burning argue that it saves from bushfires. People who do not support MFLR argue that they have no knowledge about its effectiveness and applications. So, we can say that what influences people acceptance most is their knowledge about the effectiveness of MFLR as a fuel reduction treatment in fire prone areas.

Analysing Facebook posts and Tweets bears the promise of further enriching our understanding of social acceptance of various hazard reduction technologies.



## CONCLUSION AND FUTURE RECOMMENDATIONS

We are thankful for the opportunity and funding provided by BNHCRC. This report results will be used by the UTS research team, and may be also useful for the BNHCRC, land managers, Rural Fire Services (RFS) and bushfire experts in Australia and around the world.

Even the best risk management can only reduce the bushfire risk, it cannot eliminate it completely. Fire and land managers face serious challenges in developing strategies for effective fuel management in extreme fire prone areas like Tathra. We need to act now to save our livelihoods, environment, and resources from losses associated with wildfires. In this work we have to be open for various alternative technologies and their combinations

During the short trip to the Tathra area we have seen many areas where MFLR could have been applied. If cleared, some areas could certainly decrease the intensity of fire and the risks of property damage. It is yet to be estimated what amounts of biomass can be harvested there and how much of cost reduction this biomass could bring.

Further research is also needed to understand the perceptions and preferences of local residents, and to explore whether social media can play a role in educating the public to address short and long term (pre or post) disaster management goals.

Collective research over many years demonstrated that regardless of the fuel reduction strategies and ecosystem conditions, communities can survive by taking several steps: clearing vegetation near houses, protecting exterior of the house by inflammable materials, improving communication ways for warning and participating in bushfire awareness community programs. This research also demonstrates that social technologies are transformative in exposing public concerns and issues.



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