SCION
Next generation biomaterials

RURAL FIRE RESEARCH UPDATE
May 2009 | Issue 4 | ISSN 1178-7775

Fuel load recovery in tussock grasslands

This study improves understanding of fire hazard in tussock grasslands by investigating fuel load recovery with time-since-fire. Very few studies have investigated the recovery of fuel loads following fire in tussock grasslands. The study area was located in the Waiouru Army Training Ground in the Central North Island, and contained many tussock areas burned over several different years. Knowledge on the rates of fuel load (biomass) recovery following fire is important, and results from this study will contribute to the improvement of fuel and fire behaviour models for fire management activities in tussock grasslands (i.e. hazard assessment, Wildfire Threat Analysis and fuels management).

Key findings from this study were:

- Biomass of burnt areas significantly increased with time since fire.
- Initial recovery of burnt areas contained a greater proportion of weeds and weedy species.
- Fuel load after fire recovered to about 20% of the unburned biomass within 6-12 months and to 50% by 4-7 years.
- The current fuel load model for tussock grasslands (the "tussock all" model) made good predictions of the fuel load in these tussock grasslands.

Introduction

Tussock-dominated grasslands occupy significant areas of New Zealand, and are frequently affected by wildfire events, including escapes from controlled burning. With high available fuel loads, tussock fires can burn with high intensity and impact on vegetation recovery. The primary purpose of this study was to investigate fuel load recovery with time-since-fire.

Past studies have demonstrated that burning of tussock grasslands results in changes to vegetation composition and structure over time. Reductions in plant cover and an increase of dead material and bare earth have been found. The establishment and dominance of introduced grasses and herbs after a reduction in tussock cover were also observed. Very few studies to date have investigated the recovery of fuel loads (biomass) following fire in tussock grasslands. Previous studies in tussock have typically relied on one-off or repeated sampling over time of burned and unburned areas following opportunistic wildfires. This project was the first of its kind to investigate post-fire fuel load recovery using a space-for-time approach (based on sampling of different fire sites from the same general area across a range of times since fire). Methods developed can also be applied to tussock grassland ecosystems in other parts of the country.

Photographs (above and below) sampling in unburnt and burnt vegetation, 4 years since fire

Photographs (above and below) of burnt and unburnt vegetation, 6 months since fire.

Methods

This study was undertaken at the Waiouru Army Training Ground (ATG), located in the Central Plateau of the North Island. This land is managed by the New Zealand Defence Force. Opportunities to conduct this type of research are rare, and this was an ideal location because of the frequent occurrence of fire (from military operations) and the availability of good quality fire history records. The Waiouru ATG covers an area of approximately 63,000 ha, with typical vegetation cover being tussock grasses, mixed scrublands and patches of beech forest.

Post-fire fuel load recovery in tussock grasslands was determined by biomass sampling (destructive and non-destructive techniques) of previously burnt areas of different ages (times since fire) and on adjacent unburnt (control) areas. This sampling involved measuring, clipping, bagging, drying and weighing all above-ground vegetation from 15 subplots of $1m^2$ within each area. Non-destructive biomass sampling involved measuring heights and cover percentages within each subplot. Fuel load recovery was determined by comparing differences in biomass (t/ha) for burnt areas with their respective neighbouring controls. Sampling results were also used to test how well currently available fuel load prediction models estimated the biomass of vegetation in burned and unburnt areas.

Results

- Over time, total vegetation biomass (t/ha) in burnt areas increased from 1 t/ha to 15 t/ha (Figure 1a). The neighbouring unburnt areas did not show a similar trend over time, with total biomass being highly variable (Figure 1b).
- In the early stages of recovery, much of the biomass of burnt areas comprised introduced species (pasture grasses, heather and hieracium). In the neighbouring unburnt areas, surface fuels (litter, moss, etc) contributed most to the total biomass (Figure 1b).
- Fuel loads in tussock grasslands at Waiouru recovered to about 20% (10-19%) of the unburned biomass within the first six months and about 50% (34-63%) by 4-7 years following fire (Table 1).
- By 10 years since fire, tussock fuels contributed to about 33% of the total biomass. Scrub and other fuels (understorey grasses and shrubs) contributed around 50% the total biomass, and the remainder (17%) was surface fuels (Figure 1a).
- The current models to predict fuel loads fitted well with actual regenerating biomass from burnt sites. The "tussock only" model was best for tussock fuels, "hardwood" for scrub and "ungrazed pasture" for other components.

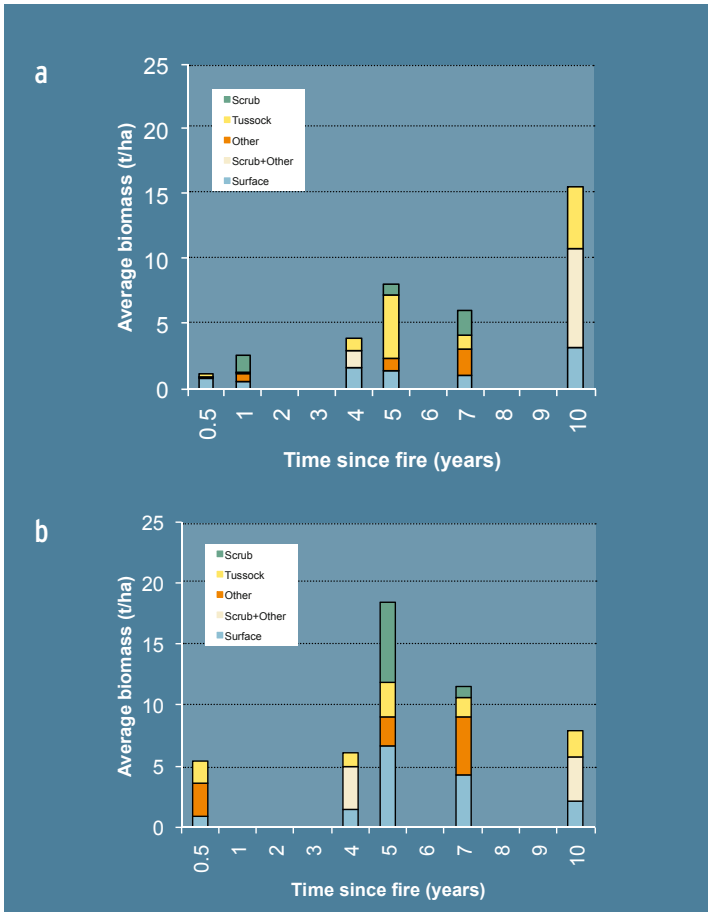
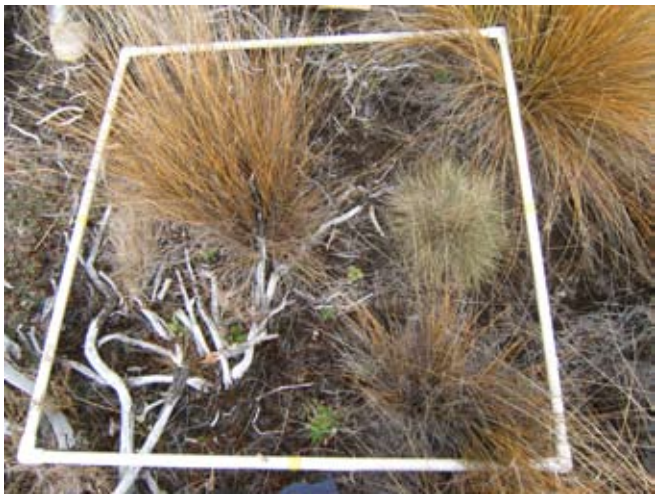
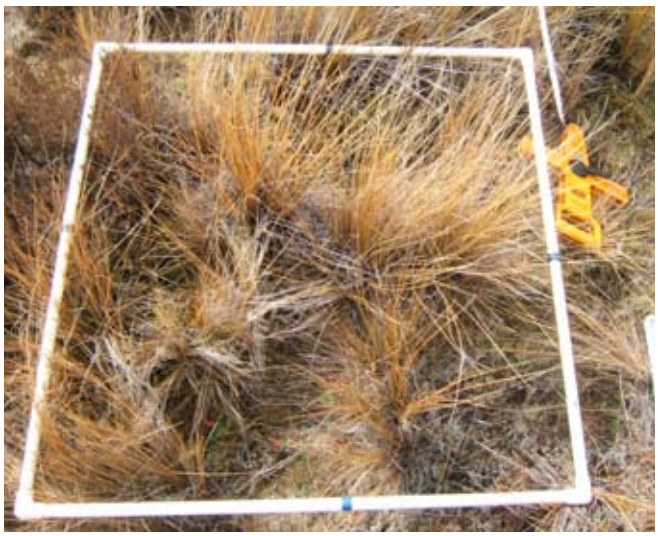


Figure 1. Average biomass (t/ha) for vegetation components (Tussock, Scrub, Other and Surface) measures from six different burnt (a) and five neighbouring unburnt (b) sites.

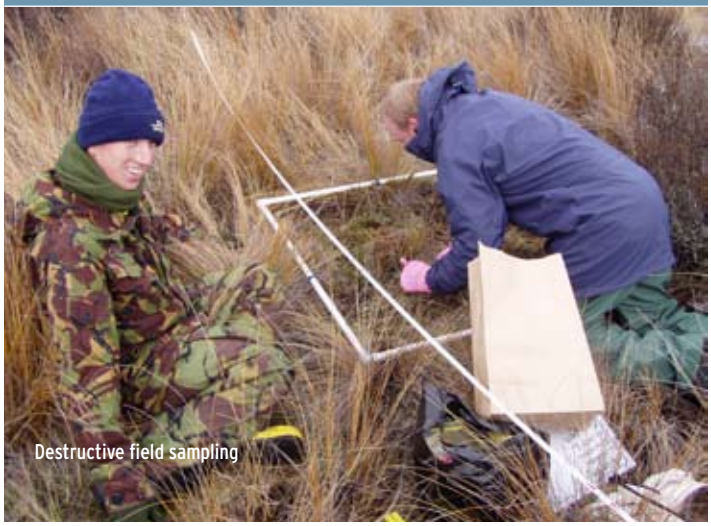
Table 1. Average fuel load/biomass results from burnt and neighbouring unburnt (control) sites.

	Biomass (t/ha)		Recovery (%)	
Age	Burnt	Control	Actual (Burnt/control*100)	Average (using the control average of 9.84)
0.5	1.03	5.36	19.12	10.41
1	2.45	-	-	24.84
4	3.83	6.11	62.69	38.92
5	8.02	18.37	43.64	81.44
7	5.98	11.52	51.88	60.71
10	15.50	7.86	197.21	157.48
Average biomass		9.85		





Photos (above and below) show the differences in burnt and unburnt vegetation 5 years since fire



Destructive field sampling

Conclusion

Results from this study determined the rate of fuel load recovery for tussock grasslands in Waiouru, and provide an indication of the rate at which fire hazard increases in these areas following fire. The fuel loads in the sampled areas were adequately predicted by the current fuel load model for tussock grasslands ("tussock all"). These results are useful for long-term fire management planning, such as threat analysis and risk mitigation efforts.

Application of these results to other areas of the country requires further investigation of the effects of fire intensity, climate, site productivity and differences between tussock species. The accuracy of the findings for Waiouru could be improved by more sampling in areas of the same age (time since fire) to reduce the effects of site differences on biomass. Extending this study to a range of tussock grasslands across the country would produce more reliable models of both fuel load and fuel recovery rates. It will also be useful to explore the link between fuel load recovery and fire potential.

Acknowledgments

The study would not have been possible without the support of the New Zealand Defence Force. Many thanks in particular to the Waiouru Fire Brigade for their help in providing local knowledge to identify suitable sampling sites, arranging access to the training grounds, collecting fire history data and providing a helping hand with sampling.

Further information

The full report can be downloaded from the Scion Rural Fire Research website (located in the publications section)

http://www.scionresearch.com/fire

Clifford, V.R & Pearce, G (2009) An interim investigation into post-fire fuel load recovery in tussock grasslands. Scion Report Number 16503. Scion, Christchurch.

Photographs showing non-destructive sampling in burnt vegetation 10 years since fire.

For more information, contact:
Rural Fire Research Group
Scion
PO Box 29237, Fendalton,
Christchurch 8540
Telephone: 03-364 2949
www.scionresearch.com/fire

Next generation biomaterials

Funding for the Scion Rural Fire Research Group is provided by the Foundation for Research, Science and Technology (FRST) along with direct funding and significant in-kind support from NZ Rural Fire Sector organisations (National Rural Fire Authority, NZ Fire Service Commission, NZ Forest Owners Association, Department of Conservation, members of Local Government NZ, NZ Defence Force and Federated Farmers of NZ Inc).