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SHADE CLOTH TRIALS IN SOUTH-EASTERN AUSTRALIA AS A METHOD OF RESTORING PEATLANDS DAMAGED BY FIRE

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In January 2003 wild fires burnt approximately 2.1 million hectares in the mountains of southeastern Australia with a high proportion of the subalpine peatlands being affected. Alpine and subalpine peatlands dominated by shrubs and restiads but including the hummock moss *Sphagnum cristatum* are common in the highlands of southeastern Australia and total 9710 ha (Hope and Nanson 2015). The peatlands in national parks in New South Wales (NSW) and the Australian Capital Territory (ACT) had been recovering gradually from the effects of cattle and sheep grazing which ended more than 50 years ago but the 2003 fires reversed some of these gains. Post-fire, field inspection showed that while the vegetation in many of the peatlands had been severely burnt, most underlying peat surfaces were scorched but remained intact. Although peatlands had been drought affected, residual moisture prevented burning of the peat except where sites had been drained (Hope *et al.,* 2012).

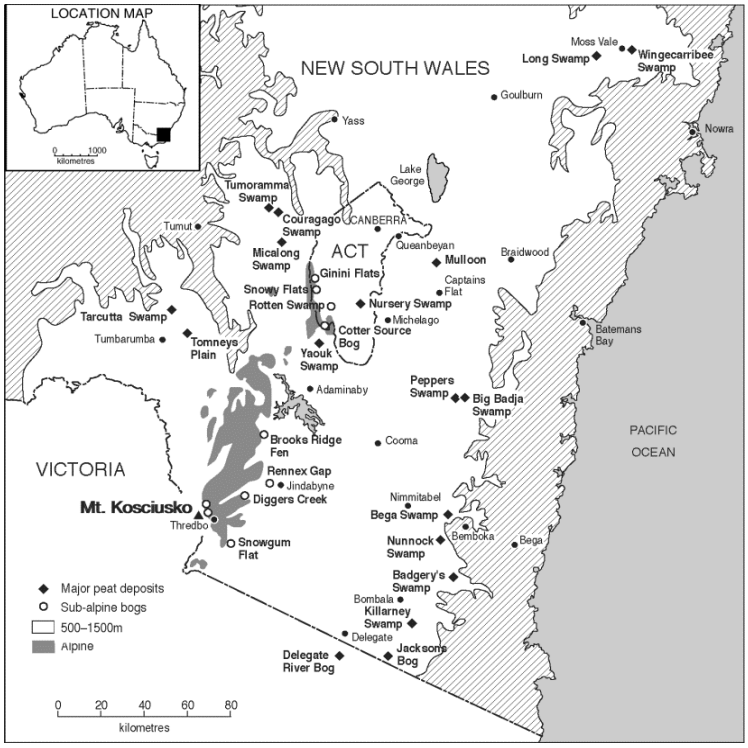

Figure 1 Upland areas of southern New South Wales and the ACT where peatlands are prominent.

The *Sphagnum* mires of the Australian Alps are climatically limited by evapotranspiration in the hottest month (Whinam *et al.,* 2003). Dry conditions result in bleaching of the hummocks and UV may also contribute to this (Good et al 2010). Up to 70% natural shading by other plants has been shown to favour *Sphagnum* moss growth (Whinam and Buxton 1997). The fires removed the shrub and graminoid cover, undermining any prospect for rapid recovery by *Sphagnum*. This prompted a program to trial artificial shading to enhance recovery at selected bogs in Kosciuszko National Park and Namadgi National Park. The aim is to restore and rehabilitate the hydrological functioning of these disturbed peatlands (Hope *et al.,* 2005, Good *et al.,* 2010). A preliminary description of the trials was provided by Hope *et al.* (2005) and the results after four years of monitoring of vegetation have been presented by Whinam *et al.* (2010). Further measurements have been made at 6 years (2009) and 10 years post fire. The results of these trials may help guide future peatland restoration techniques for montane peatlands in the region.

METHODS

At Pengillys Bog three shading treatments were established in 5 burnt and partially burnt peat areas, using 70% beige-coloured shade cloth material and loosely spread straw. Each plot included a 20 m long and 1.6 m high 70% shade cloth fence aligned east-west. Four quadrats were placed on each side of the vertical shade fence and

solar radiation levels on northern and southern sides recorded over the 2004 summer. The effect of shading was compared with a second treatment, in which 15 m lengths of 2m wide shade cloth were pegged down horizontally, to lie loosely over the bog surface. Ropes were used to prevent the shadecloth from blowing away. A third shade treatment was established using sterilised grass straw spread at a rate equivalent to 2 tonnes per hectare (70% cover equivalent). Other sites (Rotten Swamp, Ginini Bog, Cotter Source Bog) were treated for varying periods with horizontal shade cloth strips up to 20m in length.

Figure 2: Three shade treatments (vertical, horizontal and straw mulch in 2004.

Quadrats were established underneath the shade and in adjacent plots and re-measured up to twice a year for five years between 2003-2009 and biannually thereafter for plant cover, floristic diversity, peat accumulation / depth and pH values. Shade cloth was removed from most areas in 2007 but relaid in two locations over a previously treated area until 2013 to see if longer term treatment can produce additional benefits.

These plots were assessed in 2016 (year 13).

RESULTS

Spectacular shrub, restiad and *Sphagnum* growth under shade cloth compared to controls was evident on first removing the shade in 2007. Straw mulch was effectively lost by the third year after treatment but caused positive growth in sedges. Any beneficial effects of straw mulch on badly burnt areas were short-lived. There were only slight differences between quadrats adjacent to the vertical shade fences. The sample size of the experiment (a total of 20 quadrats on each side of the shade fences) was probably too small, given the variability in site characteristics and damage class, to establish any effect of vertical shade. Additionally the vertical shade fences may have had the effect of sheltering both shaded and unshaded plots.

Figure 3: Shaded plots at Rotten Swamp, ACT, 1 year after re-exposure, 6 years after the 2003 fire

Horizontal shade cloth had significant impact on the vegetation. When shade cloth was removed, the vegetation was taller, more luxuriant and greener in colour than the surrounds. Shrubs had started to grow through the cloth and in some cases it had to be lifted to accommodate the increased volume of bog vegetation that had developed. Horizontal shade cloth alone provided for the greatest increase in the vegetation cover of *Empodisma minus* and *Baloskion australe.* There was good recruitment of species and patches of *Sphagnum* had expanded to form large mats. Transplants of *Sphagnum* 20x20cm in size showed significantly better survival and subsequent expansion under shade cloth compared to plots with no treatment.

When compared to unshaded plots there was significant difference in recovery of all native plant species (percentage vegetation cover) treated with horizontal shade cloth over time ($p=0.001$), although forbs were the only lifeform that showed significant increases in cover over time ($p=0.005$). After twelve years many control plots showed similar vegetation growth to the plots that had been shaded for four years. Three years after shade had been removed, the plots shaded for longest were easily differentiated in the field from sites subject to shade for a shorter time and control sites, although there

were small areas of death in some shrubs and restiads. Comparisons of quadrat results were not dramatic but the longer-term shade plots tended to be dominated by larger shrubs, graminoids or moss with reduced diversity. This resembles more mature bog vegetation structures.

DISCUSSION

The shade cloth technique shows promise in rehabilitating sensitive areas of peatland in regions with strong sunlight and high summer temperatures. As well as providing shade, it retains humidity and protects plants from wind and ice damage. Additionally it may moderate frost effects and limit grazing by marsupials. It is particularly valuable in helping moss transplants to establish and develop. Since recovery of unshaded peatlands did eventually occur (as predicted by Walsh and McDougall 2004) shade is principally a way of accelerating the initial recovery to a mature shrub-bog structure. It is thus feasible to establish a grid of shade plots to establish nuclei of vegetation regrowth that would subsequently spread into the surrounding peatland.

From a practical perspective shade cloth is relatively cheap and showed no deterioration after four years. It is readily transported into remote areas by helicopter but must be removed. It is vulnerable to further fires and is very visible so may be unsuitable in some settings.

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REFERENCES

1. Good R 2004. Rehabilitating fire-damaged wetlands in the Snowy Mountains. *Australasian Plant Conservation* 12(4): 3-4.
2. Good, R., Wright, G., Hope, G.S. and Whinam, J. 2010. The impacts of increasing solar ultraviolet light on the wetland mires of the mainland Australian Alps. *Australian Plant Conservation* 8(4), 3-4.
3. Good, R., Wright, G., Whinam, J. and Hope, G.S. 2010. Restoration of mires of the Australian Alps following the 2003 wildfires. In S. Haberle, J. Stevenson and M Prebble eds. Altered Ecologies Fire, climate and human influence on terrestrial landscapes. *Terra Australis* 32, 353-362.
4. Hope, G. and Nanson, R. 2015. Peatland carbon stores and fluxes in the Snowy Mountains, New South Wales, Australia. *Mires and Peat* 15 (11), 1-23.
5. Hope, G.S., Nanson, R. and Jones, P. 2012. Peat-forming bogs and fens of the Snowy Mountains of New South Wales. Technical Report. Office Environment and Heritage, Sydney. Pp. 87.
6. Hope, G., Whinam, J. and Good, R. 2005. Methods and preliminary results of post-fire experimental trials of restoration techniques in the peatlands of Namadgi (ACT) and Kosciuszko National Parks(NSW). *Ecological Management and Restoration* 6, 215-218.
7. Walsh N.G. and McDougall K.L. 2004. Progress in the recovery of the flora of treeless subalpine vegetation in Kosciuszko National Park after the 2003 fires. *Cunninghamia* **8**, 439–452.
8. Whinam J. and Chilcott N. 2002. Floristic description and environmental relationships of *Sphagnum* communities in NSW and the ACT and their conservation management. *Cunninghamia* **7**, 463-500.
9. Whinam J., Hope G. S., Adam P., Clarkson B.R., Alspach P.A. and Buxton R.P. 2003. *Sphagnum* peatlands of Australasia: the resource, its utilisation and management. *Wetlands Ecology and Management* **11**, 37-49.
10. Whinam, J., Hope, G.S., Good, R. and Wright, G. 2010. Five years of post-fire monitoring of the recovery of *Sphagnum* shrub bogs in the ACT and NSW, Australia. In S. Haberle, J. Stevenson and M Prebble eds. Altered Ecologies Fire, climate and human influence on terrestrial landscapes. *Terra Australis* 32, 363-379.