Regrowth of blackberry two years after the 2003 wildfires in Victoria

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Summary An earlier study of blackberry (*Rubus fruticosus* L. agg.) after the 2003 bushfires found that even with high fire intensities some blackberry always survived to produce new stems in the following growing season post-fire. Some of the plots were assessed a second time in 2005 to determine whether blackberry had re-established dense thickets and to examine the reasons for any differences amongst the plots.

The diverse outcomes included: dominance of native shrubs, co-dominance of native shrubs and blackberry, graminoid dominance, co-dominance of blackberry with graminoids, blackberry dominance and dominance of native tree seedlings and shrubs. It is clear that pre-fire blackberry thickets often did re-establish, although not invariably, and that competition from native shrubs seems to be an important factor in reducing blackberry abundance. Absence of a substantial native shrub seedbank may have contributed to re-emergence of blackberry dominance in some cases.

Keywords *Rubus fruticosus*, fire, competition.

INTRODUCTION

European blackberry is a major weed in Victoria with about 3 million ha infested. It is also a Weed of National Significance (WoNS) (Thorp and Lynch 2000). The biology and ecology of blackberry are extensively described by Bruzzese and Lane (1996) and Amor *et al.* (1998). Blackberry is a prickly shrub growing into thickets that can be several metres high. The root system is perennial and includes a woody crown up to 20 cm in diameter. The stems (canes) of blackberry are not perennial, but generally persist for two years.

Very extensive bushfires occurred in north-east and eastern Victoria between January and March 2003 affecting 1.1 million hectares (Wareing and Flinn 2003), including many thousands of hectares with established blackberry infestations.

Controlled burning is ineffective by itself as a method of control for blackberry. Stems are destroyed, but the perennial woody crown and root system are little affected and vigorous regrowth is produced (Amor *et al.* 1998). Although sometimes useful to open up dense thickets for later control work, the main contribution of controlled burns in blackberry management is to clear dead stems after the use of herbicide. Summer wildfires could produce a different situation because higher fire intensities may be reached, potentially killing blackberry crowns and roots.

A survey of post-fire blackberry regrowth was carried out in the first growing season after the fires, at locations chosen to represent a range of fire intensities. The aim was to determine whether areas subject to higher fire intensities would have significantly reduced blackberry regrowth due to destruction of a large proportion of the perennial parts of the plant.

The survey found that a large proportion of blackberry crowns were dead, particularly in areas where fire intensities had been high. However, there was always sufficient below-ground material remaining to produce rapid re-growth of blackberry in the first season after the fires (Ainsworth and Mahr 2004). Regrowth consisted of canes developed from crowns that survived the fires, and canes arising as suckers from surviving roots. Although the growth rate of stems arising from root suckers was somewhat lower than that of stems from crowns, it seemed unlikely that the difference would have much consequence for the outcome of competition between blackberry and other species.

This paper reports the results of a re-survey of some of the original plots two growing seasons after the fires. The aims were to determine whether the blackberry thickets present pre-fire had in fact re-established and to attempt to identify possible reasons for the outcomes observed in each case.

MATERIALS AND METHODS

The original study comprised 25 plots in seven groups located within the burned areas of north-east Victoria in places that were known to have been infested with blackberry pre-fire. Each plot was 2 × 5 m in size. The majority of the plots were on river flats or in gullies, reflecting the habitat of blackberry. Plots were categorised as having been subjected to a low (L), medium (M), or high (H) intensity of fire according to criteria described in Ainsworth and Mahr (2004). During the first post-fire growing season (October 2003 to February 2004) the number of live and dead crowns, number and length of new stems and whether they arose from root suckers or crowns and the number of blackberry seedlings were recorded.

Re-visiting plots required more time than the first post-fire assessment because of the large amount of blackberry to be measured and the difficulty in relocating plots in the dense vegetation that had developed. Due to constraints on time, only 11 of the original 25 plots (all in NE Victoria) were assessed. The plots L(i), L(ii), M(i), M(ii), and H(ii) are in a forested area south of Beechworth; plots L(iv), M(iii) and H(i) around the eastern edge of Lake Buffalo; L(iii) and H(iii) on Buenba Creek in the Alpine National Park and M(iv) on Big River near Glen Valley. Fieldwork was completed in May and June 2005, when growth of blackberry had ceased. Most of the blackberry in the plots was *Rubus anglocandicans* A.Newton (called *R. procerus* in many previous publications), which is the most widespread taxon of the aggregate in Australia (Evans and Weber 2003).

2005 data collection All blackberry stems originating within the plot were extracted, their length measured to the nearest cm and presence of fruiting or formation of daughter plants by tip rooting was noted. Daughter plants were recorded if produced on stems that originated within the plot, regardless of whether the daughter plant itself was located within the plot. Daughter plants occurring inside the plot but produced from stems originating outside it were not recorded. The number of crowns per plot was not determined, as this would have required complete excavation of dense thickets. Browsing of a stem was recorded as present if the terminal bud had been completely removed, without distinguishing whether this had occurred early in the season, resulting in a branched tip or had occurred later resulting in an unbranched truncated shoot. Browsing of side shoots on a stem was not counted. Age of the stem was not recorded. Although fruiting stems would have been in their second year and tip rooting confined to first year stems, there were many stems with neither of these features, to which no age could easily be ascribed, particularly at sites where browsing was common.

Other vegetation within the plot was recorded as an approximate visual assessment of abundance usually without attempting to identify the components further than the broad groupings: 'graminoids' (grasses, sedges and rushes whether native or exotic), 'native tree seedlings or saplings', 'bracken', 'native shrubs', 'broadleaved exotics', 'broadleaved natives'. Abundance was later simplified to '-' meaning absent or insignificant, '+' obviously present but a minor component of the vegetation, '++' a major component but not dominating the plot or '+++' dominant, including co-dominant with blackberry. Notes were also made of the general appearance of the area surrounding the plot and whether cattle were present.

RESULTS

Number and length of stems Table 1 summarises the results of the blackberry measurements. Within each fire intensity, sites have been numbered according to the mean blackberry stem length m^{-2} in 2005. Most plots had a substantially higher number of stems m^{-2} in 2005 than in 2003-04, as was expected; the exceptions were L(i), L(iii) and H(i).

Vegetation composition The mean length of stem present per m^2 provides a measure of the thickness of the blackberry. Values below about 10 m m^{-2} were found in plots where blackberry was much less abundant than other vegetation components and formed a sparse ground cover of thin stems beneath native shrubs, saplings or grass tussocks. Values between 10 and 20 m m^{-2} were found where blackberry was a major component of vegetation but less abundant than the sum of the other vegetation. Values greater than 20 m m^{-2} were found where blackberry accounted for the majority of vegetation. There were no obvious associations between pre-fire density of crowns or intensity of fire and density of stems or total stem length in 2005. The blackberry rust fungus, *Phragmidium violaceum* (Schultz) was scarce to absent in all plots.

Plots were generally internally uniform in composition, with the exception of M(iii) where blackberry at one end of the plot had been heavily browsed by deer and grasses dominated, whilst at the other end dense blackberry had established. The vegetation in the plots (Table 1) could be summarised as: dominance of native shrubs in L(i) and M(ii); co-dominance of native shrubs and blackberry in L(ii) and H(ii); graminoid dominance in M(i); co-dominance of blackberry and graminoids in L(iii) and M(iii); blackberry dominance in L(iv), M(iv) and H(iii). Plot H(i) was the only one in which native tree seedlings (*Eucalyptus* spp. with some *Acacia* spp.) were prominent; they were co-dominant with native shrubs and blackberry was a minor component.

Browsing Deer were present throughout the study area. Cattle were present in the vicinity of three plots, of which L(iii) and H(iii) also had horses in the area. However, it was only in L(iii) that there were signs of cattle actually moving through or feeding in the plot. In fact plot H(iii) contained blackberry so dense that it had clearly been impenetrable to cattle and horses for at least the preceding year. Browsing in this plot

Table 1. Blackberry measurements 2003–4 and 2005 and vegetation composition 2005.

Site	Blackberry measurements: Pre-fire crowns m^{-2} from 2003–4 data	Post-fire stems m^{-2} from 2003–4 data	2005 number of stems m^{-2}	2005 total length of stems ($m\ m^{-2}$)	Fruiting stems m^{-2}	Tip-rooted stems m^{-2}	Stems browsed (%)	Relative abundance of other vegetation: Native shrubs	Bracken	Graminoids (native and exotic)	Native tree seedlings or saplings	Broadleaved exotics	Cattle present
L(i)	3.8	7.6	8.0	6.5	0	0.2	31	+++	++	+	-	-	N
L(ii)	3.0	1.5	22.9	12.1	0	2.1	6	+++	+	-	-	-	N
L(iii)	4.2	10.5	12.6	13.1	2.7	0.2	17	+	-	+++	-	+	Y
L(iv)	4.4	12.5	26.1	21.9	3.6	1.0	0	+	+	-	-	-	N
M(i)	4.8	4.0	9.6	2.4	0	0.3	98	+	-	+++	+	-	N
M(ii)	3.7	6.3	14.8	8.7	0	0.5	35	+++	-	+	-	-	N
M(iii)	4.0	2.6	12.2	13.3	0.1	1.9	21	-	-	+++	-	-	N
M(iv)	2.0	8.4	16.8	20.8	2.9	0.1	23	+	-	++	+	+	Y
H(i)	5.4	3.3	5.4	7.2	0	1.2	9	++	-	-	++	+	N
H(ii)	3.8	5.1	16.4	16.3	0	0.8	10	+++	-	+	-	-	N
H(iii)	2.1	12.1	17.9	34.8	1.1	0.2	25	-	-	-	-	-	Y

consisted of the terminal bud being nibbled off and was probably due to possums or other small herbivores, rather than larger animals that tended to bite off more of the stem. Browsing ranged from not detected at all in L(iv) to truncating 98% of stems in M(i). Stems in this plot had a mean length of only 25 cm. Post-fire spraying of blackberry surrounding the plot may have had the effect of concentrating browsing by deer on the small amount of remaining blackberry.

Blackberry fruiting and tip roots Fruiting stems were common (>1 m^{-2}) in plots L(iii), L(iv), M(iv) and H(iii). Table 1 shows fruiting stems m^{-2} rather than per cent of stems fruiting, because fruiting would only occur on two year old stems. Since stem age was not recorded it would be misleading to present fruiting stems as a proportion of all stems present. The same consideration applies to tip-rooting (below), which occurs when stems are in their first year. The plots with substantial fruiting were those with the greatest density of stems in the first season post-fire; it is these 2003–04 stems that would have borne fruit the following year. These plots were also ones where native shrubs were not abundant.

Establishment of daughter plants by tip rooting is an important process by which blackberry stands expand. There was no obvious pattern to the amount of tip rooting in relation to blackberry density, browsing or abundance of other vegetation. Unlike fruiting, tip rooting was still present when there was a dense native shrub cover.

DISCUSSION

A wide diversity of outcomes was apparent in the small number of plots that were re-visited. A larger number of plots would be required to associate outcomes reliably with different combinations of pre- and post-fire factors. However, even this limited dataset has value in quantifying some aspects of blackberry re-establishment and suggesting possible explanations that could usefully be subjected to further investigation.

Despite the fact that in all plots blackberry plants had survived the fire, there was no simple recovery of blackberry in proportion to its pre-fire abundance. Plot H(i) had the highest number of crowns pre-fire but one of the lowest blackberry densities in 2005. A plausible explanation for the state of this plot is that the combination of a hot fire and a shallow stony soil reduced the blackberry to a few root fragments, leading to regrowth that was unable to compete successfully with the abundant native shrubs and trees establishing from seed.

Contrasting results were seen in plots L(iv) and H(iii) where by 2005 dense blackberry stands had established with little other vegetation present. Both these sites possibly had a low seedbank of native plants, especially of shrubs that might out compete blackberry; L(iv) was former farmland, heavily infested with blackberry for many years and at least 50 m distant from native seed sources; plot H(iii) had a sparse overstorey of *Eucalyptus* spp. but it appeared that native shrubs had been suppressed for a long period by a combination of blackberry competition, cattle and feral animals.

It seems to be the case in several of these plots that blackberry regrowth from surviving roots and crowns was effectively suppressed by native shrubs growing from seed such as *Cassinea aculeata* (Labill.) R.Br. A post-fire intervention consisting simply of heavy seeding with local native shrubs in areas of long-term dense blackberry infestations would seem a reasonable approach to test further, as an alternative to the costly and potentially damaging option of trying to control post-fire blackberry regrowth with herbicides. The potential for use of competitive native species to exclude blackberry, including the need for re-seeding where the native seedbank is depleted, was considered at length by Davies (1998), but little of the research recommended in that paper has been done.

Some of these plots now have only a minor blackberry component and are dominated by native vegetation. An important question is whether the fire has achieved a long-term shift in vegetation composition, or whether blackberry will re-establish dominance of the shrub layer over the next few years. Predicting this requires an understanding of why blackberry originally became dominant at these sites. If the reason was that it performed better than native species under cattle grazing or in disturbed conditions created by logging, for example, then it is possible that it will remain a minor species so long as such factors are excluded. However, if blackberry succeeds because of a superior competitive ability in the absence of human disturbance then it will return, perhaps as the dense post-fire native shrub growth begins to senesce.

Our current knowledge of blackberry ecology in different native vegetation is not yet sufficient to make confident predictions, although existing information suggests that where native vegetation produces sufficient shade it may exclude blackberry for a considerable time (Amor and Stephens 1976).

Longer term observation of post-fire sites is required to answer this question, examining enough sites that effects of the many variables involved can be separated, and also encompassing fires occurring in a number of different years to account for differences in post-fire conditions such as rainfall.

In relation to the original aims of this study it is clear that pre-fire blackberry thickets often did re-establish, although not invariably, and that competition from native shrubs seems to be an important factor reducing blackberry abundance.

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REFERENCES

Ainsworth, N. and Mahr, F. (2004). Response of blackberry to the 2003 wildfires in Victoria. Proceedings of the 14th Australian Weeds Conference, eds B.M. Sindel and S.B. Johnson, pp. 294-7. (Weed Society of New South Wales, Sydney).

Amor, R.L., Richardson, R.G., Pritchard, G.H. and Bruzzese, E. (1998). *Rubus fruticosus* L. agg. *In* 'The biology of Australian weeds', Volume 2, eds F.D. Panetta, R.H. Groves and R.C.H. Shepherd, pp. 225-46. (R.G. and F.J. Richardson, Melbourne).

Amor, R.L. and Stephens, P.L. (1976). Spread of weeds from roadsides into sclerophyll forest at Dartmore, Australia. *Weed Research* 16, 111-8.

Bruzzese, E. and Lane, M. (1996). 'The blackberry management handbook'. (Department of Conservation and Natural Resources, Melbourne).

Davies, R.J.P. (1998). Regeneration of blackberry-infested native vegetation. *Plant Protection Quarterly* 13, 189-95.

Evans, K.J. and Weber, H.E. (2003). *Rubus anglocandicans* (Rosaceae) is the most widespread taxon of European blackberry in Australia. *Australian Systematic Botany* 16, 227-37.

Thorp, J.R. and Lynch, R. (2000). 'The determination of Weeds of National Significance'. (National Weeds Strategy Executive Committee, Launceston).

Wareing, K and Flinn, D. (2003). 'The Victorian Alpine Fires, January–March 2003'. (Department of Sustainability and Environment, Melbourne).