Integrated control of serrated tussock on a native grassland – more than one way to kill a cat!

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Summary

Native grasslands containing varied densities of *Nassella trichotoma* (serrated tussock) can be managed using a variety of control methods and by monitoring progress. The control methods used in Bushs's Paddock, Melton, have been wick wiping, burning, boom spraying, do nothing, spot spraying, grazing, spray topping, rabbit control, sowing of native grass seed and drowning. These are applied according to the known growth cycles of the native grasses and of serrated tussock. The focus is on integrated weed control methods ensuring that the balance of the competition favours the native grasses.

Introduction

Bush's Paddock is a 45 hectare paddock located in the Shire of Melton on the western slopes of Mt. Cotterell. It forms part of the Victorian Volcanic Plains (VVP) bioregion and contains the ecological vegetation classes of plains grassland, plains grassy woodland, and modified plains grassy wetland and plains sedgy wetland. The average rainfall is 450 mm focusing on Mt. Cotterell, height 204 metres, as the epicentre of this low rainfall region. The soils are described as being dark brown to reddish brown derived from basalt. The surface soils are generally shallow, 0.1 metre or less (Ian Sargeant 1993).

Most of the paddock's known history dates from 1982 when A.J. Bush and Son purchased it from a Mrs. Collins. Since this time it has been grazed by cattle and horses, cropped for barley and firebreaks were ploughed and graded in 1986 and 1994 respectively. Wild life reportedly seen on the property were large brown snakes, many varieties of birds including parrots, an echidna and kangaroos.

Melton Council purchased the property in 1997 to act as a buffer to the proposed adjacent quarry. The paddock is divided into two 20 ha sections by a stone wall. The top paddock can be thought of as the kangaroo grassland paddock, divided roughly into two sections, the intact section dominated by kangaroo grass, protected by a Trust for Nature covenant and a less intact section where spear grasses dominate, and serrated tussock has invaded. The latter section was spot sprayed with glyphosate in 1994.

The bottom paddock can be thought of as part woodland, also protected by a covenant, and a previously cultivated paddock where the dominant native vegetation is composed of windmill, wallaby and spear grasses. This paddock had the highest density of serrated tussock when first assessed in 1999. The sections described have been fenced to facilitate stock management.

In 1999 Pinkerton Landcare and Environment Group became involved with the joint management of Bush's Paddock, influenced by the fact that the paddock contains an extension of the Pinkerton woodland. This move was facilitated by a WWF/NHT Grant for Grassy Ecosystems to the Shire of Melton, which included the requirement of a covenant to be placed on the highly valued grassland and grassy woodland.

Methods of management

Mapping

Mapping was undertaken using the GPS system (Shire of Melton – Megan Suter, Community Conservation Grant, Chris Lindorff) and by freehand (Pinkerton Landcare and Environment Group).

Mapping is important for the following reasons:

1. Mapping competition to serrated tussock such as native and introduced pastures, other forms of native vegetation and tree plantations will assist with planning serrated tussock control methods
2. Serrated tussock mapping to include varying densities of tussock will assist with identifying which areas to target control.
3. Map and record the different control methods which may be used within a single paddock.

When these features are known, the maps will provide a visual guide and incentive towards control. Mapping can assist with links to the local councils maps, other agencies maps and programs such as the VVP Landscape Stewardship Project. Many councils have mapped their native vegetation including their grasslands. This can be useful for planning purposes, targeting weed control, revegetation and erosion, water catchment integrity and providing continuity from a regional perspective.

The maps identify:

- the main native vegetation types – native grass, dense and light distribution, greybox woodland.
- basalt field stones distribution – the reason this was done was to emphasize the role of the basalt field stones in providing habitat for local fauna and for drought proofing a paddock, it also provides an indication of the amount of disturbance a paddock has experienced in the past in relation to weed invasion.
- the stone walls – the boundary walls more or less than one metre height. They are used for preventing airborne serrated tussock seed spread in and out of the paddock, and are useful for fire control, and providing habitat as well as being important for aesthetic and heritage reasons.
- the weeds – serrated tussock, artichoke thistle and boxthorn. Initially the serrated tussock was mapped into six density categories, such was the enthusiasm, later reduced to three, light 1–10%, medium 11–50% and heavy 51–100%

Monitoring

Mapping proved useful not only for showing location of the vegetation but also for monitoring success or otherwise of control works. Comparison of the colour coded serrated tussock maps from 1999 to 2000 was undertaken by Megan Suter, who estimated that the light infestation decreased by 29.2%, the medium increased by 23.9% and the heavy decreased by 55.6%. Total decrease in serrated tussock was 19.8%. We believe the increase in medium density tussock can be explained by the large area of heavy density in the bottom paddock being reduced to medium density by wick wiping.

Quadrats have been placed in the native grass depleted sections of the paddock, the spear grass section of the top paddock and in the previously cultivated section of the bottom paddock. The restoration of these areas is being monitored.

A fauna and flora survey to monitor the success of restoration of biodiversity is an ongoing project. BOCA is monitoring the birds on a seasonal basis. By monitoring birds at the top of the food chain we will gain an idea as to whether we have been successful in restoring the biodiversity of the native grasses. Photo-point monitoring has been used for specific serrated tussock control areas and for native grass seeding results.

'How many ways to kill a cat'

These methods are listed in no particular order, and are not to be applied at the same time.

1. Wick wiping

The weed wick wiper (Weed Bug) trial was successful when applied to the

bottom paddock, from the view point of reduction of seed set and 22% total kill of serrated tussock, using glyphosate. Prior to using the wiper the native grasses were grazed to low levels to ensure that the herbicide would have a minimal effect on these competing grasses. However, the following year the tussock needed to be controlled by boom spraying.

2. Boom spray
Boom spraying was undertaken in the bottom paddock where the high density tussock was located, using glyphosate 4 L ha^{-1} initially. In subsequent years as the native grass cover increased, namely the windmill, wallaby and spear grasses, these sections were marked out by spot spraying, so that the operator could clearly see where to boom spray, and where to spot spray.

Spray topping This method has been used to prevent seed set of serrated tussock; glyphosate was used at 750 mL ha^{-1}. This was successful from the perspective of the serrated tussock, and apparently the native grasses, but cannot be sure that some of the herbs and early cool season (C3) grasses such as wallaby grass species were not affected. This action occurred in the spear grass section of the paddock, which was already depleted of the full complement of native grass species.

3. Spot spray
Spot spraying using glyphosate has proved to be one of the most useful methods of serrated tussock control. The intact section of kangaroo grass has always been a high priority, particularly where tussock has invaded along the disturbed areas such as rabbit tracks and the surrounding ploughed firebreak.

Spot spraying was also used in a high density tussock area, about one hectare in size, which had been cleared, in the woodland. On inspection prior to spraying, spear and wallaby grasses, as well as regenerating grey box were discovered. It was decided against the conventional wisdom, which was to boom spray the serrated tussock, to spot spray instead. It took five people 12 hours to do this. The result is that the effort 'broke the back' of the tussock and now there are less plants, as the competition has developed in the form of annual and perennial introduced grasses, as well as some increase in native grasses and a notable increase in growth of the greybox. It now takes two people one third of the time to spot spray this area. Direct seeding of harvested wallaby grass and windmill grass has been tried without obvious success. However, it is expected that the dormant wallaby grass seeds will germinate when the competing introduced grasses have been controlled.

4. Burning
The Melton CFA has burnt the intact kangaroo grass section in patches both in spring and autumn, to keep the grass healthy and open up the spaces to enable the wildflowers to flourish. The autumn burn was chosen so that fauna could escape into the cracks in the earth, and often in autumn there is some green matter in the late maturing native grasses, which reduces the intensity of the fire.

Large scale burning in the spear grass dominated section was undertaken for suppression of serrated tussock seed set. This was a spring burn, a cool burn. A negative effect of this latter action has been wind erosion during summer with loss of top soil during the drought.

5. Do nothing
By not undertaking the large scale actions of grazing, burning or boom spraying the paddock was rested, particularly if the actions had been recently applied. The adage that only one major management action should be applied to native grasses at any one period is true. The rest proved useful in allowing the soil litter to build up to produce the healthy soils and for the competing native grasses to set seed. The spot spraying regime continued while the paddock was resting. Monitoring the grasses rate of growth relating to the seasons was the main management action in the rest period.

6. Grazing
The purpose of grazing was to maintain and enhance the biodiversity of the grassland; this has had the added benefit of increasing the competition to the serrated tussock.

Grazing by cattle and horses has been the predominant method since 1982. Prior to this date sheep have been used, and more recently sheep again, at three times the set stocking rate, for a 10 day period at the end of winter. This late winter-early spring period is a good time to graze native pastures. We regularly inspected the pasture every two to three days, and used as a guide the most vulnerable plant, which was cranesbill (*Geranium retrorsum*), ensuring it was not grazed by more than half of the plant. When this point was reached, the stock were withdrawn.

The target was annual grasses and broad leaf weeds such as flat weed, big heronsbill (*Erodium botrys*) and thistles. These were eaten to ground level. The natives which were selectively eaten were cranesbill in the grassland and small-leaved clematis (*Clematis microphylla*) and berry saltbush (*Atriplex semibaccata*) in the woodland. The native grasses were partly eaten.

Grazing recommendations for introduced pastures in spring are to 6 to 10 cm in height, or 3-leaf stage, not less than 2-leaf (Answer not known with native grasses) which should provide optimum growth and competition to serrated tussock seedlings. It has been suggested with rye grass that grazing should not take place before two leaves are in place, preferably three leaves. If grazed when only one leaf is present, when the plant is at its most vulnerable stage, as sugar levels are low and roots are only just starting to re-grow, grazing now will have a severe effect on both the ability of the pasture to respond after grazing and its long-term persistence (research by Danny Donaghy, Southern Rural Farmer, October 2001).

As native grasses have varying vegetative forms, it is important to be able to identify the main species. Some species are low growing, such as wallaby (*Austrodanthonia* spp.) and weeping grasses (*Microlaena stipoides*), others have a tussock form, kangaroo (*Themeda australis*), red-leg (*Bothriochloa macra*) and silky blue (*Dichanthium sericeum*), and others are taller still, such as spear grasses (*Austrostipa* spp.). The grazing heights should be assessed according to grass types. The early spring low growing stems of wallaby and weeping grasses (rhizomes) should be grazed carefully always leaving some green leaf, 5 cm height is suggested.

Closely observe the grazed pasture and don't regraze until favoured species, whether it is the competing grasses or a plant with biodiversity values has fully recovered. In this manner it should be possible to manage the grazing regime to favour the native perennial grasses.

Rest the pasture for the remaining spring, summer and autumn periods, this will ensure a continuous source of replacement native grass seed and at the same time reduce the amount of herbicide needed for control of serrated tussock. Regraze in winter using rotational methods. (Answer not known with native grasses)

Knowledge of the agronomic values of native grasses is useful, compare with clovers, which 'can reach over 20% protein and over 60% digestibility. Grazing stock generally need 7–8% protein for maintenance' (Table 1).

Monitoring of the grazing impacts is important to ensure that the desirable species are maintained in a competitive state. The aim of the regime is to have 100% ground cover at all times. Bare ground provides the ideal conditions for germination of serrated tussock seeds, therefore great care needs to be taken with grazing and the overzealous application of herbicide needs to be avoided.

Research suggests similar guidelines for amount of dry matter (DM) coverage in pastures. 'Dry matter is the non water component of pasture that is utilized by the grazing stock. Pasture dry matter can be measured by cutting and drying the pasture of a known area (quadrat) at

Table 1. Agronomic values of native grasses from 'Native Grasses' by Meredith Mitchell.

	crude protein	digestibility
Wallaby grass *Austrodanthonia* spp.	10 to 17%	45 to 74%
Spear grass *Stipa* spp.	3 to 17%	<60%
Weeping grass *Microlaena stipoides*	10 to 27%	55 to 80%
Common wheat grass *Elymus scaber*	10 to 36%	53 to 90%
Kangaroo grass *Themeda australis*	5.4 to 12.3%	54 to 75%
Red-leg grass *Bothriochloa macra*	4.4 to 14.5%	48 to 59%
Windmill grass *Chloris truncata*	9.4 to 10.9%	55 to 68%

several sites within the paddock. These sites should represent the pasture cover across the whole paddock. The number of sites depends on the size of the paddock, 50 sites should ideally be sampled and then quadrats marked out at a metre square. The grass within the quadrat should be cut close to the ground placed in a bag and weighed as a fresh sample; the weight of the bag should be subtracted from the fresh weight. Place the contents of the bag into a brown paper bag or foil tray and put in a slow oven at 60 degrees, to dry the moisture out and then the contents are re-weighed. To calculate pasture mass per hectare multiply average total dry mass of all samples by 10,000 and divide by the number of square metres sampled per quadrat' (Charles Grech personal communication)

Guidelines for grazing in native pastures are – 'never let the desirable species drop below 1.5–2 tonne DM ha^{-1}' (David Kemp personal communication, University of Sydney 2002)

The Sustainable Grazing Systems (SGS) Tips and Tools on 'Grazing management of *Danthonia* and *Microlaena*-based native pastures' in high rainfall zones recommends rotational grazing up until seed heads start to appear in spring, followed by low stock density grazing or resting until after seed-set. Maintain 70% ground cover with a litter layer, dry matter levels of 1.6–2 tonne DM ha^{-1} (D. Garden and P. Dowling NSW Agriculture).

7. Rabbit control

Participation in the local Exford Rabbit Busters Group annual poisoning program, using carrots mixed with pindone and bait stations has been undertaken. Mapping of holes, fumigation and ripping of burrows by contractors and shooting have ensured that the rabbits are kept to a minimum number.

8. Sowing native grass seed

The wallaby grass seed was purchased from a local farmer who had converted a harvester so that it can be pulled by a tractor. It uses an hydraulic arm to move the brush head, thus enabling it to be raised and lowered to suit the grass height and to miss any undesirable species, such as serrated tussock and also to accommodate varying wallaby grass heights across the paddock. This was very successful and the farmer was able to harvest the wallaby grass twice in one season.

The actual sowing was done by hand broadcasting in the clearing where we had sprayed the dense serrated tussock, however we are not completely sure of the outcome. A healthy sward of wallaby grass did emerge in another area where seed had been sown, on and near the access track the following year, but this may have already been present and the rains may have spurred growth of existing plants giving the appearance of the thickening the normal plant distribution. It is reported that the wallaby grass seeds remain dormant for many years (Ian Chivers), we are still hoping for results. Our monitoring should support this comment. For the future it is the intention to harvest all varieties of native grasses to extend the dominant kangaroo grass section and the cleared area in the woodland.

9. Drowning

Stock interfered with a tap on site, which resulted in water seeping across the paddock. The water-logged ground caused the tussock to die. This is not a recommended method in our current climate of water conservation!

'The cat is dead'

Summary of methods of integrated weed control

The initial need to use the large scale management actions of boom spraying, spray topping and burning commencing in 1999 and finishing in 2002, are behind us, as there is no longer dense serrated tussock in the paddock. There remains light scattered serrated tussock however, and this has been spot sprayed over the preceding two years by the specialist environmental contractors, Bushland Recovery.

We are moving forward into a more rewarding stage of restoring the grassland in the form of herb planting and continuing with native grass harvesting and sowing. By using an integrated approach to serrated tussock control as described above, we feel that we have achieved an outcome which has increased the native grass competition to the serrated tussock and at the same time minimized damage to the wildflowers and soils, as well as reducing the long term costs.

Research

Burning

When a dense stand of serrated tussock containing a lot of organic material was burnt by a slow hot fire, on a clay surface, a reduction in the number of viable seeds (more than 20% of all seed) was observed (Daniel Joubert). This does not necessarily mean that the same seed reduction will occur in this area, with differing soil types, but it does indicate that some of the surface serrated tussock seed could be destroyed by fire.

Integrated weed control

Research into integrated weed control methods by examining the manipulation of native grass pastures is showing promising results. See 'Sustainable farming systems for steep hills' by Zhongnan Nie. The five year grazing trial in western Victoria, including a late-start deferred grazing technique, by deferring grazing from November to the autumn break, has shown that late-start deferred grazing considerably increased the perennial grasses, mostly native, and reduced the silver grass (*Vulpia bromoides*), one year after the treatment. Another beneficial initial result was that 'the ground cover of the deferred grazing treatments in March was 75–90%, much higher than that of set stocking treatment (55%)'.

In NSW, research by Warwick Badgery suggests that broad acre application of flupropanate on native grass pastures is uneconomic and unsustainable needing repeat applications every five years. There is also major seedling recruitment in areas sprayed with flupropanate. The focus of the research is on enhancing the competition to the seedling serrated tussock, which is the weakest link in the plants growth cycle.

The ideal conditions to prevent integrated weed control seedlings from establishing are biomass of more than 1.5 t ha^{-1} and less than 5–10% bare ground in spring. It was interesting to note that when 50,000 serrated tussock seeds per square metre were added, no extra seedlings survived in this situation. The conclusion is that managing the seedbank is less important then managing establishment conditions.

Competition with adult serrated tussock plants – when grazing is limited or removed, the competition is greatest from native grasses. However, when there is an increase in soil fertility there is a corresponding increase in the competitiveness of serrated tussock.

The conclusions of the research are that:

- Herbicide alone is not the answer especially in lower density infestations of serrated tussock.
- A systems approach must be used in native grasslands focusing on competition to prevent serrated tussock from establishing.
- Competition from native grasses can only be encouraged by reducing grazing intensity and duration

Implication for management in native grasslands:

- Maintain ground cover (>90–95% total ground cover) and biomass (>1.5 t ha^{-1}) of native perennial grasses by rotational grazing/rests. Long rest required over summer.
- Flupropanate kills adult serrated tussock plants but doesn't stop seedling recruitment. Practices may need revision to reduce collateral damage.
- If serrated tussock is no longer rapidly invading spot spraying may be a more realistic option.

Sustainable land management

The integrated method of managing serrated tussock in native pastures provides a realistic long-term option for control**.**

All to often we see chemical control followed by the same set stocking grazing practices, reducing the ground cover and producing the bare ground in which the serrated tussock seeds germinate. This promotes a dependent situation, needing repeat application of herbicide, which over a period of time becomes unsustainable in terms of economic cost, depletion of productivity and weed resistance to the herbicide.

Some of the methods currently used on stony ground are in fact counterproductive. This land often provides the best asset for control by the competition from intact native grass pastures which are located here, which unless disturbed by plough lines, rabbits or over grazing and will maintain a resistance to tussock invasion for many years.

Native grasses are recognized for the role they play in sustainable agriculture as in weed control, drought-proofing properties, production of fine wool and salinity prevention.

By focusing on the range of available control methods, as described, and having an informed choice of the most appropriate one for a particular situation, it is expected there will be increased success. The result is that the long term control of serrated tussock will be seen as an achievable outcome. By doing this, a positive message is promoted and people will have hope that they will in time have control of this weed.

The Victorian Serrated Tussock Working Party recommended in June 1998 that zero seed-set be the aim for the region from this time onwards. With this aim, and the knowledge that the serrated tussock seed can remain viable in the soil for 13 years (Campbell 1982) we know that control will become incrementally easier over this period of time. In Bush's Paddock with the Shire of Melton's assistance we are now into our sixth year of tussock reduction in native grasslands. We believe we are well on the way to achieving long term control.

We have the knowledge; it is up to us to use it!

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