Flupropanate non target effects - Field Trial

Interim findings report June 2010

On behalf of the Victorian Serrated Tussock Working Party

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Cover picture – Oaklands Junction site June 2010

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Executive summary

1. INTRODUCTION

Invasion of native vegetation by environmental weeds is recognised as a threatening process under the Victorian *Flora and Fauna Guarantee Act 1988* (Department of Sustainability and Environment 2009b) but no action plan has been developed. The negative impacts mentioned include limitation or prevention of recruitment of native taxa, alteration to fire regimes, hydrological cycles, nutrient cycling and other processes, increased soil erosion, genetic pollution, alterations to structure and floristics of native vegetation communities, competition, and niche modification. Invasion of native plant communities by exotic perennial grasses is listed as a key threatening process under the NSW *Threatened Species Conservation Act 1995*, based on the impact of five species, *Hyparrhenia hirta, Cenchrus ciliaris*, *Eragrostis curvula*, *Nassella trichotoma* and *Nassella neesiana* (NSW Scientific Committee 2003). Perennial grasses are one of the major groups threatening biodiversity in NSW (Downey and Coutts-Smith 2006). *N. neesiana*, *N. trichotoma* and *E. curvula* are among the major species recognised as threats in temperate grasslands (Kirkpatrick *et al.* 1995, Groves 2004).

Serrated tussock (*Nassella trichotoma*) and Chilean needle grass (*Nassella neesiana*) are South American unpalatable perennial grasses that are Weeds of National Significance in Australia due to their severe agricultural and environmental impacts (Thorp and Lynch 2000). The most popular herbicides for controlling these serious exotic stipoid grasses are glyphosate (non selective) and flupropanate (some selectivity). As flupropanate has some selectivity to species such as *Themeda sp.* (kangaroo grass), Phalaris (Campbell and Vere 1995) and red grass (Michalk *et al.* 2009), it is widely used for broad acre serrated tussock and Chilean needle grass control programs. Increasingly the off target impacts of herbicides are becoming scrutinised by Governments and the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) - thus becoming increasingly used as a tool to prevent inappropriate weed control measures that may impact on rare and endangered native grasslands. It is known that flupropanate can damage *Microlaena sp.* (weeping grass) and *Danthonia sp.* (wallaby grass) plants (Keys and Simpson 1993, Badgery *et al.* 2003), *Stipa sp.* (spear grass) (Badgery *et al.* 2003) and subterranean clover (Campbell and Vere 1995). The Victorian Serrated Tussock Working Party have been at the forefront of a concerted campaign to manage and reduce serrated tussock infestations. Flupropanate is an important management tool for broad acre serrated tussock management in this ongoing management campaign. The recent reluctance of land management bodies in recommending flupropanate due to EPBC Act 1999 concerns are becoming a serious issue compromising serrated tussock management.

Evidence from DPI experiments has shown that flupropanate has an affect on the non-target native grasses and improved pasture grasses and legumes (Snell et al. 2007). The full extent of the effects of flupropanate on native and improved pasture grasses and legumes is speculative as there are many conflicting journal papers and minimal non-target species have been examined in relation to flupropanate effects. Native grasslands are one of Australia's most threatened ecosystems (Lunt and Morgan 2002). As serrated tussock and Chilean needle grass are serious threats to these grasslands, land managers are wishing to control these noxious weeds through label recommended herbicides such as flupropanate. Anecdotal reports have suggested that some large areas of native grassland have been decimated by inappropriate use of boom spraying of flupropanate. This project aims to assess the effects of flupropanate on a range of native and improved pasture species commonly found in areas containing both Chilean needle grass and serrated tussock. It aims to assess the extent the non-target grassland species are affected at different rates of herbicide application. The interim findings of this report can be used to inform management decisions related to flupropanate use and guide future research activities to help manage native grasslands.

Photo 1. Serrated tussock in a parkland situation

MATERIALS AND METHODS

Trial sites were setup at Balliang west, Werribee (Western treatment plant) and Oaklands Junction Victoria. Each trial site consisted of 6 treatments (table 1) replicated 4 times at each site within 3x4m plots marked by pegs. Soil tests were taken to 100mm depth from each trial site and analysed for soil fertility and structure (table 2).

The plots were sprayed using a hand held boom sprayer. All treatments were applied in 150l/ha water using AI 110015 nozzle tips operating at 2 bar and 4km/hr (6 nozzle boom).

Spraying conditions (2/9/2009) at Balliang were 18 ^{o}C, wind N 8.6km/hr RH 43%, delta T 4.5.

Spraying conditions (2/9/2009) at Werribee were 18 ^{o}C, wind N 7.5km/hr RH 47%, delta T 5.3

Spraying conditions (7/9/2009) at Oaklands were 15 ^{o}C, wind N 5.8km/hr, RH 57%, delta T 5.0

Pasture basal composition was recorded prior to spraying (day 0) and post spraying at seasonal intervals (day 56, 196, 280) using a 100 point basal pasture comb. Categories of native and introduced grasses were recorded, based on species observations at the individual sites.

At each site, angularly transformed basal cover at day 280 of total native grass and were analysed using a randomised block analysis of variance. Responses are presented as back-transformed means.

Photo 2. Balliang site October 2009

Table 1: Experimental Treatments

Treatment Number	Flupropanate rate
1 Control	0.0 L/ha (0 g a.i./l)
2	0.5 L/ha (372.5 g a.i/l)
3	1.0 L/ha (745 g a.i./l)
4	1.5 L/ha (1117.5 g a.i/l)
5	2.0 L/ha (1490 g a.i./l)
6	4.0 L/ha (1490 g a.i./l)

Table 2 – Soil test results

ANALYSIS		UNITS	OAKLANDS JUNCTION	WERRIBEE	BALLIANG WEST
Phosphorus	(Olsen)	mg/kg	4.7	12.4	5.4
Potassium	(Colwell)	mg/kg	171.0	260.0	705.0
Sulphur	(KCL40)	mg/kg	14.5	15.7	13.8
pH	(1:5 water)		5.8	5.5	5.9
pH	(CaCl2)		4.8	4.6	4.9
Salinity (EC)	(1:5 water)	dS/m	0.13	0.15	0.10
Soil Texture			Clay loam	Clay loam	Clay loam
Organic Carbon		%	2.88	3.56	2.98
Nitrate		mg/kg	4.0	26.0	8.0
Ammonium		mg/kg	8.0	5.0	4.0
Phosphorus	(Colwell)	mg/kg	12.0	35.0	15.0
Calcium	(Exch)	meq/100 g	5.70	3.82	5.40
Magnesium	(Exch)	meq/100 g	5.17	2.89	3.62
Sodium	(Exch)	meq/100 g	0.92	1.11	0.70
Potassium	(Exch)	meq/100 g	0.43	0.65	1.88
Aluminium	(Exch)	meq/100 g	0.12	0.51	0.08
Calculations					
Sum of cations	(CEC)	meq/100 g			
Calcium/Magnesium ratio					
Sodium % of cations	(ESP)				
Aluminium % of cations			1.0%	5.7%	0.7%

3. RESULTS

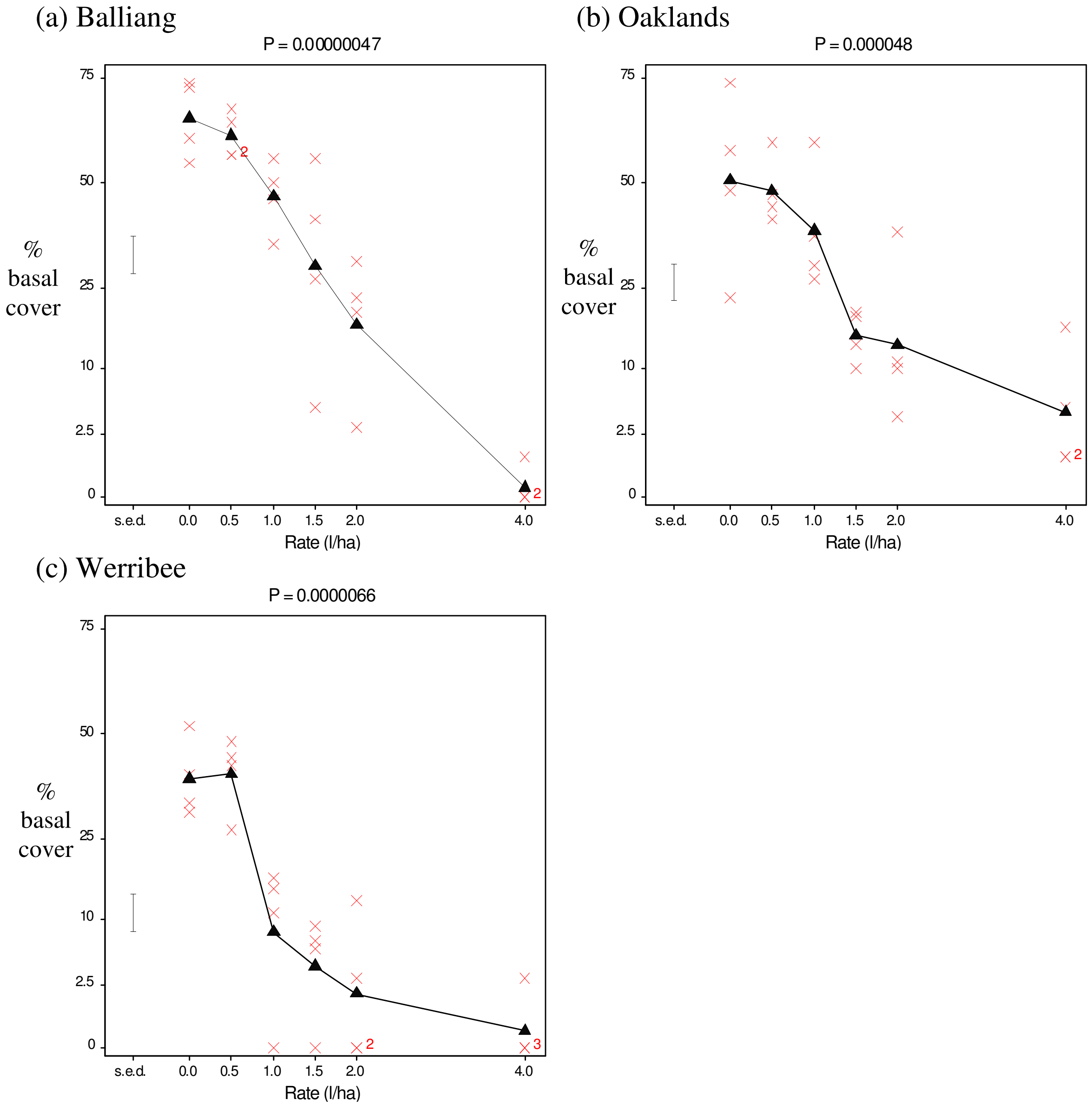


Figure 1. Response of per cent native grass basal cover to rate of flupropanate application at (a) Balliang, (b) Oaklands and (c) Werribee. Crosses indicate raw data points and numbers next to crosses indicate the number of data points observed (> 1) with that value. The y-axis is an angularly transformed scale.

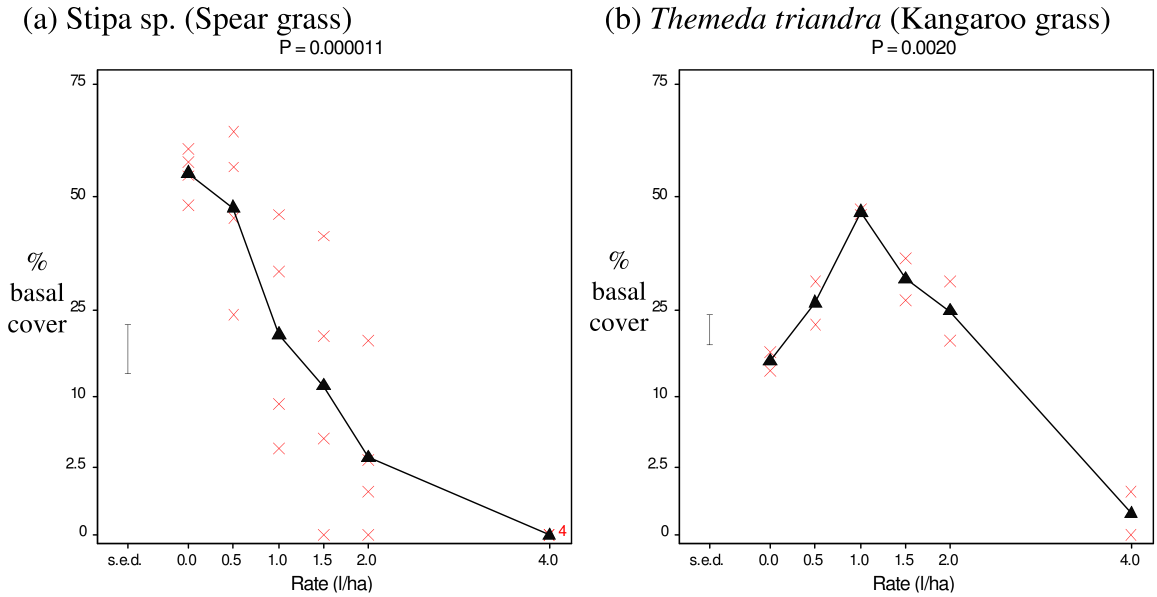


Figure 2. Response of per cent (a) *Stipa sp*. (spear grass) and (b) *Themeda sp*. (kangaroo grass) basal cover to rate of flupropanate application at Balliang. Crosses indicate raw data points and numbers next to crosses indicate the number of data points observed (> 1) with that value. The y-axis is an angularly transformed scale. The results for kangaroo grass are obtained from replicates 1 and 2 only, because there was very little kangaroo grass observed in replicates 3 and 4.

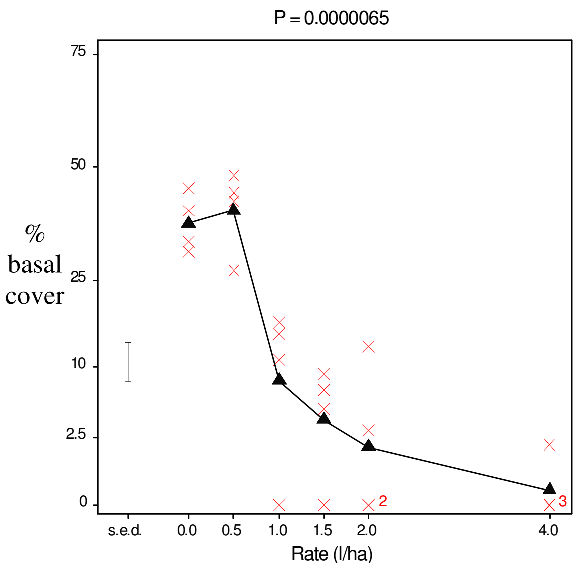
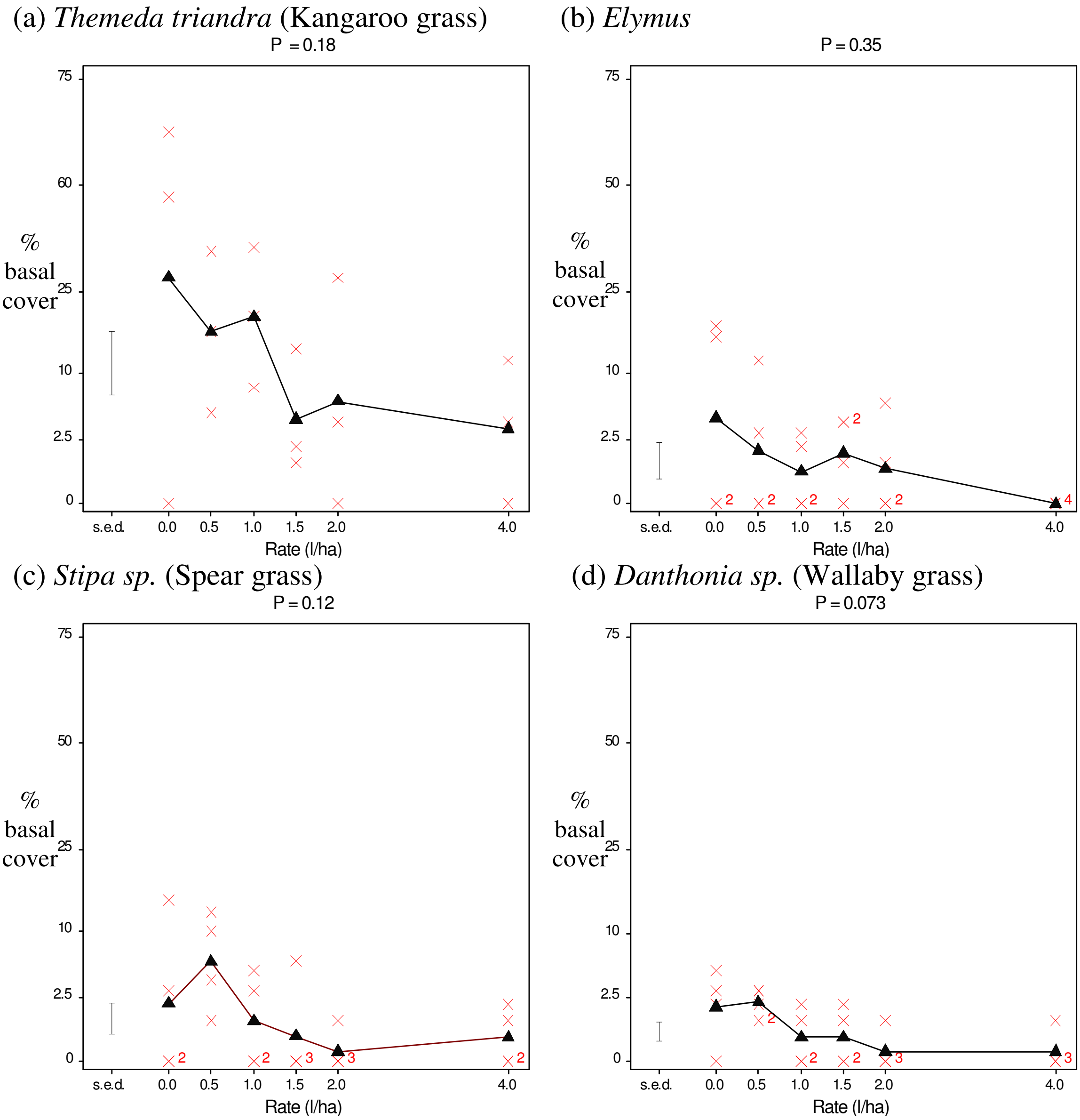


Figure 3. Response of per cent *Stipa sp.* (spear grass) basal cover to rate of flupropanate application at Werribee. Crosses indicate raw data points and numbers next to crosses indicate the number of data points observed (> 1) with that value. The y-axis is an angularly transformed scale.



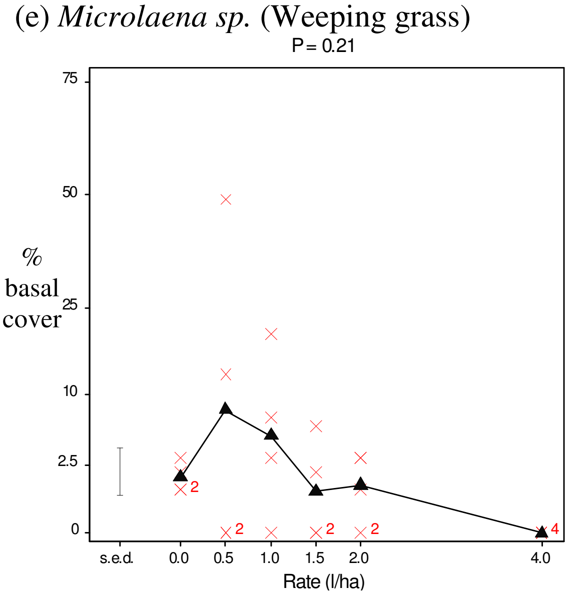


Figure 4. Response of per cent (a) *Themeda sp*. (kangaroo grass), (b) *elymus,* (c) *Stipa sp*. (spear grass), (d) *Danthonia sp.* (wallaby grass) and (e) *Microlaena sp.* weeping grass basal cover to rate of flupropanate application at Oaklands. Crosses indicate raw data points and numbers next to crosses indicate the number of data points observed (> 1) with that value. The y-axis is an angularly transformed scale. The results for kangaroo grass are obtained from replicates 1, 2 and 3 only, because there was very little kangaroo grass observed in replicate 4.

4. DISCUSSION

Given the slow acting nature of flupropanate, the data captured and analysed as part of this report represents only a short portion of the life and effects of the chemical. As such, the findings below need to be considered as part of a longer term effect, response and recovery.

Native species (as a combined analysis grouping) across all 3 sites were generally affected by higher rates of flupropanate. By day 280 (June 2010) the basal cover of total native grass species had declined significantly ($P < 0.001$) where flupropanate was applied at rates greater than 1.0l/ha (figure 1). *Stipa sp.* (spear grass) basal cover declined where flupropanate rates exceeded 1.5l/ha at both Balliang and Werribee, whereas *Themeda sp.* (kangaroo grass) was able to tolerate 1.0l/ha before basal cover declined (at both Balliang and Oaklands).

Other species such as *Microlaena sp.* (weeping grass), *Danthonia sp.* (wallaby grass), and *elymus* showed some tolerance to flupropanate rates up to 1.0l/ha although more analysis is required to confirm their true tolerance.

Although the trial sites are somewhat spatially separated, the soil tests did not show a large difference between the structural characteristics of the soils. This was not anticipated, yet confirms the similarity of responses observed of the native grasses to the various flupropanate rates.

Photo 3. Oaklands Junction site October 2009

Given the limited tools available to managing serrated tussock on a broad scale in native grasslands, more work needs to be undertaken to make better use of these tools. The interim findings of this report and the tolerance of certain native grass species to low rates of flupropanate opens up a range of management options that have generally been considered inappropriate. This trial requires ongoing analysis to capture data over multiple seasons so that conclusions can be drawn as to the response and recovery of the native ecosystem after flupropanate application.

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Photo 4. Balliang site June 2010

5. REFERENCES

Campbell MH and Vere DT (1995) *Nassella trichotoma* (Nees) Arech. *In* 'The Biology of Australian Weeds', eds R.H. Groves, R.C.H. Shepherd and R.G. Richardson, (R.G and F.J. Richardson, Melbourne) pp. 189-202.

Badgery WB, Kemp DR, Michalk DL, King WM (2003) Rethinking the management of serrated tussock, our worst perennial grass weed. *Proceedings of the 11th Australasian Agronomy Conference, 2-6 Feb. 2003, Geelong, Victoria.* pp. 1-4.

Department of Sustainability and Environment (DSE) (2009a) Flora and Fauna Guarantee Act threatened list – July 2009. http://www.dse.vic.gov.au/CA256F310024B628/0/4AC71110D293ED14CA25760800132DD7/$File/20090804+FFG+threatened+list.pdf

Groves RH (2004) CAWS Oration. Weed management at the border, at the garden fence and in the bush. In B.M. Sindel and S.B. Johnson (Eds.), *14th Australian Weeds Conference Papers and Proceedings*. Weed Society of New South Wales, Sydney, pp. 1-9.

Keys M and Simpson P. (1993) Herbicide tolerance of two native grass species. *Proceedings of the 8th Conference of the grassland society of NSW.* pp103-104.

Kirkpatrick J, McDougall K.and Hyde M (1995) *Australia's Most Threatened Ecosystem. The Southeastern Lowland Native Grasslands*. SurreyBeatty and Sons and the World Wide Fund for Nature Australia, Chipping Norton, NSW.

Downey PO and Coutts-Smith AJ (2006) Biodiversity threatened by weeds in New South Wales. In C. Preston, J.H. Watts and N.D. Crossman (Eds.), *15th Australian Weeds Conference Papers and Proceedings.* Weed Management Society of South Australia Inc., Adelaide, pp. 803-806.

Lunt ID and Morgan JW (2002) The role of fire regimes in temperate lowland grasslands of southeastern Australia. In R.A. Bradstock, J.E. Williams and M.A. Gill (Eds.), *Flammable Australia. The Fire Regimes and Biodiversity of a Continent*. Cambridge University Press, Cambridge, UK, pp. 177-196.

Osmond R, Veebeek M, McLaren DA, Michelmore M, Wicks B, Grech CJ and Fullerton P (2008) Serrated tussock - National best practice manual. *Victorian Department of Primary Industries* pp. 1-125.

Michalk D, Kemp D, Cambell M and McLaren DA (1999) Control of serrated tussock – problems in developing IWM systems. *12th Aust.Weeds.Conf. 12-16 September, West Point Convention Centre, Hobart Tasmania*. pp 20-24.

NSW Scientific Committee (2003) Invasion of native plant communities by exotic perennial grasses –Key Threatening Process declaration. NSW Scientific Committee, Hurstville.

Thorp JR and Lynch R (2000). 'The determination of weeds of national significance' (National Weeds Strategy Executive Committee, Launceston) pp 1-234.