



*Transforming
our landscapes*

*Grassy Groundcover Research Project
Summary report: 2004 - 2007
Greening Australia (Vic)*



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Cover image: Daryl Barber's property near Minyip in the Wimmera CMA showing a wonderful sward of native spear grass re-established by direct seeding

Breakthrough in Grassland Restoration

Greening Australia, the country's largest environmental focused NGO, in partnership with the University of Melbourne has achieved a major breakthrough in the restoration of grassland and grassy understorey communities through its Grassy Groundcover Research Project (GGRP).

Over a three year period the GGRP has demonstrated it is possible to reconstruct grassy plant communities on agricultural lands by direct seeding. The techniques developed by the GGRP allow for multiple outcomes; from the development of provenance-based seed crops, to the reinstatement of highly diverse plant communities, to the establishment of perennial native pasture for fodder.

Learning's from this work will enable landholders, community or landcare groups and restoration practitioners to undertake habitat restoration at a range of scales.

The advances achieved in restoration outcomes by the GGRP further enhance Greening Australia and The University of Melbourne's roles as innovators in tackling the critical issue of biodiversity loss and whole-farm sustainability through a creative blend of practical experience, science and community engagement.



Project Background and Overview

Temperate lowland native grasslands are among Australia's most threatened plant communities (Kirkpatrick et al. 1995). The most common technique for restoring these grassland communities is by the reintroduction of plants germinated from seed and grown as container-stock under nursery conditions. This represents efficiencies in the use of limited seed resources. However, introducing individual plants is labour-intensive and expensive. In addition, the establishment and the development of self-perpetuating populations are seldom reported (Hitchmough 1994, Morgan 1999).

Another approach to grassland restoration is by direct seeding. This technique has long been used in Australia for revegetation with native trees and shrubs, but has more recently been investigated for the reintroduction of herbaceous species (primarily grasses and a few selected forbs) (Lodge and Whalley 1981, Lodge 1981, Maze et al. 1993, Windsor and Clements 2001, Cole et al. 2004, Gibson-Roy et al. 2004, Cole and Lunt 2005, Cole et al. 2005). Some advantages of direct seeding over container grown (or transplanted introductions), include the potential to work at large scales, lower labour and material costs, and the establishment of large numbers of plants (Knapp and Rice 1994, Stone 1994).

To improve knowledge of the potential of direct seeding as a technique for grassland restoration, Greening Australia (Victoria) in partnership with the University of Melbourne undertook the Grassy Groundcover Research Project (GGRP), a three-year NHT funded research study.

The focus of the GGRP was twofold:

- to investigate the reintroduction of multi-species assemblages (representative of locally occurring remnants) onto land with an agricultural history;
- to investigate the production of large quantities of high quality, provenance seed, in managed production systems.

The GGRP was initiated in November 2004. Since then three annual sowings have been undertaken at each of thirteen 1 ha experimental sites across south-western Victoria (39 separate sowings in total) involving a diverse range of grassland species (Table 5). Sowing locations for this project ranged from Bendigo in the state's central region, to Colac in the south, and from Hamilton in the west, to Minyip in the north. Each of the 13 sowing sites was located on agricultural land with a history of cropping or grazing. The seed used in these sowings originated from either local grassland remnants (therefore taking into account provenance), or from plants propagated from the wild seed, under managed production facilities (Figure 2, Table 1 & 2). Most of the approximately 200 grassland species grown in these production facilities propagated readily from seed and were well suited to the intensive, above-ground seed production system

used. Seed production (rather than wild collection), simplified seed harvest and produced reliable quantities of high quality, weed-free seed at times when field production was severely restricted from the effects of drought.

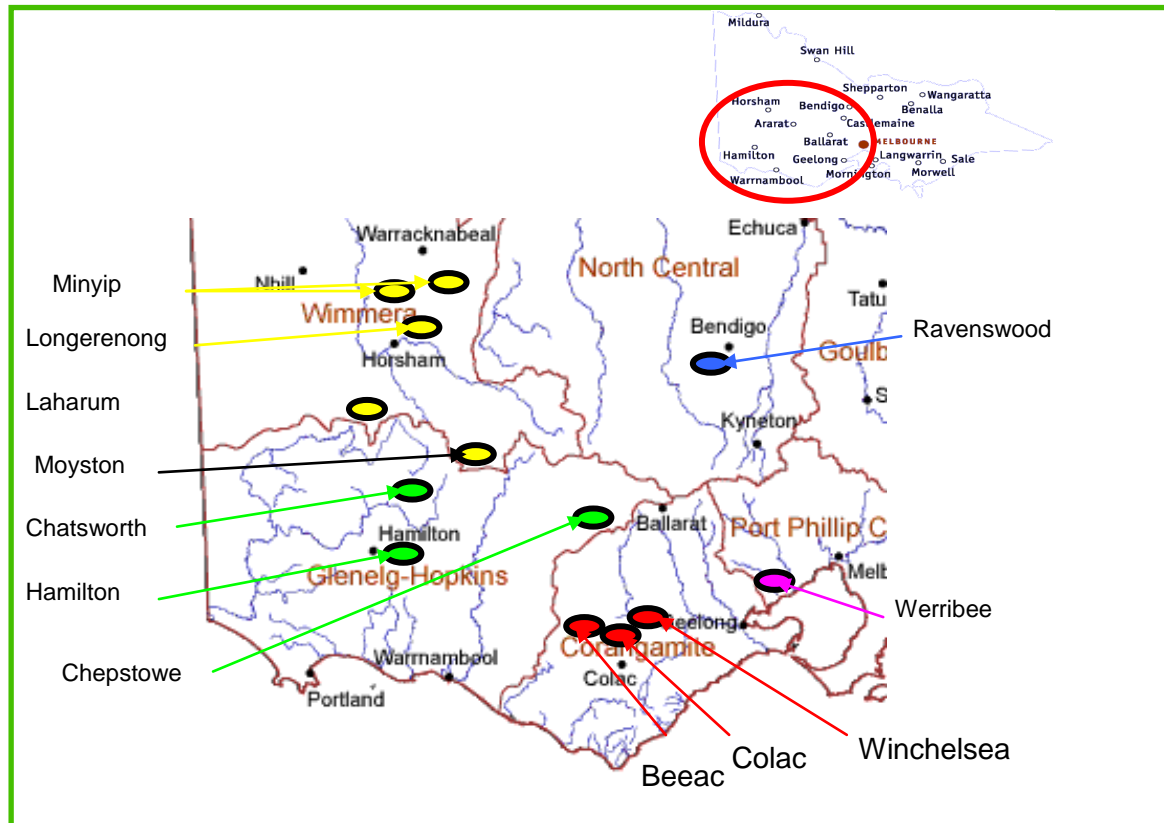


Figure 1: Sites ranged across 5 catchment management areas

Sowing Sites	Grass Sowing Weights			
	2005	2006	2007	Total (kg)
Beeac	2	50	60	112
Colac	2	50	60	112
Chatsworth	1	21	60	82
Chepstowe	0.5	55	60	115.5
Hamilton	2	25	51	78
Laharum	2	35	41	78
Longerenong	1	50	50	101
Moyston	2	35	60	97
Minyip - Barber	1	50	65	116
Minyip - DIRT	1	50	65	116
Ravenswood	1	20	30	51
Winchelsea	2	30	n/a	32
Werribee	1.5	32	22	55.5
				1146

Table 1: Figures for grass sowing rates at each site. Figures represent mass (kg) of uncleaned, mulched harvest material. Grass seed was primary sourced from wild populations, but some component was generated through seed production areas.

		Wildflower Production			
		2006		2007	
Seed Production Site	Sowing Site/s	Field	Seed Production Area	Field	Seed Production Area
Geelong Botanic Gardens	Beeac, Colac, Winchelsea	17155.1	15974.0	15831.0	17775.0
Franklin Native Plants	Chatsworth	4803.7	2230.0	706.4	168.5
Burnley College	Chepstowe	1523.9	528.7	68600.0	3165.5
Larrapinta Nursery	Hamilton	2475.0	690.0	1077.6	405.9
Narri Seeds	Laharum	8564.0	2194.0	2574.8	2139.3
Narri Seeds	Long	1443.0	7091.0	5206.7	2476.2
Narri Seeds	Minyip	4381.0	3302.0	5945.7	16707.0
Stawell Gardens	Moyston	2702.0	350.0	2692.5	329.0
Burnley College	Ravenswood	1588.8	408.1	1424.1	2522.8
Geelong Botanic Gardens	Zoo	4427.7	2734.0	10273.0	11364.0
Total		49.1	35.5	114.3	57.1
		84.6 kg		171.4 kg	

Table 2: Seed yields from field and production sources 2006/2007.



Figure 2: One of six seed production areas established across the GGRP to produce supplementary seed to field collections. Plants are grown in polystyrene containers under controlled nursery conditions.

At a time when climatic conditions (i.e. drought), were amongst the most challenging in living history, the GGRP sowings have established thirteen ha of species rich grassland. Most encouragingly, our results suggest that it is possible to use mechanized equipment (Figure 3), to sow complex combinations of grassland species under field conditions, and achieve high levels of establishment (between 40 and 100 sown plants m⁻²) (Figure 4 & Table 3 & 4). Among these are many locally, regionally and nationally threatened species. We have also noted high levels of subsequent recruitment of second generation individuals from many species established in each of the first two annual sowings.



Figure 3: The modified turf seeder which allows the sowing of multiple species in one pass in action at the GGRP Chatsworth site (Glenelg-Hopkins CMA region).



Figure 4: Impressive establishment of species on a scalped section within the GGRP Laharum sowing site twelve months after sowing (Wimmera CMA region). Note higher sward of *Austrostipa mollis*. A large number of other grass and forb species are also present.



Figure 5: The nationally threatened species *Leucochrysum albicans* subsp. *albicans* var. *tricolor* has successfully been reintroduced to six GGRP sites.



Figure 6: A 2000 m² scalped zone ready for seeding at the GGRP Beeac Cemetery site (Corrangamite CMA region). This approach was found to significantly reduce subsequent weed competition from non-sown species.

The GGRP has undertaken a number of extension activities during the funding period. The project received considerable coverage in both regional and non-regional press (electronic and print). Over 30 papers have been presented to technical and scientific forums on the undertakings of the project. Perhaps the most successful extension vehicle was the electronic newsletter entitled the Grassy Gazette. This quarterly publication reached an extremely large subscribership. Finally, the GGRP ran six field days across the southwest of the state. Each field day was oversubscribed, with in many cases, participants travelling from interstate to attend (Figure 7).



Figure 7: A number of field day participants are shown through a sward of grassland twelve months after sowing. This site was situated on the Dennis property out of Colac (Corangamite CMA region).

To-date, Greening Australia (Victoria) has received backing to initiate two related grassland/grassy understorey reconstruction projects based on the successes of the GGRP. The first, backed by the East Gippsland CMA, will reinstate 3 ha of redgum grassland near Bairnsdale, while a partnership with Alcoa Australia (at its Point Henry Plant near Geelong), aims to reconstruct 200 ha of redgum grassland over a 10-15 period.

In summary, the GGRP has succeeded in its goal of marrying scientific and practical goals. It has achieved a considerable breakthrough in restoration techniques that it is hoped will encourage restorationists and land managers to consider the use of direct seeding as a means to increase the range and diversity herbaceous plant communities. Finally, the 13 GGRP sites provide a wonderful opportunity to track the development of these reconstructed communities (across numerous trophic levels) over time and in doing so, continue to provide valuable insights into the restoration and conservation of such highly threatened communities.

	Scrape + organic matter	Scrape - organic matter	Cultivation + organic matter	Cultivation - organic matter
Beeac	76	69	17	21
Chatsworth	161	154	91	142
Chepstowe	19	22	0	1
Colac	115	108	25	30
Hamilton	137	123	41	52
Laharum	39	33	15	13
Minyip - Barber	139	153	50	19
Minyip Dirt	174	169	126	96
Moyston	44	42	32	24
Ravenswood	30	30	5	4
Werribee Zoo	94	131	75	55
Winchelsea	51	55	6	1
Average	90	91	40	38

Table 3. Average counts of individuals (sown species) twelve months after sowing, showing differences between treatments and sites. Note: no data for Longerenong.

	Scrape + organic matter	Scrape - organic matter	Cultivation + organic matter	Cultivation - organic matter
Beeac	29	37	415	355
Chatsworth	9	18	52	66
Chepstowe	34	31	105	109
Colac	20	52	123	98
Hamilton	65	44	136	242
Laharum	5	13	22	19
Minyip - Barber	79	131	307	351
Minyip Dirt	39	45	50	58
Moyston	55	91	170	206
Ravenswood	6	7	45	75
Werribee Zoo	5	10	57	50
Winchelsea	42	30	98	90
Average	32	42	132	143

Table 4. Average counts of individuals (weed species) twelve months after sowing showing differences between treatments and sites. Note: no data for Longerenong.

Genus	Species	Common Name
<i>Acaena</i>	<i>agnipila</i>	Hairy Sheep's Burr
<i>Acaena</i>	<i>echinata</i>	Sheeps Burr
<i>Acaena</i>	<i>novae-zelandiae</i>	Bidgee-widgee
<i>Actinobole</i>	<i>uliginosum</i>	Flannel Cudweed
<i>Agrostis</i>	<i>aemula</i> var. <i>aemula</i>	Blown Grass
<i>Agrostis</i>	<i>avenaceae</i>	Common Blown Grass
<i>Amphipogon</i>	<i>strictus</i>	Grey-beard Grass
<i>Aristida</i>	<i>behriana</i>	Brush Wire Grass
<i>Arthropodium</i>	<i>fimbriatum</i>	Nodding Chocolate-lily
<i>Arthropodium</i>	<i>milleflorum</i>	Pale Chocolate-lily
<i>Arthropodium</i>	<i>minus</i>	Small Vanilla-lily
<i>Arthropodium</i>	<i>strictum</i>	Chocolate-lily
<i>Asperula</i>	<i>fine</i>	
<i>Asperula</i>	<i>conferta</i>	Common Woodruff
<i>Asperula</i>	<i>scoparia</i>	Prickly Woodruff
<i>Austrodanthonia</i>	<i>carphoides</i>	Short Wallaby-grass
<i>Austrodanthonia</i>	<i>eriatha</i>	Hill Wallaby-grass
		Brown-back Wallaby-grass
<i>Austrodanthonia</i>	<i>duttoniana</i>	
<i>Austrodanthonia</i>	<i>tenuior</i>	
<i>Austrodanthonia</i>	<i>auriculata</i>	Lobed Wallaby-grass
<i>Austrodanthonia</i>	<i>pilosa</i> var. <i>pilosa</i>	Velvet Wallaby-grass
<i>Austrodanthonia</i>	<i>geniculata</i>	Kneed Wallaby-grass
<i>Austrodanthonia</i>	<i>caespitosa</i>	Common Wallaby-grass
<i>Austrodanthonia</i>	<i>racemosa</i>	Striped Wallaby-grass
<i>Austrodanthonia</i>	<i>setaceae</i>	Bristly Wallaby-grass
<i>Austrostipa</i>	<i>elegantissima</i>	Feater Spear-grass
<i>Austrostipa</i>	<i>mollis</i>	Supple Spear-grass
<i>Austrostipa</i>	<i>aristiglumis</i>	Plains Spear-grass
<i>Austrostipa</i>	<i>tricophylla</i>	
<i>Austrostipa</i>	<i>gibbosa</i>	
<i>Austrostipa</i>	<i>pubinodis</i>	
<i>Austrostipa</i>	<i>semibarbata</i>	
<i>Austrostipa</i>	<i>oligostachya</i>	
<i>Austrostipa</i>	<i>blackii</i>	
<i>Austrostipa</i>	<i>nodosa</i>	
<i>Austrostipa</i>	<i>bigeniculata</i>	
<i>Austrostipa</i>	<i>scabra</i>	Rough Spear-grass
<i>Austrostipa</i>	<i>scabra</i> sub. <i>sp.falcata</i>	Rough Spear-grass
<i>Bossiaea</i>	<i>prostrata.</i>	Creeping Bossiaea
<i>Bothriochloa</i>	<i>macra</i>	Red-leg Grass
<i>Brachyscome</i>	<i>basaltica</i>	Basalt Daisy
<i>Brachyscome</i>	<i>chrysoglossa</i>	Yellow-tongue Daisy
<i>Brachyscome</i>	<i>dentata</i>	Lobed-seed Daisy
<i>Brachyscome</i>	<i>cardiocarpa</i>	Heart-fruit Daisy
<i>Brachyscome</i>	<i>ciliaris</i>	Variable Daisy
<i>Brachyscome</i>	<i>perpusilla</i>	Tiny Daisy
<i>Brachyscome</i>	<i>diversifolia</i>	Tall Daisy

Table 5 List of species used in sowings and/or in seed production

Genus	Species	Common Name
<i>Bracteantha</i>	<i>bracteantha</i>	Golden Everlasting
<i>Brunonia</i>	<i>australis</i>	Blue Pincushion
<i>Bulbine</i>	<i>bulbosa</i>	Bulbine-lily
<i>Burchardia</i>	<i>umbellata</i>	Milkmaids
<i>Caesia</i>	<i>callaintha</i>	Blue Grass-lily
<i>Calocephalus</i>	<i>citreus</i>	Lemon Beauty-heads
<i>Calocephalus</i>	<i>lacteus</i>	Pale Beauty-heads
<i>Calotis</i>	<i>anthemoides</i>	Cut-leaf Burr-daisy
<i>Calotis</i>	<i>scabiosifolia</i>	Rough Burr-daisy
<i>Centiolepis</i>	<i>strigosa</i>	Hairy Centrolepis
<i>Centropeda</i>	<i>cunninghamii</i>	Common Sneezeweed
<i>Chamaescilla</i>	<i>corymbosa</i>	Blue Squill
<i>Chamaesyce</i>	<i>drummondii</i>	Flat Spurge
<i>Chloris</i>	<i>truncata</i>	Windmill Grass
<i>Chrysocephalum</i>	<i>semipapposum</i>	Clustered Everlasting
<i>Chrysocephalum</i>	<i>apiculatum</i>	Common Everlasting
<i>Chrysocephalum</i>	<i>apiculatum (small)</i>	Common Everlasting
<i>Convolvulus</i>	<i>remotus</i>	Bindweed
<i>Convolvulus</i>	<i>erubescens</i>	Pink Bindweed
<i>Crasspedia</i>	<i>paludicola</i>	Swamp Billy-buttons
<i>Crasspedia</i>	<i>variabilis</i>	Variable Billy-buttons
<i>Crassula</i>	<i>sieberiana</i>	Australian Stonecrop
<i>Cynoglossum</i>	<i>suaveolons</i>	Sweet Hound's Tongue
<i>Daucus</i>	<i>glochidiatus</i>	Austral Carrot
<i>Desmodium</i>	<i>varians</i>	Slender Tick-trefoil
<i>Dianella</i>	<i>longifolia</i>	Pale Flax-lily
<i>Dianella</i>	<i>revoluta</i>	Black-anther Flax-lily
<i>Dichanthium</i>	<i>sericeum</i>	Silky Blue-grass
<i>Dichelachne</i>	<i>crinita</i>	Long-hair Plume-grass
<i>Drosera</i>	<i>peltata</i>	Pale Sundew
<i>Drosera</i>	<i>whittakeri</i>	Scented Sundew
<i>Echinopogon</i>	<i>ovatus</i>	
<i>Einadia</i>	<i>nutans</i>	Nodding Saltbush
<i>Elymus</i>	<i>scabrus</i>	Common Wheat-grass
<i>Enchylaena</i>	<i>tomentosa</i>	Ruby Saltbush
<i>Enteropogon</i>	<i>acricularis</i>	Spider (Umbrella) Grass
<i>Eragrostis</i>	<i>bronwnii</i>	Common Love-grass
<i>Eragrostis</i>	<i>elongata</i>	
<i>Eryngium</i>	<i>ovinum</i>	Blue Devil
<i>Eryngium</i>	<i>versiculosum</i>	Prickfoot
<i>Euchiton</i>	<i>involucratus</i>	Common (Star) Cudweed
<i>Eutaxia</i>	<i>diffusa</i>	Spreading Eutaxia
<i>Eutaxia</i>	<i>microphylla</i>	Small-leaved Eutaxia
<i>Galium</i>	<i>gaudichaudii</i>	Rough Bedstraw
<i>Galium</i>	<i>australe</i>	Tangled Bedstraw
<i>Geranium</i>	<i>retrosum</i>	Grassland Crane's Bill
<i>Geranium</i>	<i>solanderi</i>	Austral Crane's Bill
<i>Glycine</i>	<i>clandestina</i>	Twining Glycine
<i>Glycine</i>	<i>latrobeana</i>	Clover Glycine

Table 5 continued

Genus	Species	Common Name
<i>Gnephosis</i>	<i>drummondii</i>	
<i>Gonocarpus</i>	<i>elatus</i>	Tall Raspwort
<i>Gonocarpus</i>	<i>tetragynus</i>	Common Raspwort
<i>Gonocarpus</i>	<i>humilis</i>	
<i>Goodenia</i>	<i>pinnatifida</i>	Cut-leaf Goodenia
<i>Goodenia</i>	<i>geniculata</i>	Bent Goodenia
<i>Goodenia</i>	<i>heteromera</i>	Spreading Goodenia
<i>Haloragis</i>	<i>aspera</i>	Rough Raspwort
<i>Haloragis</i>	<i>heterophylla</i>	Variable Raspwort
<i>Helichrysum</i>	<i>leucopsidium</i>	Satin Everlasting
<i>Helichrysum</i>	<i>rutidolepis</i>	Pale Everlasting
<i>Hibbertia</i>	<i>exutiacies</i>	
<i>Homopholis</i>	<i>proluta</i>	Rigid Panic
<i>Hyalosperma</i>	<i>praecox</i>	Mayweed Sunray
<i>Hydrocotyle</i>	<i>laxiflora</i>	Stinking Pennywort
<i>Hypericum</i>	<i>gramineum</i>	Small St John's Wort
<i>Ixiolaena</i>	<i>nova</i>	Woolly Buttons
<i>Ixiolaena</i>	<i>leptolepis</i>	
<i>Kennedia</i>	<i>prostrata</i>	Running Postman
<i>Lagenifera</i>	<i>gracilis</i>	Slender Lagenifera
<i>Leptorhynchus</i>	<i>(small form)</i>	
<i>Leptorhynchus</i>	<i>squamatus</i>	Scaly Buttons
<i>Leptorhynchus</i>	<i>tenuifolius</i>	Wiry Buttons
<i>Leucochrysum</i>	<i>albicans ssp. albicans var albicans</i>	
<i>Leucochrysum</i>	<i>albicans ssp. albicans var. tricolor</i>	
<i>Linum</i>	<i>marginale</i>	Native Flax
<i>Lobelia</i>	<i>pratiodies</i>	Tall Lobelia
<i>Lomandra</i>	<i>effusa</i>	Scented Mat-rush
<i>Lomandra</i>	<i>filiformis</i>	Wattle Mat-rush
<i>Lomandra</i>	<i>nana</i>	Pale Mat-rush
<i>Luzula</i>	<i>densiflora</i>	Woodrush
<i>Maireana</i>	<i>decalvans</i>	Black Cottonbush
<i>Maireana</i>	<i>enchylaenoides</i>	Wingless Bluebush
<i>Maireana</i>	<i>excavata</i>	Bottle Bluebush
<i>Mentha</i>	<i>satureoides</i>	Creeping Mint
<i>Microlaena</i>	<i>stipiodes</i>	Weeping Grass
<i>Microseris</i>	<i>lanceolata</i>	Yam Daisy
<i>Minuria</i>	<i>leptophylla</i>	Minnie Daisy
<i>Myriocephalus</i>	<i>rhizocephalus</i>	Woolly Heads
<i>Neurachne</i>	<i>alopeкуроidea</i>	Fox-tail Mulga-grass
<i>Oxalis</i>	<i>perennans</i>	Grassland Wood-sorrel
<i>Pelargonium</i>	<i>australe</i>	Stork's-bill
<i>Pelargonium</i>	<i>rodneyanum</i>	Magenta Stork's-bill
<i>Pentapogon</i>	<i>quadrifidus</i>	Five-awned Spear-grass
<i>Pimelea</i>	<i>curviflora</i>	Curved Rice-flower
<i>Pimelea</i>	<i>glauca</i>	Smooth Rice-flower
<i>Pimelea</i>	<i>humilis</i>	Common Rice-flower
<i>Plantago</i>	<i>gaudichaudii</i>	Narrow-leaf Plantain

Table 5 continued

Overview of primary participants

Greening Australia	<p>Project Leader: Dr Paul Gibson-Roy South-West regional manager: Ron Dodds Senior Project officer: Jess Gardner Media: Natalie Cook</p>
Steering Committee	<p>Chair: Bernie Dunn (Wimmera CMA) Dean Robertson (WCMA) Thea Laidlaw (Glenelg-Hopkins CMA) (retired) Aggie Stevenson (Glenelg-Hopkins CMA) Anne Buchan (Corangamite CMA) (retired) Nick McCristal (Corangamite CMA) Neville Oddie (Landholder representative) Elspeth Swan (DSE) Dr Greg Moore (Melbourne University) Carl Carthy (Greening Australia)</p>
Technical group	<p>Prof. Roger Cousens (Melbourne University) Dr Greg Moore (Melbourne University) John Delpratt (Melbourne University) Dr. John Morgan (La Trobe University) Josh Dorrough (Arthur Rylah Institute) Colin Hocking (Victoria University)</p>

Overview of primary participants

Sowing Sites & Landholders/managers	<p>Beeac: Colac/Otway shire</p> <p>Chatsworth: David Franklin</p> <p>Chepstowe: Neville Oddie</p> <p>Colac : James & Claire Dennis</p> <p>Hamilton: Dep. Primary Industry (PVI)</p> <p>Laharum: Will and Pru Pyke</p> <p>Longerenong: Longerenong Agricultural College</p> <p>Minyip 1: DIRT (Warakirri Pty Ltd)</p> <p>Minyip 2: Daryl Barber</p> <p>Moyston: David Hermans</p> <p>Ravenswood: Paul & Jo Killen</p> <p>Winchelsea: Surf coast Shire</p>
Seed Production Areas and managers	<p>Burnley College: Kerrin Huxley</p> <p>Chatsworth: David Franklin</p> <p>Geelong Botanic Gardens: Julie Duffield & Phil Mulroyan</p> <p>Hamilton: Liz Fenton</p> <p>Horsham: Rhonda & Steve La broque</p> <p>Moyston: Marlene Shuman</p>
Technical/research activities	<p>Jenny Bear, Serena DeHavilland, John Delpratt, Jenny Elliot, Liz Fenton, David Fletcher, Marjorie Hall, Kerrin Huxley, Rhonda La broque, Zhou Lin, Jenny Murphy, Jenny Tierny</p>

Schedule of primary activities

Year	Month	Field Activities	Other
2004	Oct	<ul style="list-style-type: none"> Promote project to landholders Select sowing sites Develop experimental and field protocols Identify/assess plant populations for 05 collections Collect seed 	<ul style="list-style-type: none"> Engage staff, landholders, seed production site managers, seed collectors Initiate Steering and Technical committees
	Nov	<ul style="list-style-type: none"> Promote project to landholders Select sowing sites Develop experimental and field protocols Collect seed 	<ul style="list-style-type: none"> Engage with relevant parties within stakeholder organizations
	Dec	<ul style="list-style-type: none"> Promote project to landholders Select sowing sites Develop experimental and field protocols Collect seed 	<ul style="list-style-type: none"> Liaise with staff, stakeholders, contractors, students, research partners and volunteers
2005	Jan	<ul style="list-style-type: none"> Begin to prepare sowing sites Collect seed Process seed Formalize agreements with sowing site landholders/managers Identify Seed Production Areas (SPAs) 	<ul style="list-style-type: none"> Report to Steering and Technical groups Formalize agreements with landholders and SPAs
	Feb	<ul style="list-style-type: none"> Begin to prepare sowing sites Collect seed Process seed Establish protocols for SPAs 	<ul style="list-style-type: none"> Promote project via media, newsletters, presentation and field days Initiate related research activity (student based).
	Mar	<ul style="list-style-type: none"> Propagate plants for seed production Formalize agreements with SPA managers Formalize experimental design for sowing sites 	<ul style="list-style-type: none"> Liaise with staff, stakeholders, contractors, students, research partners and volunteers
	Apr	<ul style="list-style-type: none"> Propagate plants for seed production Site preparation activities for sowing and SPAs 	

Schedule of Primary activities (cont)

May	<ul style="list-style-type: none"> • Begin to move plants into containerized seed production systems at SPAs 	
Jun	<ul style="list-style-type: none"> • Site preparation activities for sowing sites (weed control, fencing etc) 	
Jul	<ul style="list-style-type: none"> • Oversee management of SPAs (ongoing) • Site preparation activities for sowing sites (weed control, fencing etc) 	
Aug	<ul style="list-style-type: none"> • Begin to implement 1st round of experimental sowings (20m x 20m) • Identify/assess plant populations for 06 collections 	
Sep	<ul style="list-style-type: none"> • Continue with 1st round of annual sowings • Seed collection 	
Oct	<ul style="list-style-type: none"> • Monitor 1st sowings (ongoing thereafter) • Begin site preparation of 2006 sowings at each sowing site • Seed collection 	
Nov	<ul style="list-style-type: none"> • Seed collection (field and SPAs) 	
Dec	<ul style="list-style-type: none"> • Seed collection (field and SPAs) 	
2006 Jan	<ul style="list-style-type: none"> • Seed collection (field and SPAs) 	<ul style="list-style-type: none"> • Report to Steering and Technical groups
Feb	<ul style="list-style-type: none"> • Seed collection (field and SPAs) • Plan activities for 2006 SPAs 	<ul style="list-style-type: none"> • Promote project via media, newsletters, presentation and field days
Mar	<ul style="list-style-type: none"> • Propagate plants for 06 expansion of SPAs • Process seed from all collections • Begin to investigate options for specialized mechanical seeder 	<ul style="list-style-type: none"> • Manage related research activity (student based) • Liaise with staff, stakeholders, contractors, students, research partners and volunteers

Schedule of Primary activities (cont)

Apr	<ul style="list-style-type: none"> • Propagate plants for seed production • Site preparation activities for 2nd annual sowing and expanded SPAs • Purchase and modification of specialized seeder
May	<ul style="list-style-type: none"> • Move plants into containerized seed production systems at SPAs • Testing of specialized seeder
Jun	<ul style="list-style-type: none"> • Site preparation activities for larger 4000 m² sowing sites (weed control, fencing etc) • Oversee management of SPAs
Jul	<ul style="list-style-type: none"> • Site preparation activities for sowing sites , in particular soil scrapes at large scale
Aug	<ul style="list-style-type: none"> • Begin to implement 2nd round of experimental sowings (using new seeder) • Identify/assess plant populations for 07 collections
Sep	<ul style="list-style-type: none"> • Continue with 2nd round of annual sowings • Monitor 2nd sowings (ongoing thereafter) • Seed collection
Oct	<ul style="list-style-type: none"> • Continue with 2nd round of annual sowings • Seed collection (field & SPA)
Nov	<ul style="list-style-type: none"> • Seed collection (field & SPA)
Dec	<ul style="list-style-type: none"> • Seed collection (field & SPA)

Schedule of Primary activities (cont)

2007 Jan	<ul style="list-style-type: none"> • Begin site preparation for 3rd annual sowings • Seed collection (field & SPA) 	<ul style="list-style-type: none"> • Report to steering committee • Liaise with staff, stakeholders, contractors, students, research partners and volunteers • Promote project via media, newsletters and direct presentation. • Manage associate research projects • Undertake field days
Feb	<ul style="list-style-type: none"> • Seed collection (field & SPA) 	
Mar	<ul style="list-style-type: none"> • Process seed collections (field & SPA) 	
Apr	<ul style="list-style-type: none"> • Process seed collections (field & SPA) • Site prep for 3rd annual sowings 	
May	<ul style="list-style-type: none"> • Site prep for 3rd annual sowings 	
Jun	<ul style="list-style-type: none"> • Site prep for 3rd annual sowings 	
Jul	<ul style="list-style-type: none"> • Site prep for 3rd annual sowings 	
Aug	<ul style="list-style-type: none"> • Site prep for 3rd annual sowings (in particular large scale soil scrapes) 	
Sep	<ul style="list-style-type: none"> • Initiate 3rd annual sowings 	
Oct	<ul style="list-style-type: none"> • 3rd annual sowings 	
Nov	<ul style="list-style-type: none"> • 3rd annual sowings 	
Dec	<ul style="list-style-type: none"> • Monitor 1st, 2nd and 3rd sowings (ongoing thereafter) 	

Milestone Summary: 2004-2007

Milestone	Explanations of undertakings for this period
Establish Project Steering and Technical Reference groups	<p>Project Steering and technical groups were established. The steering committee met on a regular basis throughout the life of the project at venues across the study area. Chaired by Bernie Dunn of the Wimmera CMA. SC members were briefed on progress of the project and had input into actions undertaken.</p> <p>The technical group convened initially to review and approve scientific protocols. Thereafter, technical group members were approached on an individual basis throughout the project for feedback and consultation.</p>
Work plans and research plans for staff developed	<p>On-ground work plans to implement and conduct experimental and seed production activities were developed by the project leader in consultation with project staff and technical group members. These plans were also approved by the Steering Committee.</p>
Develop project protocols for on-ground activities	<p>Protocols were established to guide and streamline seed collectors, seed processing, sowing site management and seed production activities.</p>
Develop communication strategy	<p>The GGRP communication strategy was developed through a working group that included project leader (Dr P Gibson-Roy), Carl Carthy (CEO GAV) Alison Raymond (GAV publicist) and Lynne King (GAV communications manager).</p> <p>The communication strategy group identified three main areas to address in media, these being; community level or regional promotion, and then state and national coverage. The project was promoted in the regional press (print and electronic) on an ongoing basis. The GGRP also received national coverage on a number of occasions via ABC National's 'Country Hour' program. GGRP staff gave over 30 presentations to scientific, technical and stakeholder groups. The initiation of the electronic newsletter the "Grassy Gazette" (see end of milestone summary) proved a very successful communication vehicle. Compiled by Natalie Cook through Greening Australia Victoria's marketing unit, the Grassy Gazette was originally intended to facilitate communication between the dispersed members of the GGRP and notify participants of progress to-date. However, subscriber-ship was opened to those interested in grassland restoration and conservation in general. Several hundred people from throughout Australia have since subscribed and receive quarterly editions.</p>
Develop project monitoring, evaluation and reporting plan	<p>Protocols for monitoring the progress of the project involved formal reporting structures between the project leader and project manager, to the CEO and business manager of GAV, to the Steering Committee and Technical Advisory Group and to NHT through quarterly reports.</p>

Milestone	Explanations of undertakings for this period
Select experimental sites	<p>A process of community consultation via oral presentations and via the press (throughout five south-western CMA regions) was initiated early in the life of the project to seek landholders and community members interested in becoming involved with the project. This was followed by a site evaluation and selection process where staff assessed over 40 prospective sites throughout south-western Victoria for suitability. Fifteen sites were originally included in the sowing program although this was reduced to the final figure of thirteen shortly afterwards. Project agreements were reached with the relevant landholders or management authorities to then undertake the project.</p>
Seed collection activities undertaken	<p>Through promotional and regional networks the GGRP engaged the services of a number of seed collectors linked to each sowing location. These collectors worked to protocols developed for the project for seed harvest in the field and from production sites. This group of committed contractors and volunteers increased the general learning's of the project by successfully dealing with a large number of species which, up until then, had not unusually been collected or worked with in the revegetation industry. As such, one outcome of the project was to increase the skills base of this group of collectors in respect to collection and use of grassland species for revegetation purposes.</p>
Seed testing	<p>Technical staff undertook a variety of seed testing activities during the project. Purity testing was conducted on the seed of all species for all sowings. This amounted to a huge effort, encompassing testing up to one thousand seed-lots. Purity testing enabled a clearer understanding of the characteristics of each seed-lot and allowed better analysis of field establishment results. Additional germination and viability testing was conducted where necessary. Several student research projects were also undertaken focused on seed testing issues.</p>
Establish seed database	<p>During the project details of seed collection and processing were maintained. This information will be collated and scrutinized for presentation in the final GGRP report.</p>
Seed mixture development	<p>Following seed collection (field and SPA), seed mixtures were developed for annual sowings at each site. Each seed mix reflected the species present within local provenances and the available seed from harvest activities.</p>
Site preparation for weed suppression	<p>Weed suppression was a critical aspect of experimental treatments within the GGRP. Weed control treatments involved investigating a number of weed control options. We compared both short and long term chemical weed control as well as investigating weed seed bank depletion and nutrient reduction techniques. All treatments involved</p>

Milestone	Explanations of undertakings for this period
<p>Project monitoring</p>	<p>considerable input and coordination of activities from landholders/managers and a number of local contractors.</p> <p>Primary monitoring activities were undertaken by technical staff. Intensive monitoring of sowing sites was conducted by Dr Paul Gibson-Roy and Jess Gardner. A range of secondary monitoring activities were undertaken by student and collaborating research partners. For example, Dr's Allen Yen and Amanda Kobelt are undertaking research investigating the colonization of GGRP sowing sites by invertebrate species, while a number of student research projects were undertaken on GGRP sites.</p> <p>Monitoring of species within SPA sites (plant establishment and seed production characteristics) was conducted by site managers.</p>
<p>Site management and upkeep (weed control, fences, pest control)</p>	<p>Site management activities have been undertaken at each site as required. These activities have been undertaken in consultation with project staff and relevant stakeholders and include weed control, pest or vermin control and fencing.</p>
<p>Assess mechanical seed delivery systems</p>	<p>A mechanized seeder using machinery commonly used in the turf industry was developed at Burnley campus utilizing the skills and input of engineer Ross Payne and senior landscape lecturer Ian Winston. The machine developed by the GGRP is able to sow multi-species mixtures at field scales. It has been used with great success at each of 13 sowing sites over two seasons. To our knowledge, this is the first time such a machine has been successfully used for this purpose in Australia.</p>
<p>Develop seed production capacity</p>	<p>The investigation and development of seed production capacity was a major undertaking of the GGRP. Six SPAs were established linking in with the 13 sowing sites. These SPAs provided critical seed supplies supplementary to that available in the field. Indeed, in the second and third years of the project, sowings at most of the sites would have been jeopardized had it not been for seed harvested in SPAs. Activities and protocols undertaken at each SPA were developed and overseen by GGRP staff. However, the managers and other contributors contracted to undertake day to day operations of each SPA contributed significant expertise and knowledge to these facilities and the GGRP. In particular, the in kind support of staff and facilities of the Geelong SPA by the Geelong Botanic Gardens (under then director John Arnott) should be noted. Severe water restrictions impacted on several of our SPAs by restricting our capacity to irrigate boxes.</p> <p>However, over the course of the project each SPA developed critical insights into containerised and in-ground seed production techniques for a large number of species. It is believed, that in future, seed production will be fundamental to the success of meeting projected restoration targets in Australia.</p>

Milestone	Explanations of undertakings for this period
<p>Summary</p> <p>Comments:</p>	<p>The GGRP was a restoration project with strong research underpinnings that was undertaken with significant community and stakeholder support. It met all milestone obligations during the three years of NHT funding and has been described by Mr Bernie Dunn of the Wimmera CMA (and chairman of the GGRP steering committee), as one of the most successful multi-regional projects he has seen undertaken in Victoria.</p> <p>The GGRP was an example of practical and applied research undertaken at field scales. It has achieved significant advances in NRM techniques for the reconstruction of grassland or herbaceous communities and the establishment of dedicated seed production facilities. It has been a successful example of collaboration between landholders, industry practitioners, stakeholder CMAs and project managers (Greening Australia Victoria and The University of Melbourne).</p> <p>Learning's from the GGRP will significantly advance NRM undertakings in regard to reconstruction of herbaceous communities throughout Australia. The research sites will also serve as valuable opportunities for longer-term scrutiny and for conducting associated research. The aforementioned outcomes represent major achievements of the GGRP.</p>



Figure 8: Sample of the Grassy Groundcover Gazette, editions May 06 and June 07

GGRP Presentations and Publications

2004. Conference Presentation: Returning complex grassland to agricultural lands. The 6th Australian Network for Plant Conservation Conference, Adelaide, South Australia.
2005. Conference Workshop: Establishing Seed Production Systems for Plant Conservation. The 6th Australian Network for Plant Conservation Conference, Adelaide, South Australia.
2005. Forum Presentation: Maximizing Seed Resources a for Conservation Focused Revegetation Projects. Green Web; Need for Seed Provenance Forum. North Sydney, November, 2005
2005. Forum Presentation. The Volcanic Plain Research Forum. Corangamite Catchment Management Authority. Little River. Victoria.
2006. Forum Presentation: EVC Restoration. Greening Australia. Deakin University, February, 2006.
2006. Conference Presentation. Veg Futures. Greening Australia/Land & Water, Albury, NSW. March 2006.
2006. Forum Presentation: Grassland Restoration Forum. Corangamite CMA. Colac, May, 2006.
2006. Forum Presentation: Serious About Seed. ACT Land Keepers Forum. Canberra, May 26, 2006.
2006. Forum Presentation: Wimmera Vegetation Forum. Wimmera Vegetation Network, July 12, 2006.
2006. Forum Presentation: Conservation and Restoration of the Cumberland Plain Symposium. University of Western Sydney. Sydney, July 19, 2006.
2006. Forum Presentation: Grassy Groundcover Group Forum. Greening Australia. Ararat, July 26, 2006.
2006. Keynote Speaker: Restoring Indigenous Grassland. Hamilton Field Naturalists, Hamilton, August, 2006.
2006. Field Day: Grassy Groundcover Research Project Glenelg Hopkins Field Day. Greening Australia/Melbourne University. DPI Hamilton.
2006. Field Day: Grassy Groundcover Research Project Wimmera Field Day. Greening Australia/Melbourne University. Minyip.

2006. Forum Presentation. The Volcanic Plain Research Forum. Corramgamite Catchment Management Authority. Geelong. Victoria.

2006. Field Day: EVC Grassland Technical Field Day. Greening Australia/Melbourne University. Werribee Open Plains Zoo & Geelong Botanic Gardens.

2006. Forum Presentation and Field Day: From the ground up: a workshop on the conservation and rehabilitation of grassy ecosystems of the ACT and region. Australian Network for Plant Conservation. CSIRO, Canberra.

2007. Forum Presentation: Sowing the future: seed production and direct-seeding for revegetation. Euroa Arboretum. Goulburn Broken CMA – DPI Victoria.

2007. Forum Presentation: Seed Production Systems: seed production for the restoration industry. Echuca. North Central/Goulburn Broken CMA – DPI Victoria.

2007. Field Day: GGRP Technical Field Day. Corangamite Catchment Management Authority, Greening Australia/Melbourne University. Beeac Community Centre.

2007. Field Day: GGRP Technical Field Day. Corangamite Catchment Management Authority, Greening Australia/Melbourne University. Beeac Community Centre.

Papers:

2005, The Grassy Groundcover Research Project. Short Notes. Ecological Management and Restoration. Vol 6. No. 1. Blackwell Science.

2005. Returning complex grassland to agricultural lands. Australian Plant Conservation. Vol 14 , Number 2, Dec 2005.

2005. Seed Resources for Grassland Restoration. Australian Plant Conservation. Vol 15 , Number 2, June 2006.

2006. Victorian Basalt Plains grasslands – an overview. Australian Plant Conservation. Vol 15 , Number 3, Dec 2006.

2006. Viability testing of Victorian Western Plains grasses Australian Plant Conservation. Vol 15 , Number 3, Dec 2006.

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