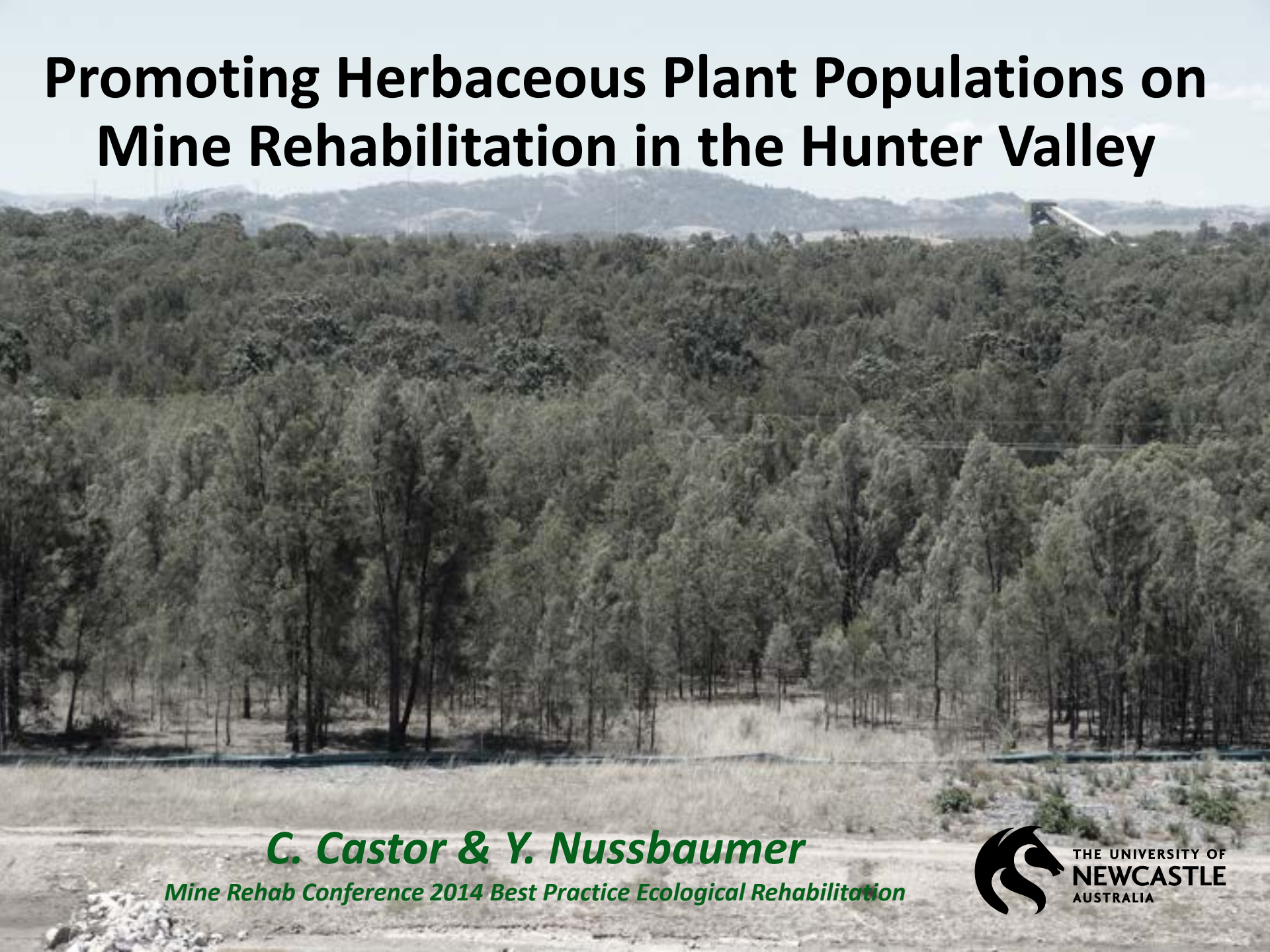
Promoting Herbaceous Plant Populations on Mine Rehabilitation in the Hunter Valley



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Mine Rehab Conference 2014 Best Practice Ecological Rehabilitation

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

Background

- Mining activity disrupts vegetation
- Many mines now need to revegetate to native sustainable ecosystems
- Spoil dumps are rehabilitated by seeding a limited number of species sometimes in combination with a seed bank from a topsoil or with soil ameliorants.
- Not many herbaceous species are transferred
- Loss of herbaceous species on rehabilitation area

Aims

- Establish an experimental area seeded with a community of native species (Phase 1)
- Incorporate target herbaceous species in the experimental area and study their niche requirements (Phase 2)

Arthropodium sp. B

Einadia nutans var. linarifolia

to Muswellbrook

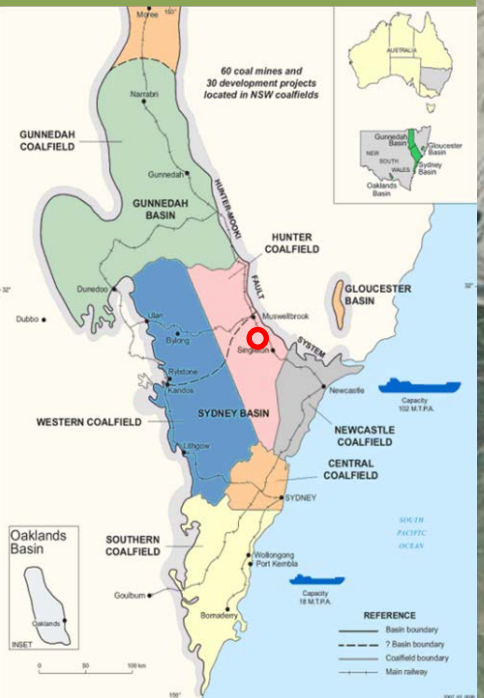
Ravensworth Operations
December 2013

Rehabilitation area

Ravensworth Pit

Study site

to Singleton

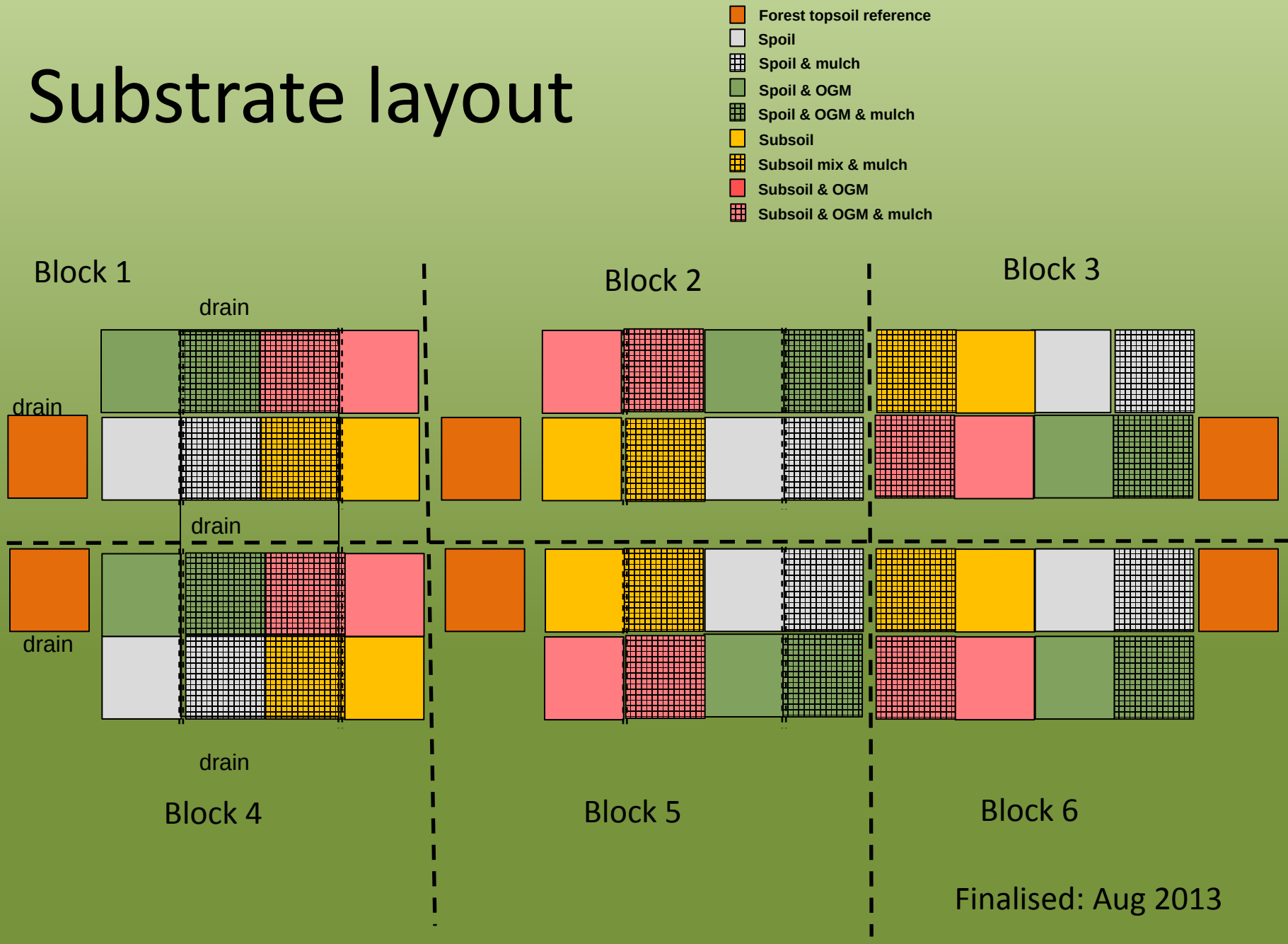


Phase 1 – Hunter Ironbark Communities Experimental Site

Substrates Trial:

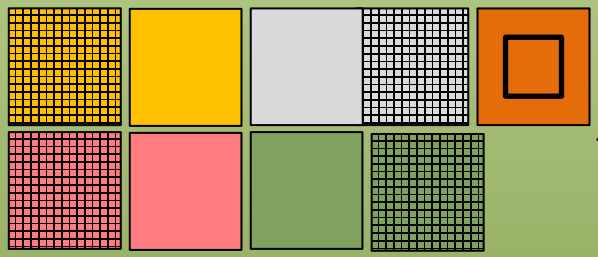
- Spoil
- Subsoil
- OGM: Organic Growth Medium
- Mulch: wood chip
- Forest topsoil

Substrate layout

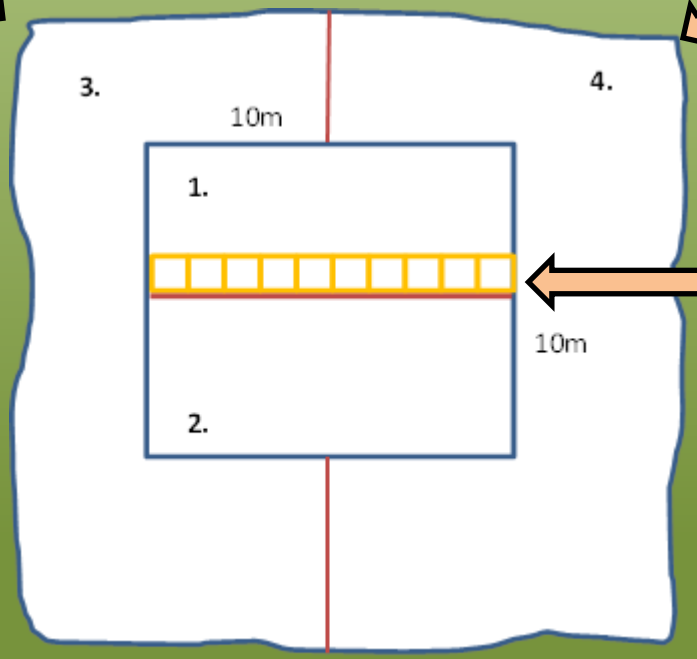


Finalised: Aug 2013

Seeding



Block 6



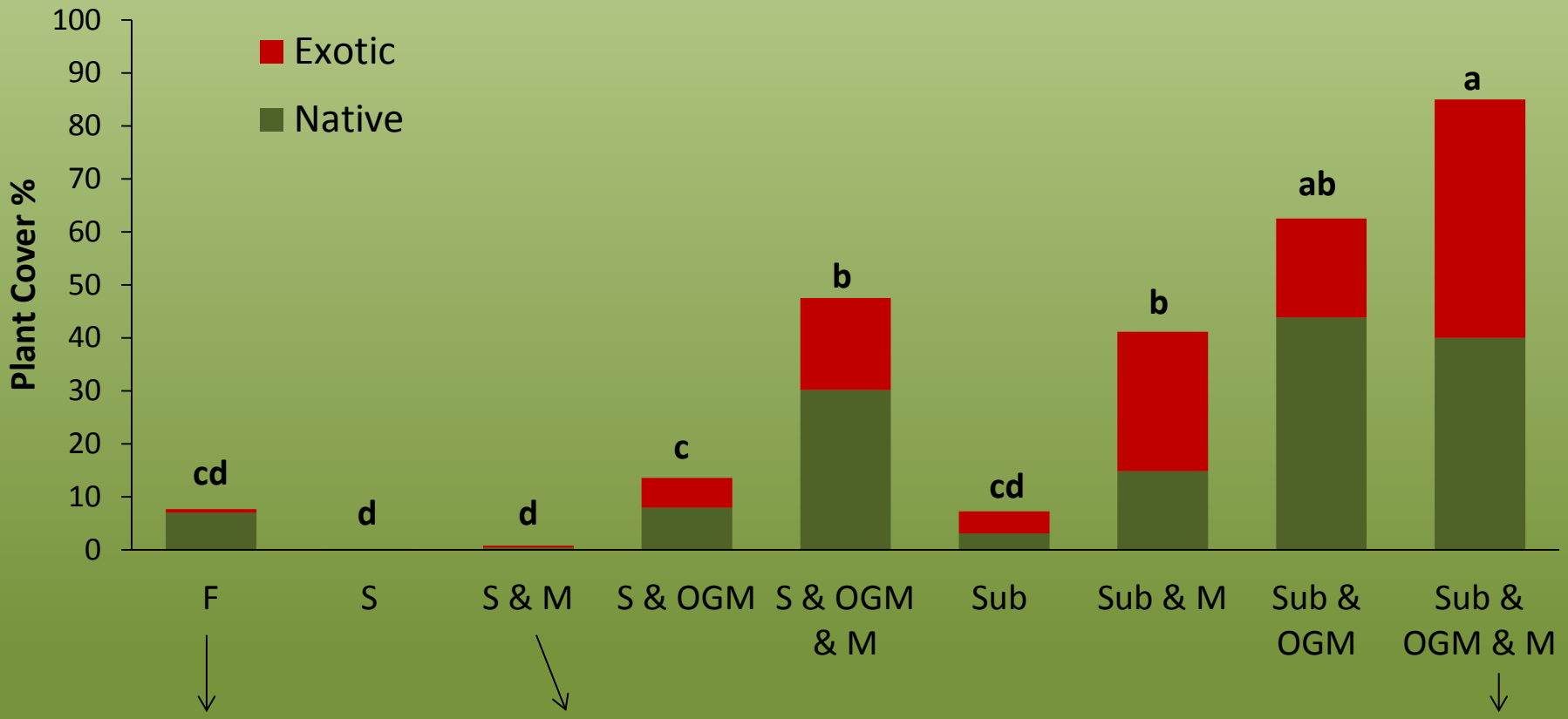
Group A & C
= Matrix
40sp

Group B
Hot Spots
10sp

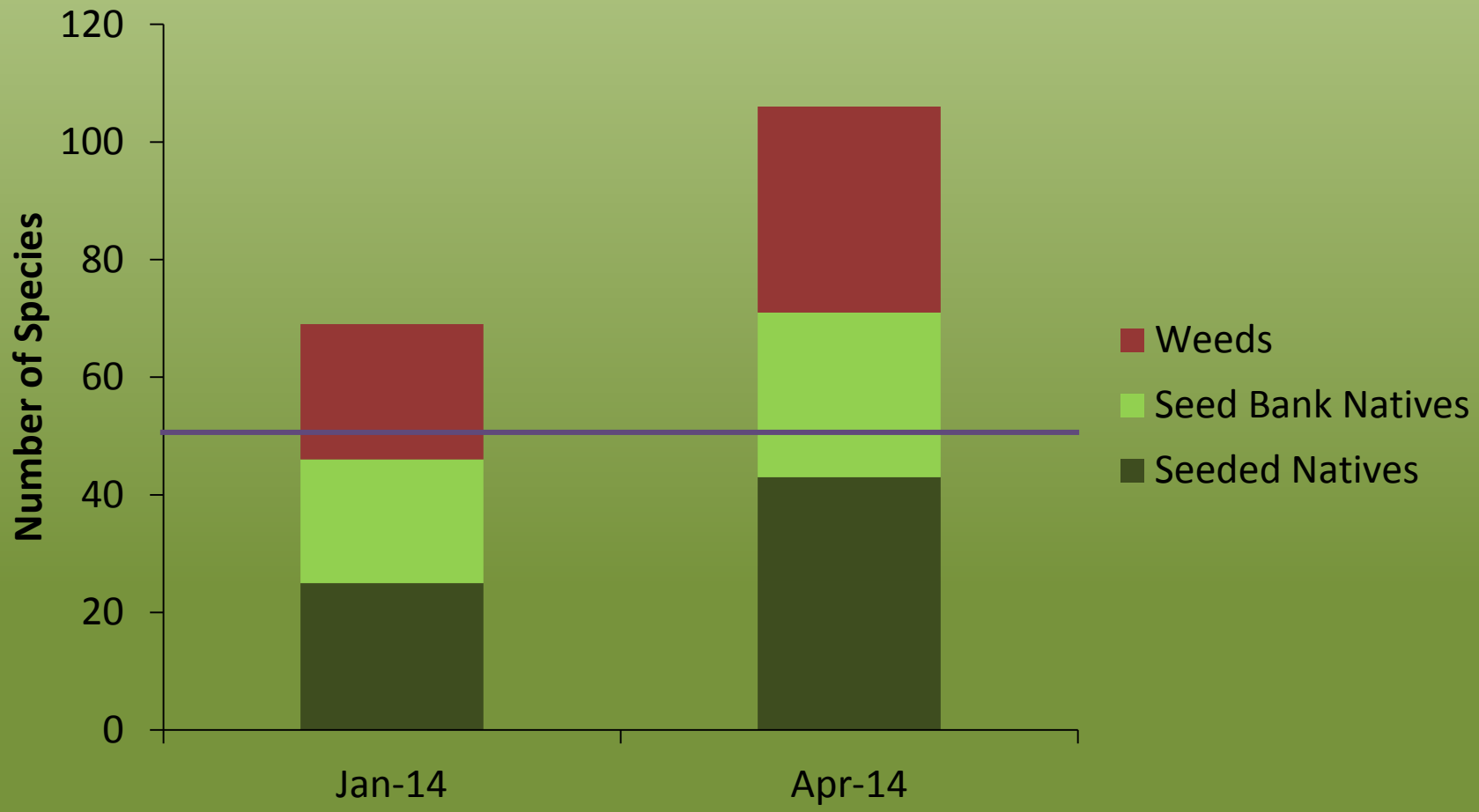
Finalised: Nov 2013

Aerial June 2014

Results – Cover



Results – Species



April = 6 months from seeding

Establishment success

Group A	Group B	Group C
Allocasuarina luehmannii	Cymbopogon refractus	Acacia amblygona
Angophora floribunda	Einadia trigonos subsp. leiocarpa	Acacia decora
Aristida ramosa	Enchylaena tomentosa	Acacia falcata
Atriplex semibractata	Eragrostis leptostachya	Acacia implexa
Austrodanthonia fulvum	Eremophila debilis	Acacia parvipinnula
Austrostipa scabra	Glycine clandestina	Acacia salicina
Austrostipa verticillata	Glycine latifolia	Brachychiton populneus
Bursaria spinosa var. spinosa	Glycine tabacina	Daviesia genistifolia
Callitris enlicherii	Solanum cinereum	Daviesia ulicifolia
Cassinia quinquefaria	Whalenbergia spp.	Hardenbergia violacea
Chloris truncata		Indigofera australis
Corymbia maculata		Kennedia rubicunda
Dichondra repens		Pultenaea microphylla
Dodonaea viscosa		Senna artemisiodes ssp. zygophylla
Eragrostis brownii		
Eucalyptus crebra		
Eucalyptus fibrosa		
Eucalyptus moluccana		
Eucalyptus tereticornis		
Kunzea ambigua		
Microlaena stipoides var. stipoides		
Olearia elliptica var elliptica		
Ozothamnus diosmifolius		
Panicum effusum		
Themeda australis		44/50
Vittadinia spp.		

Phase 2 –Herbaceous Species Niche Requirements

How they get into rehabilitation:

- Present in transferred topsoil
- Seeded/planted
- Natural colonisation from surrounding vegetation

BUT: diversity still low compared to reference sites and tendency for some species to disappear.

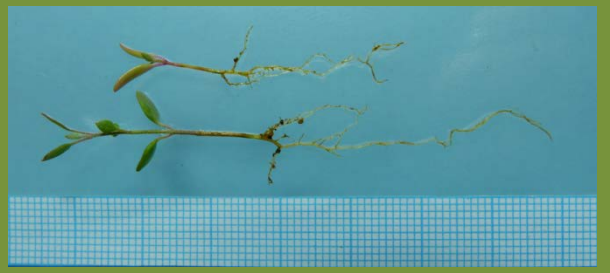
Reasons for Loss of Species

- Plant doesn't flower - competition/stress/lack of correct soil symbionts
- Seed not formed - lack of pollinators
- Seed falls to ground - predated
- Incorporation of seed into seed bank - germination cue absent (fire, soil disturbance…)
- No safe sites for germination

The Seedling Germination Microsite

Microsite characteristics defined by:

- Soil (surface roughness, compaction,...)
- Vegetation (shading, root competition,...)
- Species (seed size, root thickness,…)



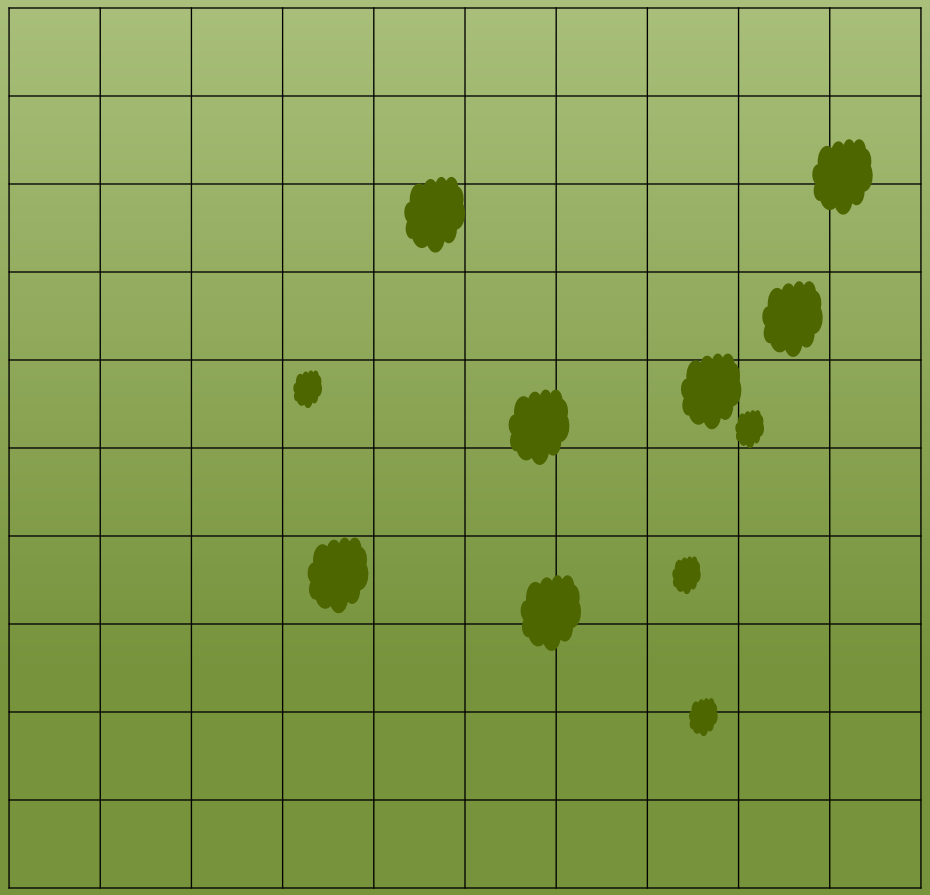
Questions

Is the seedling microsite(s) limiting species sustainability in natural and mine rehabilitation sites?

Can seedling microsites be increased on mine site rehabilitation to sustain populations of herbaceous species?

Are there differences between species' microsites and how do the species' special characteristics influence the selection of microsites?

Microsite surveys



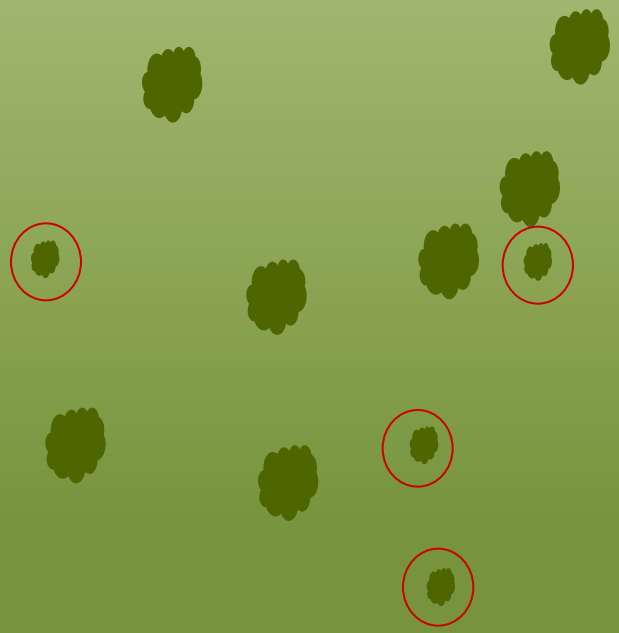
- For Natural communities: locate populations
- For Mine site communities: use experimental plot (10x10m)
- Place a grid (117 points)
- Determine microsite class for each intersection on a 1cm diameter point

- **Qualify and Quantify microsites in the landscape**

Microsite classes

Categories			Frequency (based on 6cm radius around 1cm point)					
			depression	mound	flat	in lee of rock	in lee of wood	Number of plants in 6cm radius
bare ground	organic	humus						
	organic	OGM						
	mineral							
	mixed & decompacted (ant hill etc…)							
	cracks?							
litter	euc leaves	org ground visible						
		min ground visible						
		litter < 1cm deep						
		litter > 1cm deep						
	grass leaves	org ground visible						
		min ground visible						
		litter < 1cm deep						
		litter > 1cm deep						
	twigs + soil	org ground visible						
		min ground visible	1					0
moss/lichen crust?								
rock								
wood					1			0
occupied by plant								

Seedling Microsite surveys



- Locate seedlings of target species
- Determine seedling microsite class and environment for each seedling within a 6 cm radius

- **Qualify effective microsites in the landscape**

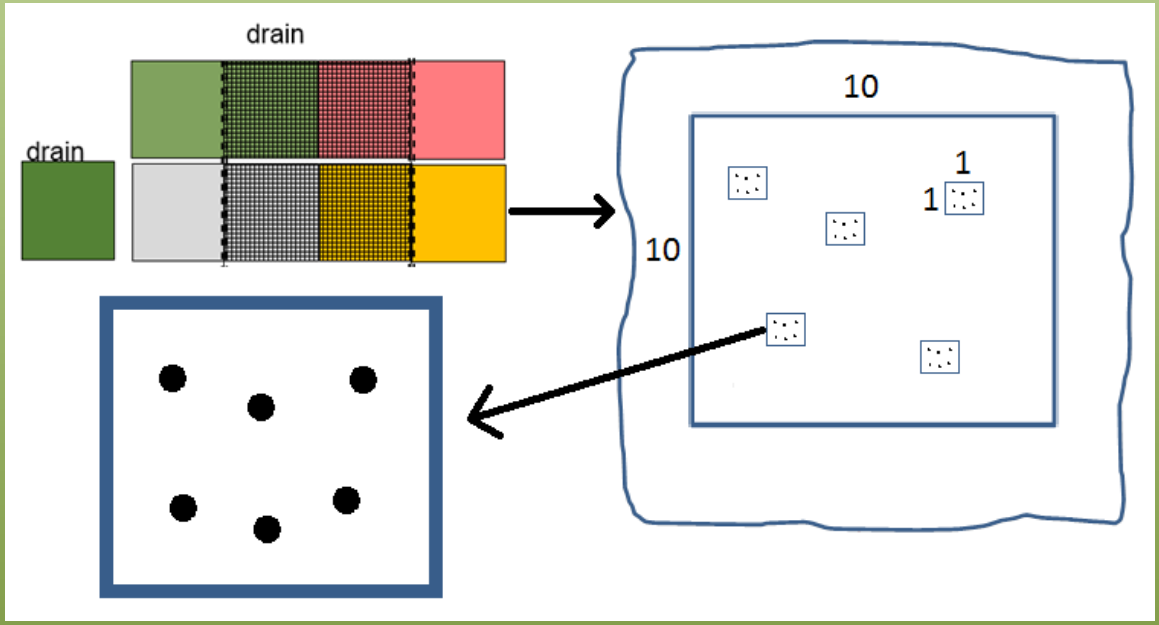
Seedling Microsite class

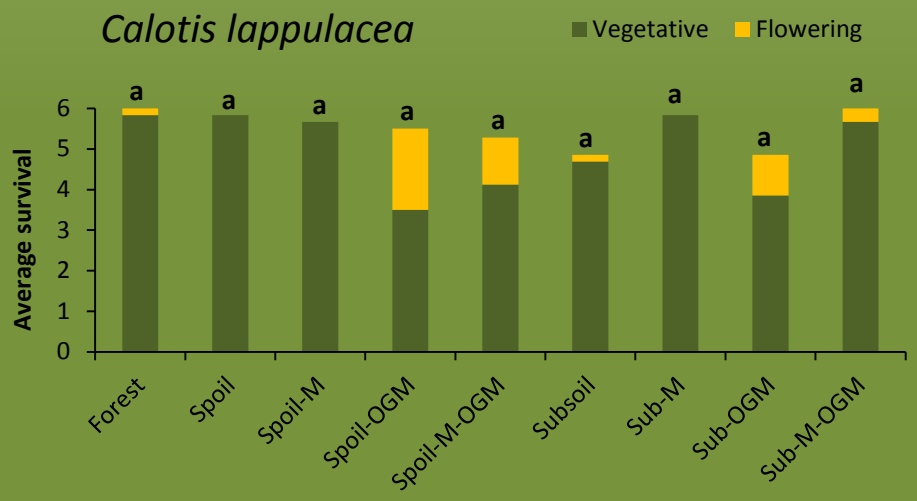
Categories			Frequency (within a 6cm radius)						
			depression	mound	flat	in lee of rock	in lee of wood	Number of plants in 6cm radius	distance to nearest conspecific
bare ground	organic	humus							
	organic	OGM							
	mineral								
	mixed & decompacted (ant hill etc…)								
	cracks?								
litter	euc leaves	org ground visible							
		min ground visible							
		litter < 1cm deep							
		litter > 1cm deep							
	grass leaves	org ground visible							
		min ground visible							
		litter < 1cm deep							
		litter > 1cm deep							
	twigs + soil	org ground visible	1				1		1.5m
		min ground visible							
moss/lichen									
others									

Target Species Selection

Species	Family	Presence on Mt Owen Rehabilitation Area	Known Germination Cues	Pollination Restrictions
Calotis lappulaceae	Asteraceae	low numbers	none	not suspected
Chrysocephalum apiculatum	Asteraceae	low numbers	after ripening, light	not suspected
Desmodium brachipodum	Fabaceae	established & recruiting	none, heat?	not suspected
Einadia nutans	Chenopodiaceae	low numbers, disappears	none, short viability	not suspected
Hibbertia obtusifolia	Dillenaceae	disappears, no seed set observed	difficult	unknown
Hypericum gramineum	Clusiaceae	low numbers	leaching, smoke water, light	not suspected
Swainsona galegifolia	Fabaceae	no second generation	none, heat?	not suspected
Ajuga australis	Lamiaceae	low numbers, disappears	light, short viability	not suspected

Establishing Target Populations





Scenarios for Microsite Evaluation and Effectiveness in Natural and Mine populations

	Seedlings Present in Natural populations	**NO seedlings present in Natural populations**
Seedlings in Mine populations	Recommendations for future rehabilitation projects.	Comparison of microsites. Possibly effects of rainfall, herbivory, weed and grass competition, pollinators,….
NO Seedlings in Mine populations	Comparison of microsites and formulation of hypothesis on failure. Also examine effects of herbivory, weed and grass competition, pollination and water availability on mine substrates.	Examination of possible effects of rainfall, herbivory, weed and grass competition, pollination limitation etc…

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