Post Construction Habitat Slab Experiment: Flora Monitoring Results

2009 – 2011

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Document History and Status

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Purpose

The purpose of this document is to:

- Describe the general approach proposed by the Sugarloaf Pipeline Alliance (the 'Alliance') to undertake flora monitoring on the habitat slab experimental plots (Section 2);
- Summarise the results of the habitat slab experiment flora monitoring to date (Section 3); and
- Provide recommendations for further monitoring and management actions.

The purpose of flora monitoring as a part of the habitat slab experiment is to:

- Document the change in species composition of both native and introduced flora species over time;
- Document the change in soil moisture within the habitat slabs over time;
- Document the variation in inter-tussock distances between the habitat slabs; and
- Document the success of the different methods of reinstatement utilised during the habitat slab experiment.

Abbreviations

Term	Description
Alliance	Sugarloaf Pipeline Alliance
DEWHA	Commonwealth Department of the Environment, Water, Heritage and the Arts (now DSEWPC)
DSE	Victorian Department of Sustainability and Environment
EMP	Environmental Management Plan
EMS	Environmental Management Strategy
EPBC	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FFG	Victorian *Flora and Fauna Guarantee Act 1988*
GSM	Golden Sun Moth
HLPS	High-lift Pump Station
ROW	Construction Right of Way
SLPA	Sugarloaf Pipeline Alliance (the 'Alliance')

1 Introduction

The Golden Sun Moth (*Synemon plana*) (GSM) occurs in grasslands and open grassy woodlands in south-eastern mainland Australia. The native grassland and grassy woodland habitats used by the GSM are amongst the most threatened of all vegetation types in Australia, with more than 99.5% estimated to have been grossly altered or destroyed (DEWHA 2009, Kirkpatrick et al. 1995, Lunt 1991). The GSM is generally found in grassy habitats that are dominated by native grass species, but they have also been occasionally found within areas dominated by non-native grasses. The species is listed as 'critically endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999,* 'threatened' under the Victorian *Flora and Fauna Guarantee* (FFG) *Act 1988* and 'critically endangered' on the Department of Sustainability and Environment (DSE) *Advisory List of Threatened Invertebrate Fauna in Victoria 2009* (DSE 2009).

In late 2008, targeted surveys undertaken by the Alliance identified the presence of flying adult GSM at a number of locations along the proposed Construction Area Right of Way (ROW) for the Sugarloaf Pipeline Project ('the Project'). Most observations were within the 3-5 km stretch of the alignment south of Yea, including the property proposed to contain the Sheoak High Lift Pump Station (HLPS)[1].

One of the post construction monitoring experiments designed to both help mitigate the impacts of the project on GSM, and to further develop scientific understanding of the species was the Habitat Slab Replacement Experiment which is described in section 7.1.3 of the Fauna Management Program – Sheoak High Lift Pump Station (SLPA 2009).

The Habitat Slab Replacement experiment is being undertaken at six locations along the ROW, all of which contain **known** GSM grassland habitat (i.e. GSM was located at these locations before construction of the pipeline commenced). Two locations occur on the Sheoak property (#326), two occur on property #335, and one occurs on each of properties #327 and #328. Given the geographical spread of the six experimental sites, each experimental site requires its own control plots. An example of the changes in the vegetation and general condition of the sites for the experiment is displayed in Figures 1 and 2.

At each location, there are ten delineated rectangular plots (each with an area of 8-9 m x 10 m; 80-90 m^2), which comprise:

1. One 'undisturbed' control plot outside but adjacent to the ROW, and
2. One 'disturbed' control plot within the 'non-slabbed' area of the ROW.
3. Four plots of replaced slabs ('set down areas') within the ROW (one of each of four experimental treatments),
4. Four laydown plots outside but adjacent to the ROW (one for each of the four treatments),

1. Undisturbed Control - Undisturbed ground *outside* ROW, but adjacent to (i.e. within 30 m of) the section of ROW that is slabbed.

[1] The Sheoak property is owned by Melbourne Water; a member of the Sugarloaf Pipeline Alliance.

This control is required to provide information on GSM habitat similar to that in the slabbed areas, but which remains undisturbed for the course of the experiment and monitoring period (i.e. what happens to the GSM population in the absence of disturbance?). The assumption is made that the habitat immediately adjacent to, but outside the ROW, is equivalent to the slabbed area within the ROW with respect to the local GSM population. Areas chosen for the experiment were selected in part on the basis of meeting this assumption (based on observed superficial habitat characteristics rather than GSM pupal case surveys).

2. Disturbed Control - Disturbed ground within ROW that is not slabbed. That is, for this 'maximum disturbance' control, the standard construction and reinstatement process for grassy agricultural paddocks that are intercepted by the project was implemented.
In most situations where the project intercepts grassy vegetation, the topsoil was stripped from the ROW initially, stockpiled for the duration of construction, and then returned to the ROW at the completion of construction. Standard reinstatement then proceeded, with grasses from the topsoil seedbank encouraged to regenerate across the ROW - without any direct plantings of seeds or tubestock, and without any additions of fertilisers, herbicides and pesticides (at least not without the permission of DSE and/or the GSM Technical Advisory Group). This control provides information on GSM and vegetation survival and/or recolonisation in the absence of the Habitat Slab Replacement (i.e. if nothing is done to mitigate against impacts to GSM).

3. Set down areas - Set down areas consist of the experimental slabs themselves. Four different treatments were utilised:
a) Slabs 20 cm deep, stored during construction on geotextile fabric directly on ground;

b) Slabs 20 cm deep, stored during construction on solid boards raised off the ground (without fabric or matting);

c) Slabs 45 cm deep, stored during construction on geotextile fabric directly on ground; and

d) Slabs 45 cm deep, stored during construction on solid boards raised off the ground (without fabric or matting).

4. Laydown areas – Laydown areas were located adjacent to but outside the ROW, but still within the approved development corridor.
The temporary storage of habitat slabs outside the ROW is likely to impact the ground and vegetation within the storage area. If that storage area also contains suitable GSM habitat, then the additional potential impact needs to be factored in to the overall benefits or impacts of the slab replacement procedure.

Flora monitoring has now been undertaken on eleven occasions within each of the 60 plots (6 locations x 10 plots). This monitoring is described in more detail below.

2 Methods

Monitoring was undertaken in accordance with the method outlined in the Golden Sun Moth Overarching Document (SLPA 2009) and the Fauna Management Program – Sheoak High Lift Pump Station (SLPA 2009).

Monitoring included an assessment of the following factors:

- Full species list including native and introduced flora species;
- Braun – Blanquet cover abundance of each species within each plot;
- Braun – Blanquet cover abundance cover of each life form within each plot (e.g. graminoids, forbs)
- Braun – Blanquet cover abundance cover of bare ground within each plot;
- Vertical structure of each life form within each plot; and
- Inter-tussock distance in four quadrants as measured at ten random points within each habitat slab (i.e. total of 40 measured distances per location).

The dates of each round of flora monitoring for the habitat slab experiment are documented in Table 1 below.

Table 1 Flora monitoring undertaken to date for the Habitat Slab experiment

Assessment type	Date
Pre-slabbing assessment	May 2009 (Slabs removed)
Post slabbing assessment round 1	June 2009 (1 month after slab removal, slabs were being stored adjacent to the ROW)
Post slabbing assessment round 2	July 2009 (2 months after slab removal, slabs were reinstated for this assessment)
Post slabbing assessment round 3	October 2009 (5 months after slab removal)
Post slabbing assessment round 4	February 2010 (8 months after slab removal)
Post slabbing assessment round 5	April 2010 (11 months after slab removal)
Post slabbing assessment round 6	July 2010 (14 months after slab removal)
Post slabbing assessment round 7	October 2010 (17 months after slab removal)
Post slabbing assessment round 8	January 2011 (20 months after slab removal)
Post slabbing assessment round 9*	April 2011 (23 months after slab removal)
Post slabbing assessment round 10	August 2011 (27 months after slab removal, 25 months after slab reinstatement)

* Access was not able to be gained to properties 327 and 328 during the April 2011 survey period due to landholder issues. Therefore, no data were collected for the two locations on these properties for this round of monitoring, which means that only four of the six experimental locations (i.e. 40 of the 60 plots) were assessed. Landowner issues were resolved for the most recent survey period- August 2011- and all sites were assessed.

Figure 1 Habitat Slab experimental plots at property 335, immediately after slabbing, May 2009

Figure 2 Habitat Slab experimental plots at property 335, 23 months after slabbing, April 2011

3 Compliance with Management Plans

This report outlines the vegetation monitoring undertaken in accordance with the measures outlined in section 7.1.3.4 Section F of the Fauna Management Program - Sheoak High Lift Pump Station (SPLA 2009b). Some changes to the monitoring became necessary when considering the practicalities of collecting the data in the field, with the changes being:

- No recording of tussock density or tussock condition and survivorship. These measures proved impractical to measure reliably in the field due to difficulty in identifying individual tussocks in the majority of instances. This also proved difficult at some of the experimental sites before the experiment began and did it was concluded that these measures would not provide useful or comparable data; and
- Structure was measured in four classes which are indicative of plant form and maturity rather than 10 cm intervals which proved impractical to measure in the field. The height intervals were 0–10 cm, 10-30 cm, 30-100 cm and over 100 cm.

The required photographs and monitoring data has been collected at three monthly intervals with this report describing changes noted in the latest round of monitoring (August 2011).

4 Results

4.1 Key Findings

Initial exploratory data analysis has been undertaken summarising two of the variables that are being assessed as part of this experiment. These two variables were chosen as they are considered likely to have a strong correlation with suitability of habitat for GSM.

Initial data analysis comparing the cover abundance (Table 2) of native graminoids (including native grasses, sedges and rushes) within each quadrat (see Table 3) and the overall cover abundance of all introduced species (see Table 4) has identified the following trends within the experiment to date:

- Throughout the experiment the Control plot has generally had the greatest cover abundance of native species when compared to the disturbed control quadrats and the set down / lay down quadrats;
- Cover abundance of native graminoids has fluctuated across the survey period, but figures have not changed substantially since the beginning of the experiment, with the exception of the control plots, which have increased in the abundance of native graminoids;
- The lay down areas appear to have a higher mean cover abundance of native graminoids than the set down areas;
- All of the treatments (both lay down and set down areas) tend to have a higher cover abundance of introduced species now compared to the start of the experiment;
- The cover abundance of introduced species is slightly higher in the set down areas when compared to the lay down areas but this is unlikely to be significant; and
- The cover abundance of introduced species has fluctuated over time but is higher than the cover of native species across all sites and treatments.

Table 2 Modified Braun-Blanquet scale used to assess cover abundance during the experiment

+	1	2	3	4	5	6
<1%	<5%	5<15%	15<25%	25-50%	50-75%	75-100%

Table 3 **Mean Braun-Blanquet cover abundance of native graminoid species across each experimental plot over ten survey periods**

	Disturbed Control - seeded	Disturbed Control – not seeded	C	L1	L2	L3	L4	S1	S2	S3	S4
May-09	-	-	1.0	2.0	2.0	1.0	3.0	1.0	1.0	2.0	1.0
Jun-09	0.7	0.7	-	0.8	0.9	1.0	0.9	-	-	-	-
Jul-09	2.5	0.8	-	1.2	1.0	1.2	1.1	-	-	-	-
Oct-09	0.5	0.5	0.9	0.9	0.5	0.6	1.0	0.3	0.3	0.7	0.6
Feb-10	0.6	0.3	2.3	1.4	1.8	1.3	1.4	1.0	0.9	0.7	0.8
Apr-10	0.5	0.2	3.4	0.9	2.5	2.0	2.1	1.3	0.6	1.4	1.4
Jul-10	0.6	1.0	3.3	1.8	2.5	1.5	2.8	0.8	0.8	0.8	1.8
Oct-10	0.7	0.8	3.0	1.0	1.6	1.1	1.5	0.5	0.6	0.5	0.9
Jan -11	1.9	0.8	3.3	1.6	2.3	2.0	2.0	1.2	0.9	1.0	1.2
April-11[2]	0.5	0.8	2.5	2.5	2.5	1.4	2.8	0.8	0.9	1.0	1.4
August-11	0.5	0.6	3.8	2.2	2.6	1.3	2.4	0.9	0.7	1.0	1.1

Table 4 **Mean Braun-Blanquet cover abundance of introduced species (all life forms) across each experimental plot over ten survey periods**

	Disturbed Control - seeded	Disturbed Control – not seeded	C	L1	L2	L3	L4	S1	S2	S3	S4
May-09	-	-	5.2	5.3	4.7	5.0	4.8	5.0	5.0	4.8	5.0
Jun-09	6.0	4.7	-	5.3	5.5	5.2	5.0	-	-	-	-
Jul-09	6.0	5.7	-	4.8	5.0	5.0	5.0	-	-	-	-
Oct-09	2.3	2.5	5.8	4.8	4.8	5.2	4.0	4.8	5.3	5.2	5.0
Feb-10	3.8	5.5	4.8	4.8	4.5	4.3	4.2	4.5	5.3	4.5	4.8
Apr-10	4.0	4.0	3.6	3.7	2.8	4.6	3.8	5.6	5.6	5.5	5.2
Jul-10	4.8	4.0	3.8	5.7	4.7	5.3	5.2	5.8	6.0	6.0	5.8
Oct-10	5.7	5.7	4.3	5.8	6.0	5.8	5.7	6.0	6.0	6.0	6.0
Jan -11	5.8	5.4	4.0	5.8	5.8	5.3	5.5	6.0	6.0	6.0	6.0
April-11[3]	6.0	5.8	5.0	6.0	5.5	6.0	5.3	6.0	6.0	6.0	6.0
August-11	6.0	6.0	4.5	5.7	5.8	5.7	5.5	6.0	6.0	6.0	6.0

[2] During the April 2011 surveys, properties 327 and 328 were not accessed due to landholder issues. This has influenced the reliability of the results for this monitoring period, as only four of the six sites were monitored.

[3] During the April 2011 surveys, properties 327 and 328 were not accessed due to landholder issues

5 Discussion

At this stage results are preliminary and may change following detailed analysis to be conducted once the experiment concludes. At this stage no transformation has been made to standardise the Braun-Blanquet cover abundance scale, nor test for significance of results, nor to report the variation of the values in Tables 3 and 4. However, some preliminary observations can be made about the experiment.

Within the control quadrats the cover abundance of both native graminoids and introduced species has fluctuated over time, with cover of both being generally high for the most recent surveys. This may be due to higher rainfall in the past year, or improved colonisation from neighbouring areas.

Similar trends are seen in the laydown and set down treatment plots, but with generally higher native tussock cover in the laydown plots. This suggests that habitat value for GSM has decreased within the disturbed areas and that the laydown treatment may provide intermediate GSM habitat when compared with controls and set down slabbed areas. It is thought the lower native tussock cover in set down plots compared to laydown plots can been attributed to the physical disturbance each set down plot slab experienced as a result of being picked up (Plate 1). However edge effects may also play some part, as a perfectly randomised control was not possible all of the laydowns and controls were laid out along the western edge (furthest from the pipeline) of each site, whilst all of the set down plots were laid along the eastern edge of the sites (closest to the pipeline). As the pipeline was reseeded predominantly with non-native vegetation, it is possible this may have caused an edge effect (an increase in non-native grasses) in the set down areas.

Alterations to the grazing practices within the study area could have impacted the results of the experiment and the suitability of the study area as GSM habitat. At present all grazing has been excluded from the experimental study area (although evidence of livestock has been detected in plots on 335 North, which appears to have resulted in a lower density of vegetation). The lack of grazing could be contributing to the increased cover abundance of introduced species within the quadrats, and therefore the decrease in suitability for GSM.

6 Next Steps

6.1 Future Monitoring works

All monitoring as part of the Habitat Slab Replacement Experiment has now finished. A final report with a full scientific analysis of the findings, and detailed discussion of the results in relation to the learning outcomes of the experiment is to be submitted to the Sugarloaf Pipeline Alliance by January 2012.

References

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Appendix A

Example data sheet for Habitat slab Grassland experiment: Flora Monitoring

31 21633 13: Golden Sun Moth Habitat Slab Replacement Floristic Survey

Property #		Date		Observers		
Easting			Photo no.'s		Quadrat dimensions	
Northing			Control site	Y / N	Overall cover abundance of vegetation	
Time started			Time completed		Site no. / ID	

1. Species abundance and Overall composition

+	1	2	3	4	5	6
<1%	<5%	5<15%	15<25%	25-50%	50-75%	75-100%

Native species (tick if present)	√ ?	Cover
Austrodanthonia caespitosa		
Austrodanthonia duttoniana		
Austrodanthonia setacea		
Austrodanthonia sp.		
Austrostipa rudis subsp. *rudis*		
Austrostipa sp.		
Carex inversa		
Cassinia sp.		
Dichondra repens		
Elymus scaber var. *scaber*		
Epilobium hirsutum		
Eucalyptus camaldulensis		
Euchiton sp.		
Juncus amabilis		
Juncus bufonius		
Juncus pallidus		
Juncus flavidus		
Juncus sp.		
Hypericum gramineum		
Lomandra filiformis		
Lythrum hyssopifolia		
Microlaena stipoides var. *stipoides*		
Oxalis perennans		
Pseudognaphalium luteoalbum		
Rumex brownii		
Senecio quadrifida		
Themeda triandra		
Unknown Native Poaceae		

Introduced species (tick if present)	√ ?	Cover
Acetosella vulgaris		
Agrostis sp.		
Anthoxanthum odoratum		
Arctotheca calendula		
Bromus diandrus		
Bromus hordeaceus subsp. *hordeaceus*		
Chenopodium pumilio		
Cirsium vulgare		
Conyza bonariensis		
Conyza sp.		
Cynodon dactylon var. *dactylon*		
Dactylis glomerata		
Festuca arundinacea		
Holcus lanatus		
Hordeum sp.		
Hypochoeris radicata		
Lactuca serriola		
Lepidium africanum		
Lolium sp.		
Lotus sp.		
Paspalum dilatatum		
Paspalum sp.		
Phalaris aquatica		
Phalaris minor		
Plantago lanceolata		
Plantago sp.		
Poa sp.		
Polygonum aviculare		
Romulea rosea		
Rubus fruticosus spp. *agg*		
Rumex sp.		
Setaria parviflora		
Sonchus sp.		
Trifolium sp.		
Vulpia sp.		
Unknown Introduced Poaceae		

Native graminoids % cover (inc.Juncus, Lomandra, Dianella etc)		Introduced graminoids % cover (inc.Cynodon)	
Native forbs % cover		Introduced forbs % cover	
Bryophytes/Lichens % cover		Bare ground % cover	
Litter % cover		Overall % cover of introduced species	

2. Vertical Structure

	0-10cm	10-30cm	30-100cm	>100cm
Native grasses (Poaceae)				
Introduced grasses				
Native sedge or rush (eg. *Lomandra, Juncus*)				
Introduced sedge or rush				
Native forbs				
Introduced forbs (inc. *R.rosa*)				

3. Inter tussock distance (irrespective of whether tussock native or introduced, alive or dead) for 10 random points within treatment/control area. Note: SM = Soil Moisture

* Distance (cm) to edge of closest tussock (inc. Juncus) **with diameter of 3 cm** (if Cynodon, distance to closest point where plant is completely attached to the ground, not just a rooting point along a rhizome).

1	Species	Distance*	SM %	SM mv
1				
2				
3				
4				

2	Species	Distance*	SM %	SM mv
1				
2				
3				
4				

3	Species	Distance*	SM %	SM mv
1				
2				
3				
4				

4	Species	Distance*	SM %	SM mv
1				
2				
3				
4				

5	Species	Distance*	SM %	SM mv
1				
2				
3				
4				

6	Species	Distance*	SM %	SM mv
1				
2				
3				
4				

7	Species	Distance*	SM %	SM mv
1				
2				
3				
4				

8	Species	Distance*	SM %	SM mv
1				
2				
3				
4				

9	Species	Distance*	SM %	SM mv
1				
2				
3				
4				

10	Species	Distance*	SM %	SM mv
1				
2				
3				
4				