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Melbourne Water

Report for Golden Sun Moth Monitoring 2011-2012 Flight Season

Adult surveys on Sheoak Property

April 2012

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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Abbreviations

Term	Description
CMP	Conservation Management Plan
DEHWA	Department of Environment, Heritage, Water and the Arts (now DSEWPaC)
DSEWPaC	Commonwealth Department of the Environment, Water, Heritage and the Arts (previously DEWHA)
DSE	Victorian Department of Sustainability and Environment
EMP	Environmental Management Plan
EPBC	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
FFG	Victorian Flora and Fauna Guarantee Act 1988
GHD	GHD Pty Ltd
GSM	Golden Sun Moth
HLPS	High Lift Pump Station
SLPA	Sugarloaf Pipeline Alliance (the 'Alliance')

Executive Summary

As part of the offset package for the Golden Sun Moth (GSM), the Sugarloaf Pipeline Alliance purchased and committed to the management of the Sheoak property in Yea, Victoria. This commitment included the development of a Conservation Management Plan (CMP) for the property to manage its threatened flora and fauna species in the 10 years after construction of the pipeline.

Within the Sheoak property, grassland habitats dominated by indigenous grass species are the most extensive habitat type. These habitats are known to support the GSM which is listed as threatened species on the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* and Victorian *Flora and Fauna Guarantee (FFG) Act 1988*.

In accordance with the project's approved mitigation measures, a rigorous monitoring program was implemented for GSM across the Sheoak property for the two years post-construction (2009/2010 and 2010/2011). Monitoring for the GSM was scheduled to be undertaken for at least five years (following construction) within the Sheoak property and was proposed to be undertaken in line with the Conservation Management Plan (CMP). Monitoring was to include the Grassland Experiment that was established on the Sheoak property also as part of the offset package for the project.

In accordance with the approval conditions, adult GSM surveys were undertaken across the broader Sheoak property and the grassland reinstatement experiments for the 2011/12 GSM flight season. The survey method and effort employed was compliant with the approved mitigation plan for the species. This document summarises the methods and results of the grassland reinstatement experiment and broader Sheoak property adult GSM monitoring for the 2011/2012 flight season.

The monitoring was considered an effective mitigation measure as it was able to determine that the population of GSM across the Sheoak property persisting. Seventy-one GSM were observed on broader Sheoak, and eight GSM were observed at the grassland habitat reinstatement site during the 2011/12 flight season.

As the numbers of GSM were depleted all across the state, it is not possible to conclusively comment on the lower numbers of GSM seen during the flight season. The continued monitoring of GSM on the Sheoak property as part of Melbourne Water's CMP will assist in the collection of data to improve the knowledge of the population.

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 species of grasses, but they have also occasionally been found within areas dominated by non-native species of grasses. The species is listed as 'critically endangered' on the Commonwealth *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999,* 'threatened' on 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).

Within the Sheoak property in Yea, Victoria, grassland habitats dominated by indigenous grass species are the most extensive habitat type. These habitats are known to support the Golden Sun Moth (GSM). The Department of Sustainability, Environment, Water, Populations and Community (DSEWPaC) species profile (DEWHA, 2009) provides a relatively comprehensive account of GSM life history and biology. For most of the GSM life-cycle, the species is present only as larvae, which remain in the soil below the ground surface and are thought to feed on the roots of grasses. It is not known how long individual GSM remain as larvae, but it is suspected to be greater than one year and possibly three years or more. Larvae eventually pupate into non-feeding adults, which emerge for reproductive activities. On an annual basis, adult GSM emerge between the months of late October through to early January (sometimes late January), although each individual adult moth is thought to typically live for only five days or less after emerging. GSM emergence is weather dependent, with moths generally emerging during hot dry periods.

As part of the offset package for the Sugarloaf Pipeline Project, the Sugarloaf Pipeline Alliance (the Alliance) purchased and committed to the management of the Sheoak property. This commitment included the development of a Conservation Management Plan (CMP) for the property to manage its threatened flora and fauna species in the 10 years after construction of the pipeline. In accordance with the project's approved mitigation measures, a rigorous monitoring program was implemented for GSM across the Sheoak property for the two years post-construction (2009/2010 and 2010/2011). Monitoring for the GSM is scheduled to be undertaken for at least five years following construction (finishing over the 2013/2014 flight season) within the Sheoak property and was proposed to be undertaken in line with the Conservation Management Plan (CMP). Monitoring was to include the Grassland Experiment that was established on the Sheoak property also as part of the offset package for the project.

In accordance with the approval conditions, adult GSM surveys were undertaken across the broader Sheoak property and the grassland reinstatement experiments for the 2011/12 GSM flight season. The survey method and effort employed was compliant with the approved mitigation plan for the species. This document summarises the methods and results of the grassland reinstatement experiment and broader Sheoak property adult GSM monitoring for the 2011/2012 flight season.

2. Methods

2.1 Overview of approach

The methods employed for GSM surveys were consistent with DSEWPaC guidelines for the minimum acceptable standards for persons or organisations undertaking GSM surveys (DEWHA, 2009), which include:

- **Aim:** to detect flying males, but also to detect laying females/eggs and/or pupal cases to confirm that reproduction is taking place on the site;
- **Timing:** during the local flying season (late October to early January), however as the timing of the flight season varies annually and geographically, the best indicator of key survey period is the presence of flying males at known local sites. Reference sites should be monitored during the expected flying period and used to guide survey timing at the target site;
- **Effort:** over at least four suitable days, at approximately weekly intervals. Once presence is established, surveys should focus on determining the relative distribution of the species on the site; and
- **Conditions:**
  - Warm to hot day (above 20 degrees Celsius by 1000 hours);
  - Warmest past of the day (1000 to 1400 hrs);
  - Clear or mostly cloudless sky;
  - Still or relatively still wind conditions during the survey period; and
  - At least two days since rain.

The aim, timing, effort and conditions during all surveys throughout the 2011/12 flying season were consistent with the DSEWPC guidelines. Details of each survey effort are presented in Sections 2.2 and 2.3.

With respect to reference sites for the 2011/2012 GSM flight season:

- Reliable locations for detecting GSM within the Sheoak property were used as the primary reference sites to guide survey timing for monitoring;
- On occasions, historically known GSM populations in the local area were also used as reference sites, including roadside locations alongside Careys Rd (off Killingworth Rd, to the north-east of central Yea);
- Regular email contact was maintained with other ecologists across the state regarding observations of GSM in flight elsewhere; and
- Email contact was also maintained with the DSE officer assigned to address GSM issues in the Goulburn region (Lance Williams, DSE, Benalla office).

2.2 Grassland habitat reinstatement experiment

The grassland habitat reinstatement experiment is being conducted on the Sheoak property, on a sloped section of the ROW which contains the buried pipe leading out from the high-lift pump station southwards to the Sugarloaf Reservoir. The purpose of the experiment is to investigate the effectiveness of different techniques for restoring grassland habitat after it has been removed by construction activities.

A number of variables are being monitored as part of this experiment, including floristic assessment of habitat recovery and the use of these areas by GSM. A total of forty experimental plots and twenty control plots were established prior to the 2009/2010 flight season. Each plot covers 3 m x 3 m (9 m2). Each plot has been assigned one of four experimental treatment types or one of two types of controls. A detailed background of the grassland habitat reinstatement experiment is available in the Sugarloaf Pipeline Alliance (SLPA) Post Construction Golden Sun Moth Monitoring Results (2011).

During the 2011/12 GSM flight season, surveys were undertaken at the 60 plots on five occasions, with visits spaced throughout the flying season. Visits used a repeatable method including:

- All 60 plots were surveyed for adult GSM on a single day;
- Surveys were conducted during the suitable time of year only (late October to early January), and when the weather conditions and time-of-day meet the DSEWPaC criteria (Section 2.1);
- Within each plot, one ecologist trained in the identification of adult GSM undertook the searches for adult GSM. The ecologist was positioned approximately 2 m from the edge of the plot. For a set period of 5 minutes, the ecologist recorded:
  - Numbers of flying moths that landed within the plot;
  - Numbers of moths that flew out of the plot; and
  - Numbers of moths that flew over the plot.

Then, for an additional set period of two minutes, the ecologist walked around the plot focussing on the ground from the edge of the plot, recording numbers of male and/or female moths observed on the ground or on vegetation within the plot.

As far as possible, care was taken not to record the same individual more than once. Opportunistic observations of GSM within or near a plot outside of the designated survey period were also recorded.

The order in which plots was visited on each occasion was changed to reduce the likelihood of bias.

The date and condition of each survey for the grassland habitat restoration experimental area is in Table 1 below.

Table 1 Survey dates and conditions for Grassland Habitat Restoration experiment

Round #	Date	Pax	Start time	End time	Temp (C°) S: start F: finish	Cloud (%)	Wind speed	Rainfall last 72 hours (mm)
1	6 December 2011	2	1015	1425	S:18.5 F: 23.2	0-20	Mild	0
2	16 December 2011	2	1002	1346	S: 22 F: 26.7	15-25	Still - Mild	0.2
3	22 December 2011	3	1102	1334	S: 25 F: 28.7	0-60	Still - moderate	0.4
4	17 January 2012	2	1010	1355	S: 25.8 F: 29.1	10-50	Mild - moderate	0
5	24 January 2012	2	1009	1400	S: 23.7 F: 32.1	0-5	Mild	0

2.3 Broader Sheoak

The Sheoak property covers an area of >200 ha. Melbourne Water currently leases the property (called 'broader Sheoak' herein for consistency with previous SLPA reports on the site) for cattle and sheep grazing.

GSM monitoring was undertaken across the broader Sheoak property to document the distribution and abundance of GSM. Transect surveys were undertaken using standard transect technique (STT), as per DSEWPaC (2011) recommended survey methods to enable coverage of the > 200 ha Sheoak property. The DSEWPaC guidelines for GSM monitoring (DEWHA 2009) acknowledge that, when GSM monitoring surveys using the STT are undertaken across large areas, it is not feasible for ecologists to cover all parts of the property. Instead, it is suggested that transects be spaced up to 200 m apart, and abundance estimates for the site then extrapolated from the data. Ecologists from GHD Pty Ltd (GHD) adopted this approach for the broader Sheoak property. In some instances, the layout of transects was modified to fit with the location of fences across the property. Transects covering the entire property were undertaken on four occasions (rounds), with each round taking multiple days to complete, and separated by at least one week.

Surveys were conducted at the appropriate time of year and in appropriate conditions (Section 2.1, Table 2). For each transect two GHD Ecologists recorded details such as time, weather conditions, location (GPS coordinates), direction of transect, searchers and moth observations.

GHD ecologists walked parallel to each other at a distance of 5m, thereby each maintaining a 2.5 m standard transect width. Each ecologist counted all GSM seen on either side, taking care not to recount individuals. Males were recorded separately from females, or from moths on the ground.

After every 100 m, the GHD ecologists stopped to document the number of moths, the time and the grid reference, and then continued on recording afresh for the next 100 m, and so on until the end of the transect. This method enabled accurate mapping of GSM sightings.

Approximately 76 km of transects were undertaken across the broader Sheoak property over the course of the four rounds of survey for the 2011/12 flying season. This effort equated to 24 person-days of survey, with one person-day representing activity during active survey time i.e. approximately 1000 to 1400 hrs.

Each of the four rounds took two teams of two ecologists a total of two days to complete, except round one, which took three days to complete due to unfavourable weather conditions. Dates and conditions of surveys are provided in Table 2 below.

Table 2 Survey dates and conditions for adult GSM monitoring on broader Sheoak

Round #	Date	Teams (of 2 people)	Start time	End time	Temp (C°) S: start F: finish	Cloud (%)	Wind speed	Rainfall last 72 hours (mm)
1	15 November 2011	1	0958	1351	S: 19.6 F: 24.9	0	Still - mild	1.4
	28 November 2011	1	1050	1408	S: 23.5 F: 26.6	30-100	Still - moderate	36.4
	29 November 2011	1	1040	1435	S: 29.1 F: 33.3	60-100	Moderate - gusty	36.4
2	5 December 2011	2	1028	1416	S: 17.1 F: 21.1	0-20	Mild	0
	6 December 2011	1	1030	1402	S: 17.0 F: 23.1	0-5	Still-mild	0
3	15 December 2011	2	0958	1402	S: 13.1 F: 25.2	5-40	Still - mild	0.2
	16 December 2011	1	1015	1350	S: 16.6 F: 27.5	8	Still	0.2
4	16 January 2012	2	1015	1400	S: 24 F: 29.2	5-10	Moderate	0.2
	17 January 2012	1	1010	1401	S: 27 F: 28	10-35	Mild - moderate	0

NB: temperatures taken using a handheld thermometer, or using BOM database (http://www.bom.gov.au/climate/dwo/IDCJDW3016.latest.shtml). Where records were not available on site, BOM data (9am and 3pm) was assumed as approximate temperatures for start and finish times.

3. Results

3.1 Grassland habitat reinstatement experiment

A total of eight GSM were detected during the 2011/12 flight season for the grassland habitat reinstatement experiment, including four incidental detections. Three GSM were observed flying over a plot being surveyed, one GSM was observed landing in a plot being surveyed, and four GSM were recorded as incidental detections at the time of survey.

Three of the four plots in which GSM were detected flying over or landing within, were control plots (i.e. plots that had received no treatment following construction). The remaining detection of a GSM flying over a plot, was made in plot 41 which had been treated 'topsoil replacement with seeding' following construction[1].

Two incidental detections of GSM were made in the vicinity of control plots, with another single detection made in between two treated plots. The remaining GSM observation was made on the broader Sheoak property following surveys at the grassland reinstatement site.

[1] HLPA 2011, describes allocation and treatment in further detail.

Table 3 Results of Grassland Habitat Restoration experiment adult GSM surveys, 2011/12

Round	Date	No. of GSM detected						
		No. flying **over** plot	No. flying **out** of plot	No. **landing within** plot	No. **males** observed **on ground**/veg within plot	No. **females** observed **on ground**/veg within plot	Other	**Total**
1	6 December 2011	0	0	0	0	0	1 incidental GSM (at 1443)	**0 (plus 1 incidental GSM)**
2	16 December 2011	1 (plot 41) 2 (plot 51)	0	1 (plot 56)	0	0	1 incidental GSM b/w plots 44 and 47; 1 incidental north of plot 52; 1 incidental GSM east of plot 53.	**4 (plus 3 incidental GSM)**
3	22 December 2011	0	0	0	0	0	-	**0**
4	17 January 2012	0	0	0	0	0	-	**0**
5	24 January 2012	0	0	0	0	0	-	**0**
Total		**3**	**0**	**1**	**0**	**0**	**4 incidental GSM observations**	**8 GSM observations**

NB: discerning between male and female GSM in flight is problematic hence the results above for flying individuals are not separated into sex.

3.2 Broader Sheoak

A total of 71 male GSM were detected across broader Sheoak during four rounds of surveys (over nine days) during the 2011/12 flight season (Table 4). No female GSM were detected. Weather conditions and survey effort are provided in Table 2, and complement the results data presented in Table 4.

The majority of GSM detections (>85%) were recorded in grassland habitat south of the creekline vegetation, near the centre of the southern portion of the property (Figures 1-4). These detections were made in a relatively small area approximately 300 m x 500 m. This activity is spatially consistent with previous years' observations of GSM on the site, and this area was used as a reference site for the 2011-12 flight season. A small number (<15%) of GSM were recorded in the grassland habitat in the northern areas of the property. The locations of GSM detected during broader Sheoak surveys throughout the 2011-12 flight season are shown in Figures 1-4.

Table 4 Results of broader Sheoak adult GSM surveys, 2011/12

Round	Date	No. of GSM detected	No of GSM detected per round
1	15 November 2011	0	38 males
	28 November 2011	28 males	
	29 November 2011	10 males	
2	5 December 2011	31 males	31 males
	6 December 2011	0	
3	15 December 2011	0	2 males
	16 December 2011	2 males	
4	16 January 2012	0	0
	17 January 2012	0	
Total		**71 males, 0 females**	

360500 361000 361500 362000 362500

5878500 5878000 5877500 5877000 5876500

962 22 23 24.2 24.1 24 25 26 28 28.1 324 326 327 328

GSM Not Detected

GSM Detected (count males only)

Paper Size A3

0 37.5 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Melbourne Water Corporation
Sheoak Conservation Management Plan

Adult GSM surveys across the broader Sheoak property - 15 to 29 November 2011

Job Number 31-28397
Revision A
Date 16 Mar 2012

Figure 1

G:\31\21633\CADD\GIS\Projects\ArcMap\Ecology\GoldenSunMoth_Transects_Sheoak2_20111213_Rnd_7_GHDtemplate.mxd

Hazelwood Drive (cnr Lignite Court) Morwell VIC 3840 Australia T 61 3 5136 5800 F 61 3 5136 5888 E mwlmail@ghd.com W www.ghd.com

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Data source: GHD, Melbourne Water Created by:cillingworth

360500 361000 361500 362000 362500

5878500 5878000 5877500 5877000 5876500

962 22 23 24.2 24.1 24 25 26 28 28.1 324 326 327 328

- GSM Not Detected
- GSM Detected (count males only)

Paper Size A3

0 50 100 200 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Adult GSM surveys across the broader Sheoak property - 5 to 6 December 2011

Job Number 31-28397
Revision A
Date 16 Mar 2012

Figure 2

G:\31\21633\CADD\GIS\Projects\ArcMap\Ecology\GoldenSunMoth_Transects_Sheoak2_20111213_Rnd_8_GHDtemplate.mxd

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360500 361000 361500 362000 362500

5878500 5878000 5877500 5877000 5876500

962 22 23 24 24.2 24.1 25 26 28 28.1 324 326 327 328

GSM Not Detected

GSM Detected (count males only)

Paper Size A3

0 50 100 200 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Adult GSM surveys across the broader Sheoak property - 15 to 16 December 2011

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Revision A
Date 16 Mar 2012

Figure 3

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G:\31\21633\CADD\GIS\Projects\ArcMap\Ecology\GoldenSunMoth_Transects_Sheoak2_20111213_Rnd_9_GHDtemplate.mxd

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360500 361000 361500 362000 362500

5878500 5878000 5877500 5877000 5876500

962 22 23 24 24.2 24.1 25 26 28 28.1 324 326 327 328

GSM Not Detected

GSM Detected

1:7,500 Paper Size A3

0 50 100 200 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Adult GSM surveys across the broader Sheoak property - 16 to 17 Januaray 2012

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Revision A
Date 16 Mar 2012

Figure 4

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4. Discussion

The monitoring was considered an effective mitigation measure as it was able to determine that the population of GSM across the Sheoak property persisting. Seventy-one GSM were observed on broader Sheoak, and eight GSM were observed at the grassland habitat reinstatement site during the 2011/12 flight season.

Over 97% of GSM detections across broader Sheoak were made over three site visits (and two rounds) which fell within the course of a one week period (28 November to 5 December 2011). This period appears to have been the peak active period for GSM across the Sheoak property, with the only other records comprising two detections made on 16 December. This period correlates with unpublished information provided by ecological consultants and other GSM specialists from across Victoria, who also recorded GSM in a number of locations between 5-8 December 2011. The peak period for GSM activity at the grassland experiment plots appears to have been around 16 December, with seven of the eight detections coming from this single day. These dates exhibited warmer weather following cool and wet periods[2], and may have represented suitable emergence conditions for GSM.

The number of GSM detected on Broader Sheoak in the 2011-12 flight season (71) is significantly lower than the number of detections made in previous years surveys i.e. 251 GSM in 2010-11, and 1879 GSM in 2009-10. While these results suggest that the population on broader Sheoak is in decline, given the contrasting weather conditions between the 2009/10 and the 2011/12 flight seasons, it is problematic to draw conclusions regarding the population at Sheoak, particularly considering that the species appears to be highly weather-dependant for emergence and activity.

Further information provided by consultants and GSM specialists confirms that GSM did not emerge in reasonable numbers across the majority of its Victorian distribution until late November / early December 2011 and that they continued to be seen in flight until late January, in southern Victoria. This activity is outside the prescribed survey period (DEWHA 2009), and highlights the variability in activity of the species. Detections of GSM from across the state were commonly made in small numbers (i.e. less than 10 individuals per sighting), which suggests a low-level of activity for the species across their Victorian range. These observations are consistent with GSM activity detected on the Sheoak property during the 2011/12 flight season.

As the numbers of GSM were depleted all across the state, it is not possible to conclusively comment on the lower numbers of GSM seen during the flight season. The continued monitoring of GSM on the Sheoak property as part of Melbourne Water's CMP will assist in the collection of data to improve the knowledge of the population.

[2] Bureau of Meterology, Coldstream Victoria, Daily Weather Observations, December 2011 http://www.bom.gov.au/climate/dwo/201112/html/IDCJDW3016.201112.shtml Accessed: 9 March 2012.

5. References

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