Post Construction Golden Sun Moth Monitoring Results

2009 – 2010 Flight Season

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Document History and Status

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Purpose

The purpose of this document is to:

- Describe the post construction monitoring results of the Golden Sun Moth (*Synemon plana*) (GSM) from the 2009/2010 flight season for the Sugarloaf Pipeline Project.

The purpose of the GSM post construction monitoring is to:

- Evaluate the impact of the project on the GSM population/s,
- Document the recovery of the GSM population/s (i.e., habitat use and breeding by adults) within impacted areas following completion of construction, and
- Provide information on the distribution and abundance of GSM populations within the Project area.

Abbreviations

Term	Description
Alliance	Sugarloaf Pipeline Alliance
CMP	Conservation Management Plan
DEWHA	Commonwealth Department of the Environment, Water, Heritage and the Arts (now DSEWPaC: Department of Sustainability, Environment, Water, Populations and Communties)
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 (*Synemon plana*)
HLPS	High-lift Pump Station
FMP	Fauna Management Program
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 2009a, 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).

For most of the Golden Sun Moth's life-cycle, the species is present only as larvae, which remain in the soil below the ground surface. They 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 up to 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, although each individual adult moth is thought to typically live for only 5 days or less after emerging.

In late 2008, targeted surveys undertaken by the Sugarloaf Alliance (the 'Alliance') identified the presence of flying adult GSM at a number of locations along the proposed alignment 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 that contains the Sheoak High Lift Pump Station (HLPS)[1]. Subsequent targeted searches for the presence of empty GSM pupa cases (left at the ground surface by the adult moths as they emerge), were undertaken in January 2009 at locations where adults had previously been seen in flight, and confirmed the presence of breeding activity by the species within the project alignment.

Prior to the targeted GSM surveys, all areas of grassland habitat along the proposed pipeline alignment north of Devlin Bridge were categorised as **possible** or **unlikely** GSM habitat. Properties along the proposed pipeline alignment where GSM were subsequently detected during the targeted surveys were re-categorised as **known** GSM habitat. All other areas of grassland habitat along the alignment north of Devlin Bridge where GSM were not detected remained as, or were re-categorised as, **unlikely** GSM habitat.

The Fauna Management Programs for the Sheoak High-lift Pump Station (HLPS) EMP section (SLPA 2009a) and for the Yea-to-Devlin Bridge EMP section (SPA 2009b) both specify that the Alliance will undertake post-construction monitoring for the GSM. Four types of monitoring were undertaken in **known** GSM habitats within these EMP sections for both adults and pupa cases. These are summarised in Table 1 below:

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

Table 1: Monitoring requirements and corresponding EMP sections

Monitoring for GSM Adults and Pupa Cases	**Sheoak HLPS EMP section**	**Yea-to-Devlin EMP section**
Monitoring of Habitat Slab Experiment	Yes – 2 slab locations for 2 years As described in the Sheoak HLPS FMP (SPA 2009a)	Yes – 4 slab locations (one on each of property 327 and 328, plus two on property 335) for 2 years As described in Appendix D of the Yea-to-Devlin Bridge (SPA 2009b).
Monitoring of Grassland Reinstatement Experiment	Yes – one location for 2 years As described in the Sheoak HLPS FMP (SPA 2009a)	Not applicable
Monitoring of ROW and adjacent undisturbed land	Yes – in Type 2 and 3 disturbance areas within properties 324-326 for 2 years. As described in the Sheoak HLPS FMP (SPA 2009a)	Yes – on properties 18/961, 327, 328, 330, 335 for 2 years. As described in Appendix D of the Yea-to-Devlin Bridge (SPA 2009b).
Monitoring of broader Sheoak Property	Yes – across all parts of property not disturbed during construction for 5 years As described in the Sheoak HLPS FMP (SPA 2009a)	Not Applicable

This document summaries the methods and results of the first season of post-construction monitoring for the GSM, during the 2009/2010 flight season of the GSM.

2 GSM Monitoring Approach and Techniques

2.1 Overview of Approach

The following monitoring was undertaken for GSM adults and pupa cases during the first post-construction flight season:

- Monitoring of GSM and the recovery of GSM habitat values as part of Habitat Slab Replacement Experiment,
- Monitoring of GSM and the recovery of GSM habitat values as part of Grassland Reinstatement Experiment,
- Monitoring GSM adults and pupa cases in all other[2] **known** GSM grassland habitats intercepted by the Construction Area, and
- Monitoring GSM adults and pupa cases across the broader Sheoak Property.

The monitoring program and methods for the project were developed as a stand-alone document prior to the commencement of the 2009/10 flight season (SLPA 2009b). The methods were consistent with the recently released national guidelines for the minimum acceptable standards for persons or organisations undertaking GSM surveys (DEWHA 2009a). The following important aspects of the national guidelines were incorporated into the Alliance's GSM monitoring methods:

- The main technique for monitoring GSM populations should be the detection of flying adult males. Where possible, the more difficult and time consuming processes of detecting adult females (laying eggs or not), empty pupa cases or living subsurface larvae should be used also to confirm that reproduction is occurring at a site.
- Sites where moths are detected reliably should be visited repeatedly as reference sites to guide survey timing at target sites. For the Sugarloaf Project, the Sheoak property (outside the construction footprint) was used for this purpose to guide survey timing for all of the control and treatment sites (i.e. habitat slabs areas).
- For reliable results, surveys for flying adult moths should be undertaken:
  - On warm to hot days (where the temperature is at or above 20°C by 1000 hrs) between late October and early January;
  - During the warmest part the day (i.e. 1000 hrs – 1400 hrs);
  - At times when the sky is clear or mostly cloudless;
  - When wind conditions are relatively still; and
  - No sooner than two days after substantial rainfall.

In addition to the monitoring of GSM adults, pupa cases and/or larvae, Alliance Ecologist(s) conducted monitoring of floristic characteristics of the grassland habitat in **known** GSM habitat areas as part of the experiments. This is described in detail in the relevant FMP documents (SLPA 2009a and SLPA 2009b), but not in this document. The results of the floristic monitoring that have been undertaken since the completion of construction in GSM habitat are not presented within this document. The results of the floristic analysis may add to existing knowledge in regard to GSM habitat requirements.

[2] That is, areas not being used for the experiments.

2.2 Adaptive management

An adaptive management system is identified as one that "*can absorb and accommodate future events in whatever unexpected form they may take"* (Holling 1973 in Lindenmayer and Burgman, 2005). During the implementation of the Sugarloaf Pipeline Project, Adaptive Management has been used as a measure to manage the project's impact on the environment when an unanticipated issue has arisen (SLPA, 2008b).

The monitoring program for GSM (SLPA, 2009a, 2009b, 2009c) was developed on the basis of the current understanding of the species' biology and seasonal periods of activity in addition to a suite of survey techniques that have proven to be repeatedly successful in the detection of the species. However, for a range of reasons, the methods described may need to be modified or replaced by the Alliance Ecologists due to unforeseen circumstances (e.g. weather). In the event of such as scenario and the Alliance Ecologists confirm that the measures need to be altered, the relevant regulatory authorities will be notified and any adaptive management measures discussed and implemented if necessary. The Alliance Ecologists would have sought their advice and approval prior to implementing the adaptive management measures.

There were no changes to the implementation of the GSM monitoring program that required any adaptive management during the 2009/2010 flight season.

3 Habitat Slab Experiment

3.1 Background

The Habitat Slab Replacement experiment is being undertaken at six locations along the ROW, all of which contain **known** GSM grassland habitat. Two locations occur on the Sheoak property, two occur on property #335, and one occurs on each of properties #327 and #328. At each location, there are ten delineated rectangular plots (each within an area of 8-9 m x 10 m; 80-90 m^2), which comprise:

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

Monitoring for pupa cases and adult moths was undertaken within each of the 60 plots (6 locations x 10 plots) during the 2009/2010 flight seasons.

The aims of the GSM monitoring undertaken as part of the habitat slab replacement experiment are to determine whether GSM larvae are able to survive the slabbing process, and whether 'slabbing' improves habitat reinstatement for the GSM compared to the project's standard reinstatement method. The aim of the experiment is not to determine whether there has been a decline in the overall GSM population due to construction activities but merely to determine whether they are able to survive this particular reinstatement technique; however some information on this may be inferred from the results.

This monitoring is described in more detail below.

3.2 Methods

3.2.1 Monitoring for GSM Adults

During the 2009-10 GSM flight season, adult GSM were surveyed at every plot on four occasions (each separated by at least one week), using the repeatable method described here. All 10 plots at any one location were surveyed for adult GSM on a single day. Surveys were conducted during the suitable time of year only (November and December 2009), and when: (a) the weather conditions and time-of-day meet the criteria outlined earlier (in Chapter 2.1 of this document).

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 10 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 5 minutes, the ecologist recorded from the edge of the plot:

- 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 as incidental observations. A copy of the datasheet used to record the results of the adult GSM surveys at the habitat slab experiment is provided in Appendix A.

Typically, at least two trained ecologists were in the field on each day to maximise the number of plots that are surveyed on similar days with similar weather conditions. The order in which plots was visited on each occasion was changed to reduce the likelihood of bias.

The date and times of each adult GSM survey for each of the habitat slab experimental area is in Table 2 below.

Table 2: Dates and times[3] of the four GSM adult surveys for the Habitat Slab Replacement experiment during the 2009-10 survey period

Property	Survey 1		Survey 2		Survey 3		Survey 4	
	Date	Time	Date	Time	Date	Time	Date	Time
326 North	10/11/09	10.23-13.07	19/11/09	13.05-14.20	02/12/09	13.42-15.04	21/12/09	09.58-11.17
326 South	12/11/09	10.20-11.35	24/11/09	10.00-11.19	14/12/09	10.00-11.15	22/12/09	12.56-14.11
327	12/11/09	11.45-13.05	24/11/09	11.33-12.52	03/12/09	10.15-11.24	21/12/09	11.36-12.54
328	17/11/09	10.00-12.30	24/11/09	13.06-14.23	03/12/09	11.10-12.22	21/12/09	13.06-14.23
335 North	19/11/09	11.21-12.48	02/12/09	11.47-13.12	14/12/09	11.37-12.53	22/12/09	11.10-12.26
335 South	19/11/09	10.04-11.19	02/12/09	10.15-11.41	14/12/09	12.55-14.10	22/12/09	09.52-11.07

* Represents occasions when only one Alliance Ecologists undertook the surveys. On all other occasions, the surveys of a plot were undertaken by two Alliance Ecologists (although each ecologist viewed separate plots).

3.2.2 Monitoring for GSM Pupa Cases

The Alliance Ecologists searched for empty pupa cases within each of the 60 plots once in the middle of each flying season (late November to mid-December 2009) and again at the end of each flying season (early-mid January 2010). Pupa case searches were undertaken at varying times of day, and were often undertaken in the early morning or mid-late afternoon, (i.e., before or after the completion of adult moth monitoring surveys).

The pupa case surveys of each plot were undertaken over a period of 30 minutes by four trained ecologists, who carefully searched on the ground across the whole plot. All discarded pupa cases that were considered to be potentially GSM were collected in a glass vial and appropriately labelled. Discarded exoskeletons of all other insects and spiders were also collected. Relevant data was collected in the field on a prepared datasheet.

The specimens were dried, and then sorted into broad groups (which included a group of cases that were considered to be potentially GSM). An external specialist, Dr Anett Richter from University of Canberra. was engaged to identify the specimens.

The date and times of each Pupa Case survey for each of the habitat slab experimental area is in Table 3 below.

[3] Times are Australian Eastern Daylight Savings Time.

Table 3: Dates and times of the two GSM pupa case surveys for the Habitat Slab Replacement experiment during the 2009-10 survey period

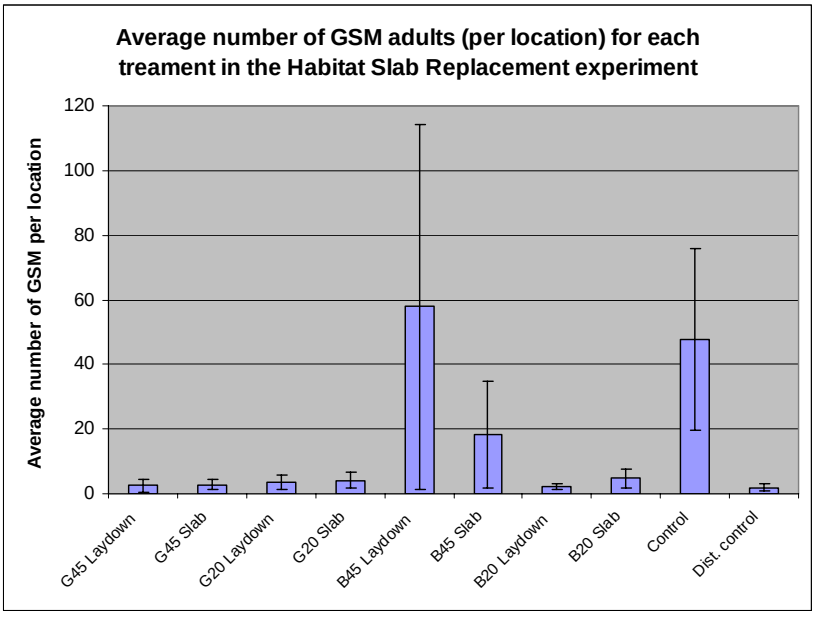
Site Name	Survey 1 (December 2009)			Survey 2 (January 2010)		
	Date	Time (min per plot)	People (per plot)	Date	Time (min per plot)	People (per plot)
Sheoak Nth	10/12/09	30	4	13/01/10	30	4
Sheoak Sth	09/12/09	30	4	14/01/10	30	4
#327	11/12/09	30	4	18/01/10	30	4
#328	10/12/09	30	4	19/01/10	30	4
#335 north	09/12/09	30	4	20/01/10	30	4
#335 south	08/12/09	30	4	21/01/10	30	4

3.3 Results from Habitat Slab Experiment Monitoring

3.3.1 Adult GSM Surveys

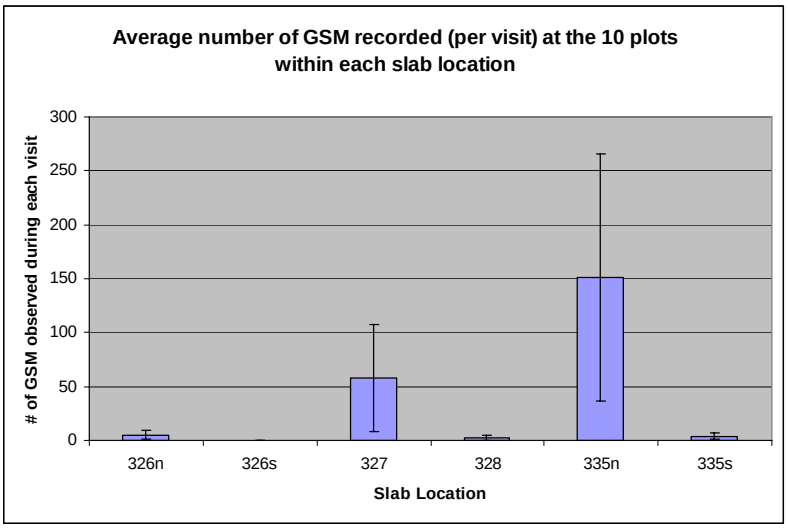
Graph 1 presents the average number of adult GSM detected for each of the 10 plot types, irrespective of the site location or visit number. The standard error is also provided. Each of the 10 plot types was visited on 24 occasions (= 6 locations x 4 visits). While the average number of adults detected in three of the plot types (the control sites, the 45 cm slabs on boards and the laydown area for the 45 cm slabs on boards) appears noticeably higher than the other 7 plot types, these 3 plot types each have a very high level of variance in the data. The high level of variance largely reflects a small number of outliers (i.e., single occasions when very high numbers of GSM were detected).

Graph 1: Average (and standard error) umber of GSM adults seen around each habitat slab treatment per location (tallied for each of the four visits)



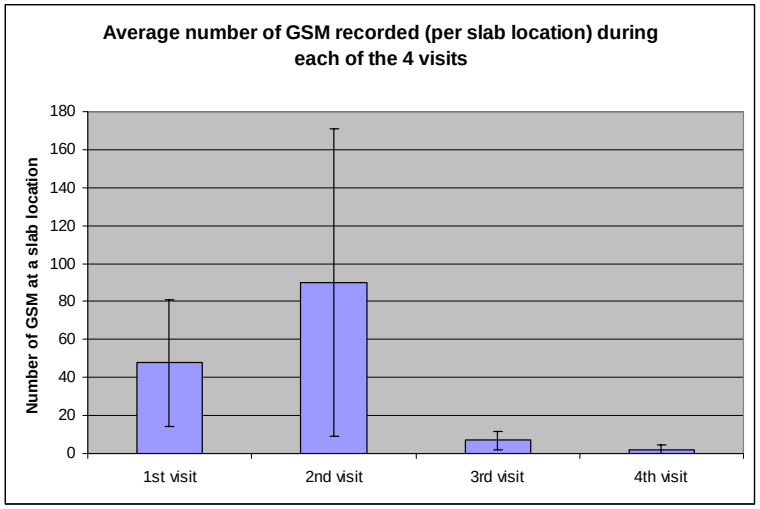
Graph 2 identifies the average number of GSM detected at each of the six locations, across all ten plots, during each visit. Site 335 north and 327 both have average numbers of GSMs detected that are much greater than any of the other sites, which partially reflects single visits with very high numbers of GSM seen (i.e., 206 GSM seen in or over slabs during the first visit to #327, and 493 GSM seen in or over slabs during the second visit to site #335 north). Locations #326 north, #328 and #335 south were relatively similar, with average numbers of GSM seen per visit ranging from 2.5 to 5.0. From the four visits to site #326 south, no adult GSM were detected at all.

Graph 2: Average (and standard error) number of GSM adults recorded per visit to each habitat slab location, 2009-10 surveys



Graph 3 identifies the average number of adult GSM seen at a slab location during each of the four visits (totalled across all ten plots). The first two visits, conducted from mid-November to early December 2010, had substantially higher numbers of GSM seen compared to the latter two visits conducted from mid to late December 2010. During the second visit, adult GSM were recorded at all six locations. By the fourth visit, adult GSM were detected at only one of the six locations (#335 north).

Graph 3: Average (and standard error) number of GSM adults recorded per visit across slab locations (tallied across plots), 2009-10 surveys



3.3.2 Pupa Case GSM Surveys

During the searches for GSM pupa cases, all types of pupa cases and other discarded exoskeletons were collected. Across the six slab locations, and the two survey time-periods, over 1400 items were collected. Of these, approximately one third comprised a pupa case of some type. Through the analysis of Anett Richter (see Appendix B for report), 43 of the pupa cases were confirmed as being from the GSM, which were collected from two locations only (property 328 and 335 north), and also only during the first search period (see Table 4 for details).

Table 4. Pupa cases and other invertebrate exoskeletons collected from the habitat slab locations during the 2009/2010 surveys

Property	Survey 1 (December 2009)			Survey 2 (January 2010)		
	# items total	# pupa cases (all types)	# confirmed GSM	# items total	# pupa cases (all types)	# confirmed GSM
326 Nth	171	32	0	45	21	0
326 Sth	109	81	0	107	22	0
327	229	61	0	112	50	0
328	89	43	1	75	17	0
335 Nth	181	86	42	112	46	0
335 Sth	97	15	0	181	31	0

4 Grassland Habitat Restoration Experiment

4.1 Background

The grassland habitat restoration experiment is being conducted on the Sheoak property (#326), on a sloped section of the ROW which contains the buried pipe leading out from the pump station southwards to the Sugarloaf Reservoir.

A number of variables will be monitored as part of this experiment, including floristic assessment of habitat recovery and the use of these areas by GSM. The aim of the GSM monitoring undertaken as part of this experiment is to determine whether any of the grassland habitat restoration techniques result in an increased use by the GSM compared to the project's standard reinstatement method, and where possible to compare the use of treatments by GSM. The primary aim is not to determine whether there has been a decline in the GSM population due to construction activities, although some information on this may be inferred from the results.

A total of forty experimental plots and twenty control plots of 3 m x 3 m (9 m^2) were established. Each plot will be assigned one of four experimental treatment types or one of two types of controls.

The different treatment types are:

- Subsoil left at the surface after construction, with no reinstatement (control);
- Topsoil replacement only (experiment treatment);
- Topsoil replacement supplemented with planting of tubestock (experimental treatment);
- Topsoil replacement supplemented with plant seeds (experimental treatment);
- Topsoil replacement with replacement collected prior to construction, and maintained through the construction phase (experimental treatment);
- Undisturbed control in adjacent grassland area beyond the ROW (control).

Within each of the 60 plots (10 for each treatment or control), monitoring was be undertaken for GSM pupa cases and adult moths, as described below.

4.2 Methods

4.2.1 Monitoring for GSM Adults

During the GSM flight season, adult GSM were surveyed at every one of the 60 plots on four occasions (with visits to each separate plot spaced apart by at least one week), using the repeatable method described here. All 60 plots were surveyed for adult GSM on a single day. Surveys were conducted during the suitable time of year only (November and December 2009), and when the weather conditions and time-of-day meet the criteria outlined earlier (in Chapter 2.1 of this document).

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 2 minutes, the ecologist recorded from the edge of the plot:

- Numbers of male and/or female moths observed on the ground or on vegetation within the plot.

A copy of the datasheet used to record the results of the adult GSM surveys at the grassland restoration experiment is provided in Appendix A.

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.

Typically, at least two trained ecologists were in the field on each day to maximise the number of plots that are surveyed on similar days with similar weather conditions. The order in which plots was visited on each occasion was changed to reduce the likelihood of bias.

The date of each survey for the grassland habitat restoration experimental area is in Table 5 below.

Table 5: Dates of the four adult GSM surveys for the Grassland Habitat Restoration experiment during the 2009-10 survey period

Visit #	Date	Time	Personnel
1	01/12/09	10.19-13.45	2
2	07/12/09	10.05-14.11	2
3	14/12/09	10.00-14.07	2
4	21/12/09	09.57-13.43	2

4.2.2 Monitoring for GSM Pupa Cases

The Alliance Ecologists searched for empty pupa cases within each of the 60 grassland habitat restoration plots once in the middle of each flying season (late November to mid-December 2009) and again at the end of each flying season (early-mid January 2010). Pupa case searches were undertaken at varying times of day, and were often undertaken in the early morning or mid-late afternoon, (i.e., before or after the completion of adult moth monitoring surveys).

Each pupa case survey of each plot was undertaken over a period of 15 minutes by a single trained ecologist, who carefully searched on the ground across the whole plot. All discarded pupa cases that were considered to be potentially GSM were collected in a glass vial and appropriately labelled. Discarded exoskeletons of all other insects and spiders were also collected. Relevant data was collected in the field on prepared datasheets.

The specimens were dried, and then sorted into broad groups (which includes a group of cases that were considered to be potentially GSM). An external specialist, Dr Anett Richter from University of Canberra, was engaged to identify which of the pupa cases were GSM.

The date and times of each Pupa Case survey for the Grassland Habitat Restoration experiment is provided in Table 6 below.

Table 6. Dates of the two pupa case surveys for the Grassland Habitat Restoration experiment during the 2009-10 survey period

Visit #	Date	Time (min per plot)	# of plots	Pax (per plot)
1	09/12/09 – 11/12/09	15	60	1
2	13/01/10 – 15/01/10	15	60	1

4.3 Results from Grassland Habitat Restoration Project

4.3.1 Adult GSM Surveys

Table 7 presents the total numbers of adult GSM individuals recorded within each treatment type during each round of survey visits. Excluding the ten 'undisturbed control' plots, only eight adult GSM were recorded at any of the other 50 plots during the 4 visits (~0.04 adult GSM per plot per visit). In contrast, fifty-four GSM were recorded from the ten 'undisturbed control' plots across the four visits (~1.35 adult GSM per plot per visit).

Table 7. Total number of adults observed for the different treatments in the Grassland Habitat Restoration experiment (tallied across all ten plots of each experimental treatment or control type)

Treatment	Survey 1		Survey 2		Survey 3		Survey 4		Total
	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	
Tussock replacement into topsoil	1	0	0	0	0	0	0	0	***1***
Seeding in topsoil	0	0	0	0	0	0	0	0	***0***
Planting in topsoil	2	0	0	0	0	0	0	0	***2***
Top soil only	2	1	2	0	0	0	0	0	***5***
Subsoil control	0	0	0	0	0	0	0	0	***0***
Undisturbed control	49	0	4	0	0	0	1	0	***54***
Total	***54***	***1***	***6***	***0***	***0***	***0***	***1***	***0***	***62***

4.3.2 Pupa Case GSM Surveys

During the searches for GSM pupa cases, all types of pupa cases and other discarded exoskeletons were collected. Across the grassland experiment, and the two survey time-periods, 237 items were collected. Of these, over 80% comprised a pupa case of some type. Through the analysis of Anett Richter (see Appendix B for report), only one of the pupa cases were confirmed as being from the GSM (see Table 7 for details). This was from the undisturbed control.

Table 8. Pupa cases and other invertebrate exoskeletons collected from the grassland tussock experiment during the 2009/2010 surveys

Treatment	Survey 1 (December 2009)			Survey 2 (January 2010)		
	# items total	# pupa cases (all types)	# confirmed GSM	# items total	# pupa cases (all types)	# confirmed GSM
Tussock replacement into topsoil	23	16	0	24	21	0
Seeding in topsoil	20	17	0	55	50	0
Planting in topsoil	23	22	0	18	16	0
Top soil only	27	25	0	20	18	0
Subsoil control	17	12	0	8	7	0
Undisturbed control	11	4	1	12	5	0
TOTAL	**121**	**96**	**1**	**116**	**98**	**0**

5 Within and Adjacent to the ROW

5.1 Background

The Alliance undertook monitoring for GSM within areas of **known** GSM grassland habitat within the ROW that are not being used for the experiments. The relevant properties are:

- 18/961;
- 324/325/326;
- 327;
- 382;
- 330;
- 335.

Monitoring also occurred in undisturbed land (i.e., land not disturbed by the Project) immediately adjacent to the boundaries of the construction area in private and public properties that contain **known** GSM grassland habitat. This includes properties listed above and suitable grassy public roadsides adjacent to those properties. Monitoring undertaken in undisturbed private land adjacent to the ROW was undertaken where landholder consent was obtained.

This monitoring is described in more detail below.

5.2 Methods

5.2.1 Monitoring for GSM Adults

GSM monitoring was conducted within all **known** GSM habitat that was intercepted by the Construction Area (i.e., within ROW), and in immediately surrounding areas (i.e., adjacent properties or road reserve) to document the distribution and relative abundance of adult GSM.

This was undertaken in accordance with the Standard Transect Technique (STT). This technique is endorsed by DEWHA (2009a, 2009b), which is generally consistent with the technique used previously by the Alliance during the 2008/09 flight season (SLPA 2009a). Surveys were conducted at the appropriate time of year and in appropriate conditions. Surveys were repeated on four occasions at each location. Repeat surveys were separated by a week or more.

The STT involved two or more Alliance Ecologists initially standing at one end of the ROW within a property and recording the following details:

- start time;
- weather conditions;
- general description of location (e.g., Sheoak property);
- specific location (GPS coordinates);
- direction of travel (see below);
- numbers of searchers.

The Ecologists then walked along the ROW through the property and documented all GSM individuals seen, taking care not to count individuals more than once. The Ecologists walked in parallel 5 m from each other, thereby each maintaining the 2.5 m standard transect width. Each ecologist counted all GSM seen within 2.5 m on either side. Where possible, flying males were recorded separately from females, or from moths on the ground.

After every 100 m, the Ecologists stopped to document the number of moths observed, then continued on recording afresh for the next 100 m, and so on until the end of the ROW through that property. The finish time, and other relevant details would be recorded on the datasheet at the end of the transect.

Where the landowner had granted permission for GSM surveys to be conducted within the undisturbed land outside the ROW (i.e., all properties except 330), then the two Alliance Ecologists conducted the STT parallel to the ROW (but moving in the opposite direction, thereby returning to the starting point of the ROW transect). Wherever possible, the transect was located no closer than 20 metres from the ROW. The distance between the parallel transects undertaken within and adjacent to the ROW was documented on the data sheet.

The date of each survey for within and adjacent to the ROW is in Table 9 below.

Table 9: Dates of the four adult GSM surveys within and adjacent to the ROW

Property	Survey 1			Survey 2			Survey 3			Survey 4		
	Date	Time	Time (min)	Date	Time	Time (min)	Date	Time	Time (min)	Date	Time	Time (min)
326 ROW	11/11/09	10.19-10.28	9	18/11/09	11.53-12.01	8	25/11/09	12.26-12.35	9	04/12/09	12.27-12.29 / 12.49-12.56	9
326 Adj	11/11/09	10.02-10.17	15	18/11/09	11.41-11.51	10	25/11/09	12.37-12.45	8	04/12/09	12.30-12.32 / 12.59-13.11	14
327 ROW	11/11/09	10.30-10.51	21	18/11/09	12.04-12.22	18	25/11/09	11.52-12.07	15	03/12/09	10.49-11.04	15
327 Adj	11/11/09	12.05-12.30	25	18/11/09	13.49-14.09	20	25/11/09	11.32-11.47	15	03/12/09	10.30-10.46	14
328 ROW	11/11/09	10.52-11.07	15	18/11/09	12.25-12.40	15	25/11/09	11.05-11.12 / 12.07-12.12	12	03/12/09	09.59-11.10	11
328 Adj	11/11/09	11.50-12.04	14	18/11/09	13.30-13.45	15	25/11/09	11.14-11.29	15	03/12/09	10.12-10.27	15
330 ROW	11/11/09	11.09-11.22	13	18/11/09	12.46-13.02	16	25/11/09	10.28-10.40	12	03/12/09	11.22-11.23 / 11.31-11.43	13
330 Adj	11/11/09	11.26-11.46	20	18/11/09	13.07-13.22	15	25/11/09	10.42-10.56	14	03/12/09	11.25-11.27 / 11.45-11.57	14
335 ROW	11/11/09	12.47-12.55	8	18/11/09	10.01-10.09	8	25/11/09	09.54-10.02	8	04/12/09	10.36-10.44	8
335 Adj	11/11/09	13.00-13.13	13	18/11/09	10.11-10.24	13	25/11/09	10.04-10.16	12	04/12/09	10.46-10.57	11
18/961 ROW	11/11/09	13.32-13.48	16	18/11/09	10.45-10.59	14	25/11/09	13.07-13.23	16	04/12/09	11.13-11.32	19
18/961 Adj	11/11/09	13.54-14.14	20	18/11/09	11.02-11.22	20	25/11/09	13.26-13.46	20	04/12/09	11.36-11.57	21

5.2.2 Monitoring for GSM Pupa Cases

A 9 m^2 plot was established within every 100 m length of **known** GSM grassland habitat along the ROW (outside experimental areas), and then searched for GSM pupa cases using the Standard Pupa Case Technique (SPCT). This technique involved an Alliance Ecologist searching for empty pupa cases within each plot. Search effort was standardised for each plot (i.e. each plot is the same size and is searched by one Ecologist for a set time of 15 minutes). Searches for pupa cases were undertaken once in the middle of each flying season and again at the end of each flying season. This increased the chances of detecting pupa cases, while allowing for variability in the timing of adult emergence (depending on weather, the period of emergence may occur earlier or later than predicted) and the uncertainty over how long pupa cases last before they begin to disintegrate and become undetectable. Pupa case searches can be undertaken at any time of day, however, in practice they are most likely to be undertaken in the afternoon, after completion of adult moth monitoring surveys (i.e. after 2 pm).

As for the Habitat Slab experiment, pupa cases and exoskeletons from all species found within the plot were collected. Pupa cases suspected to be that of GSM were separated and later analysed by a specialist to confirm their identification (Anett Richter, University of Canberra). Survey effort was documented. The dates and survey effort for each of the survey areas is in Table 10 below.

If the landowner had granted permission for GSM surveys to be conducted within the undisturbed land outside the ROW, then the Alliance ecologists surveyed for pupa cases adjacent to the ROW. For every 100 m length of **known** GSM grassland habitat adjacent to the ROW, a 9 m^2 plot was established and then searched for GSM pupa cases using the SPCT (see Section 4.4.2). In instances where permission was not be obtained, the plots were established and searched within the adjacent road reserve every 100 m.

Pupa cases and evidence of other invertebrate species (beetles, grasshoppers, centipedes, spiders and other unidentified species) were also collected to provide information on general biota present within the experimental areas and temporary plots.

Table 10: Dates and survey effort of the two GSM pupa case surveys for each survey area

Survey Area	**Survey 1 (December 2009)**			**Survey 2 (January 2010)**		
	Date	**Time (min per plot)**	**People (per plot)**	**Date**	**Time (min per plot)**	**People (per plot)**
ROW and Adjacent	01/12/09 – 10/12/09	15	1	15/01/10 – 21/01/10	15	1

5.3 Results from within and adjacent to ROW monitoring

5.3.1 Adult GSM Surveys

GSM adult surveys were conducted within the ROW and adjacent property/road reserve during November/December 2009. A total of 272 adult moths (Table 11) were observed during this period. Almost ten times as many GSM individuals were recorded in the adjacent areas (247) compared to the ROW survey areas (25). The greatest number of GSMs were documented from property 327.

Table 11. Total number of adult GSMs documented during each adult transect survey visit within the ROW and adjacent of known GSM properties

Property	Survey 1	Survey 2	Survey 3	Survey 4	Total
WITHIN ROW					
326	0	1	0	1	2
327	0	3	0	0	3
328	0	0	1	0	1
330	0	1	0	1	2
335	0	0	0	0	0
18/961	0	15	2	0	17
ADJACENT TO ROW					
326	0	7	11	0	18
327	28	61	46	12	147
328	0	25	32	20	77
330	0	0	0	0	0
335	0	1	0	2	3
18/961	2	0	0	0	2
Total	30	114	92	36	272

5.3.2 Pupa Case GSM Surveys

During the searches for GSM pupa cases, all types of pupa cases and other discarded exoskeletons were collected. Across all of the properties, and the two survey time-periods, only 15 items were collected. Of these, one was a pupa case of some type. Through the analysis of Anett Richter (see Appendix B for report), it was determined that it was not a GSM pupa case (see Table 12 for details).

Table 12. Pupa cases and other invertebrate exoskeletons collected from the properties during the 2009/2010 surveys

Property	Survey 1 (December 2009)			Survey 2 (January 2010)		
	# items total	# cases not GSM	# confirmed GSM	# items total	# cases not GSM	# confirmed GSM
326	6	0	0	12	5	0
327	22	6	0	22	9	0
328	31	9	0	53	23	0
330	14	5	0	63	20	0
335	15	9	0	41	11	0
18/961	4	1	0	10	0	0

6 Broader Sheoak

6.1 Background

GSM monitoring was undertaken across the broader Sheoak property to document the distribution and abundance of GSM. As described below, a standard transect-based survey technique was used and pupa case searches were undertaken to obtain information on breeding activity.

Transect surveys were undertaken using the technique endorsed by DEWHA (2009a, 2009b), which is consistent with the technique used previously by the Alliance during the 2008/09 flight season (SLPA 2009a). Surveys were conducted at the appropriate time of year and in appropriate conditions (see chapter 4.2 for details). Adult surveys were repeated on four occasions at each location. Repeat surveys were separated by at least one week.

To conduct a transect survey, two or more Alliance Ecologists initially stood at one end of a linear transect, and recorded the following details:

- start time
- weather conditions
- general description of location (e.g., Sheoak property)
- specific location (GPS coordinates)
- direction of travel (see below)
- numbers of searchers

The Alliance Ecologists then walked along a linear transect documented all GSM individuals seen, taking care not count individuals more than once. The Ecologists walked parallel to each other at a distance of 5m, thereby each maintaining the 2.5 m standard transect width. Each ecologist counted all GSM seen within 2.5 m on either side. Where possible, flying males were recorded separately from females, or from moths on the ground.

After every 100 m, the Alliance 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. The finish time, and other relevant details would be recorded on the datasheet at the end of the transect.

6.2 Methods

6.2.1 Monitoring for GSM Adults

The broader Sheoak property is much larger than the construction footprint within the Sheoak property. The construction area covers ~10 ha within the total property area of >200 ha. This describes the surveys undertaken within the Sheoak property, but beyond the construction area.

The DEWHA guidelines for GSM monitoring (DEWHA 2009b) 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. The Alliance has adopted that approach for the broader Sheoak property.

Approximately 20 km of transects were undertaken across the broader Sheoak property during each of the four visits. This includes transects that:

- Survey for GSM across the broader Sheoak property (including the eastern side of the Melba Hwy);

- Are at a higher density in the vicinity of the construction area, where habitat areas have been fragmented by the construction footprint;

The layout of transects was modified to fit with the location of fences across the property, which needed to be altered during the course of the surveys as fence and gate locations were modified (as were the movements of cattle within the various paddocks).

Each of the four visits took two teams of two ecologists a total of two days to complete. Dates and times of surveys are provided in Table 13 below.

6.2.2 Monitoring for GSM Pupa Cases

Approximately 40 plots were established across the Sheoak property, with a higher density of plots established in closer proximity to the construction areas. Each plot was 3m by 3m.

Each plot was surveyed twice; once in the middle of the flying season (December 2009) and then again at the end of the flying season (January 2010). Survey times were designed to maximise the chances of detecting pupa cases, while allowing for variability in the timing of adult emergence (depending on weather, the period of emergence may occur early or late in the season) and the uncertainty over how long pupa cases last before they begin to disintegrate and become undetectable.

Each plot was surveyed by an ecologist for a period of 15 minutes. Pupa cases and evidence of other invertebrate species (beetles, grasshoppers, centipedes, spiders and other unidentified species) were also collected to provide information on general biota present within the experimental areas and temporary plots. Pupa cases found during the survey that were suspected to be GSM were collected and analysed by a specialist (Anett Richter) for confirmation of their identification.

Survey effort was documented. The dates and survey effort for e ach of the survey areas is in Table 14 below.

Table 13. Dates and times of monitoring for adult GSM across the broader Sheoak property during the 2009/10 flight season.

Broader Sheoak	Survey 1			Survey 2			Survey 3			Survey 4		
	Date	Time	Time (min)	Date	Time	Time (min)	Date	Time	Time (min)	Date	Time	Time (min)
Team 1	9/11/09	11.30-13.40	130	17/11/09	10.12-14.00	228	02/12/09	10.11-14.00	229	15/12/09	09.51-14.10	259
Team 2	10/11/09	10.02-14.18	256	17/11/09	10.16-14.12	236	04/12/09	12.33-14.12	99	15/12/09	10.04-14.10	246
Team 3	12/11/09	10.08-14.23	255	20/11/09	10.08-13.12	184	04/12/09	10.23-14.02	219	23/12/09	09.35-11.54	139
Team 4	12/11/09	13.22-13.59	37	20/11/09	10.06-13.58	232	07/12/09	10.22-13.59	217	NA		
Team 5	NA			NA			07/12/09	10.13-10.59	46	NA		
Total			678			880			810			644

Table 14. Dates and times of monitoring for pupa cases across the broader Sheoak property during the 2009/10 flight season.

Survey Area	Survey 1 (December 2009)			Survey 2 (January 2010)		
	Date	Time (min per plot)	Pax (per plot)	Date	Time (min per plot)	Pax (per plot)
Broader Sheoak	04/12/09 – 07/12/09	15	1	20/01/10 – 22/01/10	15	1

6.3 Results from Broader Sheoak Monitoring

6.3.1 Adult GSM Surveys.

A total number of 1879 adult GSMs were observed (Table 14) during STT across the broader Sheoak property (i.e. not including the ROW) during November/December of 2009 (See section 5.4). Of the 1879 adults only five were females.

Table 15 Total number of adult GSMs documented during each survey of Broader Sheoak

Property	Survey 1	Survey 2	Survey 3	Survey 4	Total
Broader Sheoak	88	984	631	176	1879

The locations of adult GSMs detected during each of the four survey periods is provided in Figures 1 to 4.

6.3.2 Pupa Case GSM Surveys

During the searches for GSM pupa cases, all types of pupa cases and other discarded exoskeletons were collected. Across the Sheoak property, and the two survey time-periods, a total of 235 items were collected. Of these, 42 were a pupa case of some type. Through the analysis of Anett Richter (see Appendix B for report), it was determined that six of there were a GSM pupa case (see Table 12 for details).

Table 16. Pupa cases and other invertebrate exoskeletons collected from broader Sheoak during the 2009/2010 surveys

Survey Type	Survey 1 (December 2009)			Survey 2 (January 2010)		
	# items total	# cases not GSM	# confirmed GSM	# items total	# cases not GSM	# confirmed GSM
Broader Sheoak	131	16	6	104	20	0

361000 362000

5878000 5878000

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

38.3 38.2 (1.0) 38.1 (3.0) 37.5 37.4 (4.0) 37.3 (6.0) 37.2 37.1 30.4 30.5 31.1 31.2 30.2 30.1 9.1 36.2 (2.0) 36.1 35.2 35.1 (8.0) 34.1 9.2 34.2 (5.0) 33.11 (4.0) 12.3 12.2 12.1 11.1 33.10 (7.0) 32.3 32.9 4.1 8.2 8.1 39.1 39.2 39.3 (12.0) 13.1 13.2 13.3 13.4 13.5 40.1 (4.0) 40.2 (1.0) 40.3 44.1 (1.0) 41.2 41.1 (2.0) 21.1 21.2 13.6 22.1 13.7 20.4 20.3 20.2 20.1 19.3 (1.0) 19.2 42.1 33.8 32.4 1.2 3.1 33.7 32.5 28.1 2.4 1.8 2.3 3.2 33.6 (3.0) 32.7 (1.0) 32.6 22.4 13.8 13.9 33.5 33.4 22.3 32.8 23.1 (1.0) 24.1 1.6 2.2 2.1 4.1 3.3 7.4 29.1 28.3 27.1 28.3 7.3 29.2 28.2 27.2 26.2 26.1 7.2 29.3 28.1 (1.0) 27.3 5.1 7.1 6.1 19.1 33.3 33.2 32.10 32.12 (8.0) 18.9 32.9 18.10 18.11 18.12 18.13 18.14 18.15 35.1 32.13 13.4 13.3 13.2 18.1 17.2 17.1 16.1 16.2 16.3 16.4 15.1 14.5 14.4 14.3 14.2 14.1

Sugarloaf Pipeline Project

Figure 1- Indicative transect routes for GSM surveys beyond construction footprint on Sheaok property
Golden Sun Moth Adult Surveys (flying season 09/10) Broader Sheoak Transects -1

SUGARLOAF PIPELINE ALLIANCE

GDA94 MGA55

N

0 50 100 200 300

Metres

Legend

Transect Routes

- GSM Not Detected
- GSM Detected (With Amount M/F)

NB: Higher density of transects around the construction footprint
NNV = Non-Native Vegetation

361000 362000

5878000 5877000

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

Sugarloaf Pipeline Project

Figure 2- Indicative transect routes for GSM surveys beyond construction footprint on Sheaok property
Golden Sun Moth Adult Surveys (flying season 09/10) Broader Sheoak Transects -2

SUGARLOAF PIPELINE ALLIANCE

GDA94 MGA55

N

0 50 100 200 300

Metres

Legend

Transects

- GSM Not Detected
- GSM Detected (With Amount M/F)

NB: Higher density of transects around the construction footprint
NNV = Non-Native Vegetation

361000 362000

5878000 5877000

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

Sugarloaf Pipeline Project

Figure 3- Indicative transect routes for GSM surveys beyond construction footprint on Sheaok property
Golden Sun Moth Adult Surveys (flying season 09/10) Broader Sheoak Transects -3

SUGARLOAF PIPELINE ALLIANCE

GDA94 MGA55

N

0 50 100 200 300

Metres

Legend

Transects

- GSM Not Detected
- GSM Detected (with count M,F)

NB: Higher density of transects around the construction footprint
NNV = Non-Native Vegetation

G:\31\21633\CADD\GIS\Projects\ArcMap\Ecology\GoldenSunMoth_Transects_Sheoak2_20091202.mxd

361000 362000

5878000 5877000

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

Sugarloaf Pipeline Project

Figure 4- Indicative transect routes for GSM surveys beyond construction footprint on Sheaok property
Golden Sun Moth Adult Surveys (flying season 09/10) Broader Sheoak Transects -4

SUGARLOAF PIPELINE ALLIANCE

GDA94 MGA55

N

0 50 100 200 300

Metres

Legend

Transects

- GSM Not Detected
- GSM Detected (with count M,F)

NB: Higher density of transects around the construction footprint
NNV = Non-Native Vegetation

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7 References

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009a) *Significant Impact Guidelines for the Critically Endangered Golden Sun Moth (*Synemon plana*) January 2009.* http://www.environment.gov.au/epbc/publications/pubs/golden-sun-moth.rtf Accessed 24 June 2009@15.47:22

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009b). Synemon plana *in Species Profile and Threats Database*, Department of the Environment, Water, Heritage and the Arts, Canberra. Available from: http://www.environment.gov.au/sprat. Accessed 2009-06-24@15:39:32.

Gilmore, D., Koehler, S., O'Dwyer, C. and Moore, W., (2008), 'Golden Sun Moth *Synemon plana* (Lepidoptera: Castniidae): Results of broad survey of populations around Melbourne.' *The Victorian Naturalist*. 125(2):39-46.

Kirkpatrick, J.B., K. McDougall & M. Hyde (1995) Australia's most threatened ecosystem – the southeastern lowland native grasslands. Surrey Beatty and Sons, Chipping North, NSW.

Lindenmayer, D. and Burgman, M. 2005. *Practical Conservation Biology.* CSIRO Publishing, Collingwood, Australia.

Lunt, I.D. (1991) Management of lowland grasslands and grassy woodlands for nature conservation: a review. Victorian Naturalist 108, (3): 56-66.

Sugarloaf Pipeline Alliance (SLPA) (2008a). *Flora and Fauna Assessment. Sugarloaf Pipeline Project. Appendix H in the Project Impact Assessment.* Prepared as part of the Sugarloaf Pipeline Project.

Sugarloaf Pipeline Alliance (SLPA) (2008b). *Environment Management Strategy. Attachment 7. Mitigation Plan for Terrestrial Fauna listed under the EPBC Act and FFG Act.* Prepared as part of the Sugarloaf Pipeline Project.

Sugarloaf Pipeline Alliance (SLPA) (2009a). *Golden Sun Moth Overarching Document. Document No. SPA-REP-GL-ENV-0001-rev B-version 01.* Prepared as part of the Sugarloaf Pipeline Project.

Sugarloaf Pipeline Alliance (SLPA) (2009b). *Fauna Management Program – Sheoak High Lift Pump Station Document No. SPA-EPR-SH-ENV-0005 Rev C – Version 01.* Prepared as part of the Sugarloaf Pipeline Project.

Sugarloaf Pipeline Alliance (SLPA) (2009c). *Golden Sun Moth Mitigation Strategy - Appendix D of Fauna Management Program – Yea to Devlin Bridge.* Prepared as part of the Sugarloaf Pipeline Project.

Sugarloaf Pipeline Alliance (SLPA) (2009d). *Fauna Management Program – Killingworth. Document No. SPA-REP-GL-ENV-0001 Rev X – Version 01.* Prepared as part of the Sugarloaf Pipeline Project.

Appendix A

Example data sheet for Adult GSM Surveys – Habitat slab and Grassland experiments

31 21633 13: Golden Sun Moth Adult Habitat Slab and Tussock Restoration Surveys (season 10/11)

Date:		**Property ID:**		**Observers :**		**Temp at start**		**Cloud Cover %**		Still / Mild breeze / Mod breeze / Gusty	**Survey type:**	Habitat slab / Tussock restoration

Hab slab or tussock rest no.	Treatment type	Size of search area (m^2)	Pax	GPS (mid point)	Time Start	Time Finish	No. fly **over** the plot	No. fly **out** of the plot	No. land **within** the plot	No. **males** observed **on ground**/veg within plot	No. **females** observed **on ground**/veg within plot
1											
2											
3											
4											
5											
6											
7											
Notes:											

Appendix B

Anett Richter Report

Final Report

Golden Sun Moth (*Synemon plana*) Larval and Pupal case identification

Anett Richter & Will Osborne

April 2010
Institute for Applied Ecology, University of Canberra

Introduction

Anett Richter and Will Osborne from the Institute for Applied Ecology were commissioned by GHD to undertake the identification of Golden Sun Moths (*Synemon plana*) from larvae and pupal cases collected by GHD.

This report presents the results of two days of identification work conducted by Anett Richter between 22 and 23 of April 2010 in Melbourne. A total of 142 invertebrate larval specimens and 409 empty lepidopteran pupal cases were examined for the presence of Golden Sun Moth larvae and pupal cases. Individual examination of each specimen (larvae and pupal cases provided by GDH) confirmed the presence of 25 Golden Sun Moth larvae and the presence of 52 Golden Sun Moth pupal cases. Each Golden Sun moth larva was measured for total length and the sex of pupal cases that were intact were also determined. In addition, all other types of larvae that were in good condition were identified to the level of order.

This report summarises the findings and highlights any limitation of this identification work.

Aims of the visit to GHD

The main aim of the visit by Anett Richter was to identify to species level empty lepidopteran pupal cases and preserved larvae collected by GHD.

The specific aims were to:

- report on the number of samples processed,
- examine each specimen (both larvae and pupal cases) and determine whether they were Golden Sun Moths;
- describe the demographic characteristics (based on size) of the Golden Sun Moth specimens and the locations from which they had been collected; and

- record the sex ratio of Golden Sun Moth pupal cases.

Methods

The larvae of the Golden Sun Moth have not yet been described so we were dependent on our previous experience and training with the identification of this species. In Canberra, following the visit to GHD, we also referred to photographs taken of the GHD specimens and compared them to Golden Sun Moth larvae and pupal cases held in our own collection at the University of Canberra. The identifications of specimens in this collection have been previously confirmed by an expert entomologist, Ted Edwards, from CSIRO Division of Entomology in Canberra.

Each specimen was placed under the microscope and identified according to the characteristics of typical larval and pupal cases e.g. shape, size, arrangement of segments, colour and arrangement of hairs. In cases where the identification revealed that the specimens were not Golden Sun Moth, Anett Richter attempted to identify the remaining larvae to insect order. No further identification was possible with the other types of lepidopteran pupal cases (non Golden Sun Moth pupal cases). Following the positive identification of Golden Sun Moth larvae, each larva was measured in length (mm) with a ruler. Golden Sun moth pupal cases were sexed according to morphological characteristics when intact.

Results

A total of 142 invertebrate larvae were available for examination. All specimens had been stored in glass containers in ethanol (95% solution). The preservative had affected the colouring of many of the specimens and their shape. Each specimen was examined. Twenty five of the 142 invertebrate larvae were determined to be Golden Sun Moths (*Synemon plana*) (GSM) (Figure 1).

The specific geographic locations (properties) that had positive records for GSM larvae were properties 335, 327 and 326. Almost all specimens (>90%) came from property 335. With one exception, (depth 20 cm) all GSM larvae were present in samples that were taken from samples labeled as 45 cm depth. According to the labeling present on the vials, the GSM larvae had been collected from areas referred as to “replacement” (n=13) and “extraction” (n=12).

Figure 1: Series of Golden Sun Moth larvae photographed under the microscope.

The Golden Sun Moth larvae ranged in body length from 6.0mm to 29.0 mm (front of the head the end of the abdomen). GSM larvae collected in “extraction” were on average larger (4.25mm) than larvae collected in “replacement” (3.69mm). It was possible to group the larvae into three size classes (class I: 6 mm - 10 mm; class II: >10 mm – 20 mm; III: >20 mm). Most of the larvae (n=16) were contained in size class II. Six larvae were assigned to size class I and three specimens to size class III.

The remaining invertebrate larvae were identified to insect order level when possible. Of these, about half were identified as coleopteran (beetle) larvae (Figure 1). Less than 10% of remaining larvae belonged to the insect order of Diptera and only a very small proportion of remaining non GSM larvae were lepidopteran larvae (Figure 2, Figure 3).

Figure 2: Photographs of Coleopteran larvae (left) and Diptera larvae (right) present in the sample.

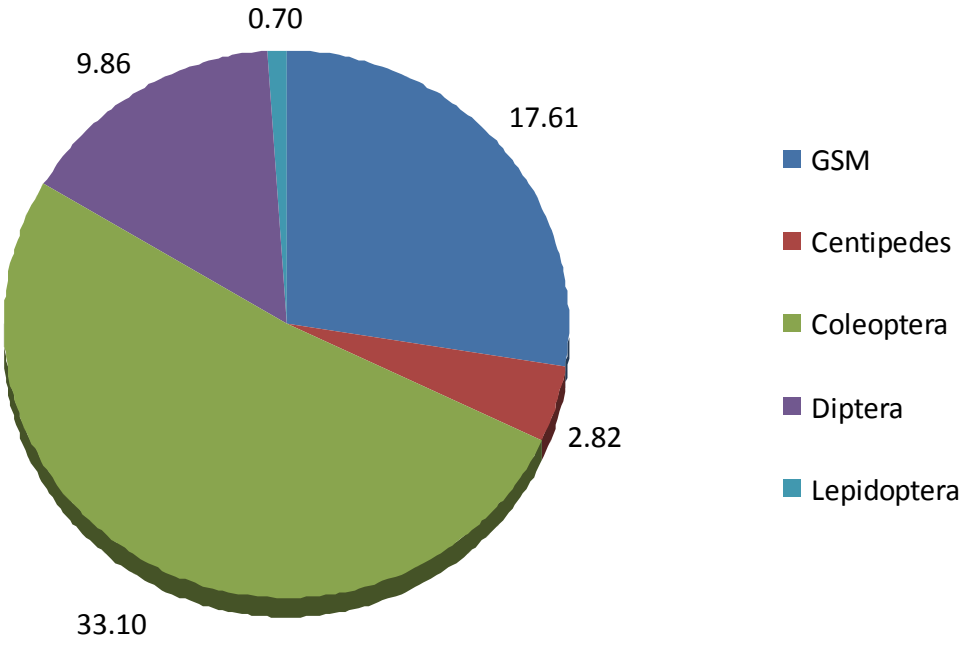

Figure 3: Percentage of the samples that were Golden Sun Moths (GSM) or other invertebrates (coleopterans, dipterans, lepidopterans, and centipedes.

A total of 409 lepidopteran pupal cases were individually examined under the microscope. Fifty two cases were identified as being Golden Sun Moth pupal cases collected from properties 326, 335 and 328. Twenty seven of these Golden Sun moth cases were damaged and could not be sexed or further assessed. The remaining 24 Golden Sun moth cases comprised 14 females and

10 male GSM cases. The majority of cases identified were derived from collections conducted in December 2009. Three GSM cases were collected in January 2010.

Figure 4: Unidentified lepidopteran pupal case (left), samples (middle) and Golden Sun Moth pupal case (right) viewed through the microscope after removal of surrounding soil and silk.

The comprehensive list of identified larvae and pupal cases is attached as an appendix to this report and attached electronically (excel file).

Limitations

The larva and the pupa case of the Golden Sun Moth have never been taxonomically described. Therefore our ability to identify the larvae is based on our prior experience in identification of Golden Sun Moths in Victoria (Altona) and in the ACT (many sites). This involved us in collecting larvae and pupal cases that were clearly from the family Castiinidae and having our identifications confirmed by a lepidopteran expert (Ted Edwards CSIRO Division of Entomology, Canberra). Since GSM were abundant at these sites and were the only species of *Synemon* present we are confident that the larvae and pupal cases that we are experienced with are Golden Sun Moths. However, we have not personally examined the adult Golden Sun Moths at the sites from which GHD collected the specimens examined in this present study. We have been assured by Vanessa McKenzie (zoologist with GHD) that only one species of castiniid is present at these sites and that it is *Synemon plana*. We are therefore confident of our identification.

Acknowledgments

We would like to thank GHD for commissioning us to undertake this work. We particularly thank Vanessa McKenzie for organising the visit and for her general assistance.

Appendix

Table A: Larvae identification

Table B: Pupal case identification

NB the Table letter (A or B) is recorded on the top left side of the spread sheet.

A	Label							
Nr.	Property number	Direction	Site	Sample depth	Sample Number	Action	ID	Size in mm
1	335	N	B	45		Replacement	GSM	7.5
2	335	N	B	45		Replacement	GSM	23.0
3	335	N	B	45		Replacement	GSM	10.0
4	335	N	B	45		Replacement	Coleoptera	
5	335	N	B	45		Replacement	Coleoptera	
6	335	N	B	45		Replacement	GSM	9.5
7	335	N	B	45		Replacement	GSM	17.5
8	335	N	B	45		Replacement	GSM	13.5
9	335	N	B	45		Replacement	GSM	11.5
10	335	N	B	45		Replacement	GSM	9.0
11	335	N	B	45		Replacement	GSM	12.5
12	335	N	B	45		Replacement	GSM	6.0
13	335	N	B	45		Replacement	not possible	
14	335	N	B	45		Replacement	GSM	9.5
15	335	N	B	45		Replacement	GSM	10.5
16	335	N	B	45		Replacement	GSM	13.0
17	326	S	B	20	4	Extract	Diptera	
18	326	S	B	45	8	Extract	Coleoptera	
19	327		B	45	4	Extract	Diptera	
20	326		B	45	6	Extract	Diptera	
21	328		G	45	4	Extract	Coleoptera	
22	327		B	20	1	Extract	Coleoptera	
23	327		B	20	3	Extract	Diptera	
24	328		B	20	2	Extract	Coleoptera	
25	327		B	45	3	Extract		
26	328		G	45	2	Extract		
27	327		B	20	2	Extract	Coleoptera	
28	327		B	45	5	Extract	Diptera	
29	327		B	45	2	Extract	Coleoptera	
30	327		B	45	6	Extract	Coleoptera	
31	327		G	45	3	Extract		
32	328		B	20	1	Extract	Coleoptera	
33	328		G	45	1	Extract	Diptera	
34	327		B	45	1	Extract	Coleoptera	
35	327		G	45	2	Extract		
36	328		G	45	3	Extract	Coleoptera	
37	326	S	B	20	6	Extract	Coleoptera	
38	335	N	G	45	4	Extract	GSM	10.5

A	Label							
Nr.	Property number	Direction	Site	Sample depth	Sample Number	Action	ID	Size in mm
39	335	N	B	45	3	Extract	GSM	13.0
40	335	N	B	45	6	Extract	GSM	13.5
41	335	N	B	45	7	Extract	GSM	12.5
42	335	N	B	20	4	Extract	GSM	20.0
43	335	N	B	20	1	Extract		
44	335	N	B	45	5	Extract	GSM	29.0
45	335	S	G	20	2	Extract	Termite ?	
46	335		G	45	5	Extract	GSM	12.0
47	335		B	45	10	Extract	GSM	15.5
48	335	N	B	45	11	Extract	GSM	15.5
49	335	N	B	45	9	Extract	GSM	11.5
50	335	S	G	20	3	Extract		
51	335	S	G	20	1	Extract		
52	335	S	G	20	4	Extract		
53	326	S	B	45	7	Extract	Coleoptera	
54	326	S	B	20	4	Extract	Coleoptera	
55	326	N	G	45	3	Extract	Coleoptera	
56	326	S	B	20	2	Extract		
57	326	S	B	45	10	Extract	Coleoptera	
58	326	S	B	45	4	Extract	Coleoptera	
59	326	S	B	45	2	Extract	Coleoptera	
60	326	S	B	20	3	Extract	Diptera	
61	326	S	B	45	5	Extract	Lepidoptera	
62	326	N	B	20	1	Extract	Diptera	
63	326	S	G	20	1	Extract	Coleoptera	
64	326	N	G	20	1	Extract	Coleoptera	
65	326	S	G	45	1	Extract	Diptera ?	
66	326	S	B	45	3	Extract		
67	326	N	B	45	1	Extract	ID not possible	
68	335	N	B	20	2	Extract	Diptera	
69	335	N	G	20	5	Extract	Coleoptera	
70	335	N	B?	20	3	Extract	Diptera ?	
71	327	G		20			GSM	13.5
72	326	B	B	45		Extract	GSM	17.4
73	unlikely	P.22	T.3				Coleoptera ?	
74	335	S	B	45	2	Extract	Coleoptera	
75	335	N	B	45	4	Extract	Diptera	

A	Label							
Nr.	Property number	Direction	Site	Sample depth	Sample Number	Action	ID	Size in mm
76	335	N	B	45	8		Diptera	
77	335	S	G	45	2	Extract	Coleoptera	
78	328		G	20	1	Extract	Diptera	
79	335	N	G	45	1		Coleoptera	
80	335	N	B	45	1		Coleoptera	
81	335	S			4	Replacement		
82	335	S			1	Replacement		
83	335	S			1	Replacement		
84	335	S			1	Replacement		
85	335	S			1	Replacement		
86	335	S			1	Replacement		
87	335	S			1	Replacement		
88	335	S			1	Replacement		
89	335	S			1	Replacement		
90	335	S			1	Replacement		
91	335	S			3	Replacement		
92	335	S			3	Replacement		
93	335	S			3	Replacement		
94	328		B	45		Replacement		
95	335	S			2	Replacement		
96	335	S			2	Replacement		
97	335	S			2	Replacement		
98	326	N			2	Replacement		
99	326	N			2	Replacement		
100	328		B	20	2/2	Replacement		
101	328		B	20	2/2	Replacement		
102	335	S			4 2/ 2	Replacement	Coleoptera	
103	335	S			4 2/ 2	Replacement		
104	335	S			2 2 /2	Replacement		
105	335	S			2 2 /2	Replacement		
106	326	S			4 2/ 2	Replacement	Coleoptera	
107	326	S			4 2/ 2	Replacement	Coleoptera	
108	326	S			4 2/ 2	Replacement	Coleoptera	
109	326	S			4 2/ 2	Replacement	Coleoptera	
110	326	S			4 2/ 2	Replacement	Coleoptera	
111	328		GEOF	20		Replacement	Coleoptera	
112	328		GEOF	20		Replacement	Coleoptera	
113	328		GEOF	20		Replacement	Coleoptera	
114	328		GEOF	20		Replacement	Coleoptera	

A	Label							
Nr.	Property number	Direction	Site	Sample depth	Sample Number	Action	ID	Size in mm
115	328		GEOF	45	AB 2/ 2	Replacement	Coleoptera	
116	328		GEOF	45	AB 2/ 2	Replacement	Coleoptera	
117	328		GEOF	45	AB 2/ 2	Replacement	Coleoptera	
118	328		GEOF	45	AB 2/ 2	Replacement		
119	335	N	B	20	2/ 2	Replacement		
120	328		GEOF	20	2 /2	Extract		
121	326	S			1 2/ 2	Replacement	Coleoptera	
122	326	S			1 2/ 2	Replacement	Coleoptera	
123	326	S			1 2/ 2	Replacement	Coleoptera	
124	326	S			1 2/ 2	Replacement	Coleoptera	
125	326	S			1 2/ 2	Replacement	Coleoptera	
126	326	S			1 2/ 2	Replacement	Coleoptera	
127	326	S			1 2/ 2	Replacement	Coleoptera	
128	326	S			1	Replacement		
129	326	S			1	Replacement		
130	326	S			1	Replacement		
131	326	S			1	Replacement		
132	326	N			2	Replacement	Centipedes	
133	326	N			2	Replacement	Centipedes	
134	326	N			2	Replacement	Centipedes	
135	326	N			2	Replacement	Centipedes	
136	326	N			2	Replacement		
137	326	N			2	Replacement		
138	326	N			2	Replacement		
139	326	N			2	Replacement		
140	326	N			2	Replacement		
141	326	N			2	Replacement		
142	326	N			2	Replacement		

B	Label								
Nr.	Property number	Direction	Site	Sample depth	Sample Nr.	Vials… of...	Date	ID	Sex
1	326		GL Exp		56		12/2009	no GSM	
2	326				52		12/2009	no GSM	
3	326				52		12/2009	no GSM	
4	326		GL Exp		52	1 of 3	12/2009	yes	male
5	326		Broader Sheoak		24	2 of 3	12/2009	no GSM	
6	326		Broader Sheoak		22	2 of 2	12/2009	no GSM	
7	326		Broader Sheoak		11	1 of 1	12/2009	no GSM	
8	326		Broader Sheoak		4	1 of 1	12/2009	no GSM	
9	326		Broader Sheoak		15	1 of 2	12/2009	yes	not possible
10	326		Broader Sheoak		33	1 of 1	12/2009	no GSM	
11	326		Broader Sheoak		19	1 of 1	12/2009	no GSM	
12	326		Broader Sheoak		27	1 of 1	12/2009	no GSM	
13	326		Broader Sheoak		24	3 of 2	12/2009	no GSM	
14	326		Broader Sheoak		15	2 of 2	12/2009	no GSM	
15	326		Broader Sheoak		6	2 of 2	12/2009	no GSM	
16	326		Broader Sheoak		18	1 of 2	12/2009	no GSM	
17	326		Broader Sheoak		30	1 of 2	12/2009	no GSM	
18	326		Broader Sheoak		31	1 of 2	12/2009	no GSM	
19	326		Broader Sheoak		34	1 of 1	12/2009	no GSM	
20	326		Broader Sheoak		29	1 of 1	12/2009	yes	not possible
21	326		Broader Sheoak		24	1 of 3	12/2009	yes	male

B	Label								
Nr.	**Property number**	**Direction**	**Site**	**Sample depth**	**Sample Nr.**	**Vials… of...**	**Date**	**ID**	**Sex**
22	326		Broader Sheoak		24	1 of 3	12/2009	yes	female
23	326		Broader Sheoak		24	1 of 3	12/2009	yes	not possible
24	326		Broader Sheoak		24	1 of 3	12/2009	yes	not possible
25	325	N	B	45	Laydown	2 of 5	12/2009	no GSM	
26	325	N	B	45	Laydown	2 of 5	12/2009	no GSM	
27	325	N	B	45	Laydown	2 of 5	12/2009	no GSM	
28	325	N	B	45	Laydown	2 of 5	12/2009	no GSM	
29	325	N	B	45	Laydown	2 of 5	12/2009	no GSM	
30	325	N	B	45	Laydown	2 of 5	12/2009	no GSM	
31	325	N	B	45	Laydown	2 of 5	12/2009	no GSM	
32	335		HapSlap B	20	S	1 of 2	12/2009	no GSM	
33	335	N	HabSlap B	45	S	2 of 5	12/2009	no GSM	
34	335		HabSlap B	45	S	3 of 5	12/2009	no GSM	
35	335		HabSlap B	45	S	3 of 5	12/2009	no GSM	
36	335	N	HabSlap G	20	S	3 of 3	12/2009	no GSM	
37	335	N	HabSlap B	20	L	2 of 3	12/2009	no GSM	
38	335	N	HabSlap B	20	L	1 of 3	12/2009	no GSM	
39	335	N	HabSlap B	45	S	4 of 5	12/2009	yes	not possible
40	335	N	HabSlap B	45	S	4 of 5	12/2009	yes	female
41	335	N	HabSlap B	45	S	4 of 5	12/2009	yes	female
42	335	N	HabSlap B	45	S	4 of 5	12/2009	yes	not possible
43	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	not possible
44	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	not possible

B	Label								
Nr.	**Property number**	**Direction**	**Site**	**Sample depth**	**Sample Nr.**	**Vials… of...**	**Date**	**ID**	**Sex**
45	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	not possible
46	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	not possible
47	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	not possible
48	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	not possible
49	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	not possible
50	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	not possible
51	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	not possible
52	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	not possible
53	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	not possible
54	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	male
55	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	male
56	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	female
57	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	female
58	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	female
59	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	female
60	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	female
61	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	female
62	335	N	HabSlap B	45	L	5 of 5	12/2009	yes	not possible
63	335	N	HabSlap B	45	L	5 of 5	12/2009	yes	not possible
64	335	N	HabSlap B	45	L	5 of 5	12/2009	yes	not possible
65	335	N	HabSlap B	45	L	5 of 5	12/2009	yes	not possible
66	335	N	HabSlap B	45	L	5 of 5	12/2009	yes	not possible
67	335	N	HabSlap B	45	L	5 of 5	12/2009	yes	not possible

B	Label								
Nr.	**Property number**	**Direction**	**Site**	**Sample depth**	**Sample Nr.**	**Vials… of...**	**Date**	**ID**	**Sex**
68	335	N	HabSlap B	45	L	5 of 5	12/2009	yes	not possible
69	335	N	HabSlap B	45	L	5 of 5	12/2009	yes	not possible
70	335	N	HabSlap B	45	L	5 of 5	12/2009	yes	not possible
71	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	female
72	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	female
73	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	female
74	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	female
75	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	female
76	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	male
77	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	male
78	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	male
79	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	male
80	335	N	HabSlap B	45	L	4 of 5	12/2009	yes	male
81	326		Broader Sheoak		25	1 of 2	01/2010	no GSM	
82	326		Broader Sheoak		14	1 of 2	01/2010	no GSM	
83	326		Broader Sheoak		34	1 of 1	01/2010	no GSM	
84	326		Broader Sheoak		1	2 of 2	01/2010	no GSM	
85	326		Broader Sheoak		32	1 of 1	01/2010	no GSM	
86	326		Broader Sheoak		32	1 of 1	01/2010	no GSM	
87	326		Broader Sheoak		2	1 of 2	01/2010	no GSM	
88	326		Broader Sheoak		11	1 of 2	01/2010	no GSM	
89	326		Broader Sheoak		11	1 of 3	01/2010	no GSM	
90	326		Broader Sheoak		27	1 of 2	01/2010	yes	male
91	328		A		6	2 of 3	12/2009	no GSM	
92	328		A		3	1 of 2	12/2009	no GSM	

B	Label								
Nr.	Property number	Direction	Site	Sample depth	Sample Nr.	Vials… of...	Date	ID	Sex
93	328		A		3	1 of 2	12/2009	no GSM	
94	328		A		3	1 of 2	12/2009	no GSM	
95	328		A		5	1 of 1	12/2009	no GSM	
96	328		A		6	1 of 3	12/2009	no GSM	
97	327		A		6	1 of 2	12/2009	no GSM	
98	330		R		4	1 of 1	12/2009	no GSM	
99	335		A		3	1 of 1	12/2009	no GSM	
100	335		A		3	1 of 1	12/2009	no GSM	
101	335		A		3	1 of 1	12/2009	no GSM	
102	335		R		5	1 of 1	12/2009	no GSM	
103	330		A		5	1 of 1	12/2009	no GSM	
104	330		A		3	1 of 2	12/2009	no GSM	
105	330		A		3	1 of 2	12/2009	no GSM	
106	330		A		3	1 of 2	12/2009	no GSM	
107	328		A		4	1 of 1	12/2009	no GSM	
108	328		A		4	1 of 1	12/2009	no GSM	
109	335	S	HabSlap B	20	S	2 of 3	12/2009	no GSM	
110	335	S	HabSlap B	20	S	2 of 3	12/2009	no GSM	
111	335	S	HabSlap B	20	S	2 of 3	12/2009	no GSM	
112	335	S	HabSlap B	45	S	2 of 3	12/2009	no GSM	
113	335	S	HabSlap G	20	S	4 of 4	12/2009	no GSM	
114	335	S	HabSlap G	20	S	3 of 4	12/2009	no GSM	
115	335	S	HabSlap G	45	S	2 of 2	12/2009	no GSM	
116	335	S	HabSlap B	20	L	2 of 2	12/2009	no GSM	
117	335	S	HabSlab G	45	L	2 of 4	12/2009	no GSM	
118	335	S	HabSlab G	45	L	3 of 4	12/2009	no GSM	
119	335	S	HabSlab Control			1 of 1	12/2009	no GSM	
120	335	S	HabSlab Control			1 of 1	12/2009	no GSM	
121	335	S	HabSlab Control			1 of 1	12/2009	no GSM	
122	328		HabSlab B	20	Lay	1 of 2	01/2010	no GSM	
123	328		HabSlab B	20	Lay	1 of 2	01/2010	no GSM	
124	328		HabSlab Control			1 of 2	01/2010	yes	not possible
125	328		HabSlab B	20	Lay	1 of 2	01/2010	no GSM	
126	328		HabSlab B	20	Lay	1 of 2	01/2010	no GSM	
127	326		HabSlab G	20	S	2 of 2	*	no GSM	

B	Label								
Nr.	Property number	Direction	Site	Sample depth	Sample Nr.	Vials… of...	Date	ID	Sex
128	326	S	HabSlab B	20	L	2 of 2		no GSM	
129	326	S	HabSlab B	20	L	2 of 2		no GSM	
130	326	S	HabSlab B	20	L	2 of 2		no GSM	
131	326	S	HabSlab G	45	S	3 of 4		empty vial	
132	326	S	HabSlab G	45	S	1 of 4		no GSM	
133	326	S	HabSlab G	45	S	1 of 4		no GSM	
134	326	S	HabSlab G	45	S	1 of 4		no GSM	
135	326	S	HabSlab G	45	S	1 of 4		no GSM	
136	326		HabSlab B	20		1 of 3		no GSM	
137	326		HabSlab B	20		1 of 3		no GSM	
138	326		HabSlab B	20		1 of 3		no GSM	
139	326		HabSlab G	20	L	2 of 3	12/2009	no GSM	
140	326	S	HabSlab Dist Control			1 of 3	12/2009	no GSM	
141	326	S	HabSlab Dist Control			1 of 3	12/2009	no GSM	
142	326	S	HabSlab G	45	L	2 of 2	12/2009	no GSM	
143	326	S	HabSlab G	45	L	2 of 2	12/2009	no GSM	
144	326	S	HabSlab B	45	L	1 of 2	12/2009	no GSM	
145	326	S	HabSlab B	45	L	1 of 2	12/2009	no GSM	
146	326	S	HabSlab B	45	L	1 of 2	12/2009	no GSM	
147	326	S	HabSlab B	45	L	1 of 2	12/2009	no GSM	
148	326	S	HabSlab B	45	L	1 of 2	12/2009	no GSM	
149	326	S	HabSlab B	45	S	1 of 3	12/2009	no GSM	
150	326	S	HabSlab B	45	S	1 of 3	12/2009	no GSM	
151	326		HabSlab G	20	S	2 of 2	12/2009	no GSM	
152	326	S	HabSlab G	45	S	3 of 4	12/2009	no GSM	
153	326	S	HabSlab G	45	S	1 of 4	12/2009	no GSM	
154	326	S	HabSlab G	45	S	1 of 4	12/2009	no GSM	
155	326	S	HabSlab G	45	S	1 of 4	12/2009	no GSM	
156	326	S	HabSlab G	45	S	1 of 4	12/2009	no GSM	
157	326	S	HabSlab B	20	S	1 of 3	12/2009	no GSM	
158	326	S	HabSlab B	20	S	1 of 3	12/2009	no GSM	
159	326	S	HabSlab B	20	S	1 of 3	12/2009	no GSM	
160	327		HabSlab G	20	L	1 of 3	01/2010	no GSM	
161	327		HabSlab G	20	L	1 of 3	01/2010	no GSM	

B	Label								
Nr.	Property number	Direction	Site	Sample depth	Sample Nr.	Vials… of...	Date	ID	Sex
162	327		HabSlab B	20	L	1 of 3	01/2010	no GSM	
163	327		HabSlab B	20	L	1 of 3	01/2010	no GSM	
164	327		HabSlab B	20	L	1 of 3	01/2010	no GSM	
165	327		HabSlab B	20	L	1 of 3	01/2010	no GSM	
166	327		HabSlab B	20	L	1 of 3	01/2010	no GSM	
167	327		HabSlab B	20	L	1 of 3	01/2010	no GSM	
168	327		HabSlab B	20	L	1 of 3	01/2010	no GSM	
169	327		HabSlab B	20	L	2 of 3	01/2010	no GSM	
170	327		HabSlab B	20	L	2 of 3	01/2010	no GSM	
171	327		HabSlab B	45	S	1 of 4	01/2010	no GSM	
172	327		HabSlab B	45	S	1 of 4	01/2010	no GSM	
173	327		HabSlab B	45	S	1 of 4	01/2010	no GSM	
174	327		HabSlab B	45	S	1 of 4	01/2010	no GSM	
175	327		HabSlab B	45	S	1 of 4	01/2010	no GSM	
176	327		HabSlab B	45	L	1 of 2	01/2010	no GSM	
177	327		HabSlab B	45	L	1 of 2	01/2010	no GSM	
178	327		HabSlab B	45	L	1 of 2	01/2010	no GSM	
179	327		HabSlab B	45	L	1 of 2	01/2010	no GSM	
180	327		HabSlab B	45	L	1 of 2	01/2010	no GSM	
181	327		HabSlab B	45	L	1 of 2	01/2010	no GSM	
182	327		HabSlab B	45	L	1 of 2	01/2010	no GSM	
183	327		HabSlab B	45	L	1 of 2	01/2010	no GSM	
184	327		HabSlab Control			1 of 2	01/2010	no GSM	
185	327		HabSlab Control			1 of 2	01/2010	no GSM	
186	327		HabSlab Control			1 of 2	01/2010	no GSM	
187	327		HabSlab Control			1 of 2	01/2010	no GSM	
188	327		HabSlab Control			1 of 2	01/2010	no GSM	
189	327		HabSlab Control			1 of 2	01/2010	no GSM	
190	326		GL Exp		56	1 of 2	01/2010	no GSM	
191	326		GL Exp		51	1 of 2	01/2010	no GSM	
192	326		GL Exp		51	1 of 2	01/2010	no GSM	
193	326		GL Exp		60	1 of 1	01/2010	no GSM	
194	335	S	HabSlab B	20	L	2 of 3	01/2010	no GSM	

B	Label								
Nr.	Property number	Direction	Site	Sample depth	Sample Nr.	Vials… of...	Date	ID	Sex
195	335	S	HabSlab B	20	L	2 of 3	01/2010	no GSM	
196	335	S	HabSlab B	20	L	2 of 3	01/2010	no GSM	
197	335	S	HabSlab B	20	L	2 of 3	01/2010	no GSM	
198	335	S	HabSlab Control			1 of 2	01/2010	no GSM	
199	335	S	HabSlab Control			1 of 2	01/2010	no GSM	
200	335	S	HabSlab Control			1 of 2	01/2010	no GSM	
201	335	S	HabSlab Control			1 of 2	01/2010	no GSM	
202	335	S	HabSlab Control			1 of 2	01/2010	no GSM	
203	335	S	HabSlab Control			1 of 2	01/2010	no GSM	
204	335	S	HabSlab Control			1 of 2	01/2010	no GSM	
205	335	S	HabSlab Control			1 of 2	01/2010	no GSM	
206	335	S	HabSlab Control			1 of 2	01/2010	no GSM	
207	335	S	HabSlab Control			1 of 2	01/2010	no GSM	
208	335	S	HabSlab Control			1 of 2	01/2010	no GSM	
209	335	S	HabSlab Control			1 of 2	01/2010	no GSM	
210	335	S	HabSlab Control			1 of 2	01/2010	no GSM	
211	335	S	HabSlab Control			1 of 2	01/2010	no GSM	
212	335	S	HabSlab Control			1 of 2	01/2010	no GSM	
213	335	S	HabSlab Control			1 of 2	01/2010	no GSM	
214	335	S	HabSlab Control			1 of 2	01/2010	no GSM	
215	335		Row&Adj		A1	1 of 2	01/2010	no GSM	
216	335	S	B	20	Lay	1 of 3	01/2010	no GSM	

B	Label								
Nr.	Property number	Direction	Site	Sample depth	Sample Nr.	Vials… of...	Date	ID	Sex
217	335	S	B	20	Lay	1 of 3	01/2010	no GSM	
218	335		Row&Adj		A5	2 of 3	01/2010	no GSM	
219	326		Broader Sheok		13	2 of 2	01/2010	no GSM	
220	327		Row&Adj		A3	1 of 2	01/2010	no GSM	
221	327		Row&Adj		A3	1 of 2	01/2010	no GSM	
222	335		Row&Adj		A5	1 of 3	01/2010	no GSM	
223	328		Row&Adj		A1	1 of 2	01/2010	no GSM	
224	328		Row&Adj		A1	1 of 2	01/2010	no GSM	
225	335		Row&Adj		A4	1 of 1	01/2010	no GSM	
226	330		Row&Adj		A5	1 of 3	01/2010	no GSM	
227	330		Row&Adj		A5	1 of 3	01/2010	no GSM	
228	328		Row&Adj		A7	1 of 2	01/2010	no GSM	
229	327		Row&Adj		A1	1 of 2	01/2010	no GSM	
230	330		Row&Adj		XI	2 of 3	01/2010	no GSM	
231	335		Row&Adj		A3	1 of 2	01/2010	no GSM	
232	335		Row&Adj		A3	1 of 2	01/2010	no GSM	
233	335		Row&Adj		A3	1 of 2	01/2010	no GSM	
234	328		Row&Adj		A3	1 of 2	01/2010	no GSM	
235	330		Row&Adj		A2	1 of 2	01/2010	no GSM	
236	330		Row&Adj		A2	1 of 2	01/2010	no GSM	
237	330		Row&Adj		A2	1 of 2	01/2010	no GSM	
238	328		Row&Adj		A2	1 of 2	01/2010	no GSM	
239	328		Row&Adj		A6	1 of 2	01/2010	no GSM	
240	326		Row&Adj		A4	1 of 3	01/2010	no GSM	
241	326		Row&Adj		A4	2 of 3	01/2010	no GSM	
242	328		Row&Adj		R3	1 of 2	01/2010	no GSM	
243	335		Row&Adj		A2	1 of 1	01/2010	no GSM	
244	326		Row&Adj		A2	1 of 2	01/2010	no GSM	
245	328		Row&Adj		A4	1 of 1	01/2010	no GSM	
246	326	S	HabSlabB	20	L	1 of 2	01/2010	no GSM	
247	326	S	HabSlabB	20	L	1 of 2	01/2010	no GSM	
248	326	S	HabSlabB	20	S	1 of 3	01/2010	no GSM	
249	326	S	HabSlabG	20	S	1 of 2	01/2010	no GSM	
250	326	S	HabSlabG	45			01/2010	no GSM	
251	326	S	HabSlabDistControl			1 of 3	01/2010	no GSM	
252	326	N	HabSlabB	20	Lay	1 of 3	01/2010	no GSM	
253	326	N	HabSlabB	20	Lay	1 of 3	01/2010	no GSM	

B	Label								
Nr.	Property number	Direction	Site	Sample depth	Sample Nr.	Vials… of...	Date	ID	Sex
254	326	N	HabSlabB	45		1 of 3	01/2010	no GSM	
255	326	N	HabSlabB	45	Lay	1 of 3	01/2010	no GSM	
256	326	N	HabSlabB	20	Lay	2 of 3	01/2010	no GSM	
257	326	N	HabSlabG	20		1 of 2	01/2010	no GSM	
258	326	N	HabSlabG	20		1 of 2	01/2010	no GSM	
259	326	N	HabSlabG	20		1 of 2	01/2010	no GSM	
260	327		HabSlabG	20	S	2 of 3	12/2009	no GSM	
261	327		HabSlabG	20	S	2 of 3	12/2009	no GSM	
262	327		HabSlabB	20	L	2 of 2	12/2009	no GSM	
263	327		HabSlabB	20	L	2 of 2	12/2009	no GSM	
264	327		HabSlabB	20	S	1 of 4	12/2009	no GSM	
265	327		HabSlabB	20	S	1 of 4	12/2009	no GSM	
266	327		HabSlabB	20	S	1 of 4	12/2009	no GSM	
267	327		HabSlabB	20	S	3 of 4	12/2009	no GSM	
268	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
269	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
270	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
271	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
272	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
273	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
274	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
275	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
276	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
277	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
278	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
279	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
280	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
281	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
282	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
283	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
284	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
285	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
286	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
287	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
288	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
289	327		HabSlabB	45	L	1 of 2	12/2009	no GSM	
290	327		HabSlabB	45	S	1 of 2	12/2009	no GSM	
291	327		HabSlabB	45	S	1 of 2	12/2009	no GSM	
292	327		HabSlabB	45	S	1 of 2	12/2009	no GSM	

B	Label								
Nr.	Property number	Direction	Site	Sample depth	Sample Nr.	Vials… of...	Date	ID	Sex
293	327		HabSlabB	45	S	1 of 2	12/2009	no GSM	
294	327		HabSlabB	45	S	1 of 2	12/2009	no GSM	
295	327		HabSlabG	45	S	1 of 4	12/2009	no GSM	
296	327		HabSlabG	20	L	2 of 2	12/2009	no GSM	
297	327		HabSlabG	20	L	2 of 2	12/2009	no GSM	
298	327		HabSlabG	20	L	2 of 2	12/2009	no GSM	
299	327		HabSlabG	20	L	2 of 2	12/2009	no GSM	
300	327		HabSlabG	20	L	2 of 2	12/2009	no GSM	
301	327		HabSlabG	20	L	2 of 2	12/2009	no GSM	
302	327		HabSlabG	20	L	2 of 2	12/2009	no GSM	
303	327		HabSlabG	20	L	2 of 2	12/2009	no GSM	
304	327		HabSlabG	20	L	2 of 2	12/2009	no GSM	
305	327		HabSlab Control			2 of 3	12/2009	no GSM	
306	327		HabSlab Control			2 of 3	12/2009	no GSM	
307	327		HabSlab Control			2 of 3	12/2009	no GSM	
308	327		HabSlab Control			2 of 3	12/2009	no GSM	
309	327		HabSlab Control			2 of 3	12/2009	no GSM	
310	327		HabSlab Control			2 of 3	12/2009	no GSM	
311	327		HabSlabG	45	S	1 of 4	12/2009	no GSM	
312	326	N	HabSlabG	20		1 of 3	12/2009	no GSM	
313	326	N	HabSlabG	20		1 of 3	12/2009	no GSM	
314	326	N	HabSlabB	20		1 of 3	12/2009	no GSM	
315	326	N	HabSlabB	20		1 of 3	12/2009	no GSM	
316	326	N	HabSlabB	20	Lay	4 of 4	12/2009	no GSM	
317	326	N	HabSlabG	45	Lay	1 of 2	12/2009	no GSM	
318	326	N	HabSlabG	20	Slab	4 of 4	12/2009	no GSM	
319	326	N	HabSlabG	20	Slab	4 of 4	12/2009	no GSM	
320	326	N	HabSlabG	20	Slab	4 of 4	12/2009	no GSM	
321	326	N	HabSlabG	20	Slab	4 of 4	12/2009	no GSM	
322	326	N	HabSlabG	20	Slab	4 of 4	12/2009	no GSM	
323	326	N	HabSlabG	20	Slab	4 of 4	12/2009	no GSM	
324	326	N	HabSlabG	20	Slab	4 of 4	12/2009	no GSM	
325	326	N	HabSlabG	20	Slab	4 of 4	12/2009	no GSM	

B	Label								
Nr.	Property number	Direction	Site	Sample depth	Sample Nr.	Vials… of...	Date	ID	Sex
326	326	N	HabSlabG	20	Slab	4 of 4	12/2009	no GSM	
327	326	N	HabSlabG	20	Slab	4 of 4	12/2009	no GSM	
328	326	N	HabSlabG	20	Slab	4 of 4	12/2009	no GSM	
329	326	N	HabSlabB	20	Lay	2 of 4	12/2009	no GSM	
330	326	N	HabSlabB	20	Lay	1 of 4	12/2009	no GSM	
331	326	N	HabSlabB	20	Lay	1 of 4	12/2009	no GSM	
332	326	N	HabSlabB	20	Lay	1 of 4	12/2009	no GSM	
333	326	N	HabSlabB	20	Lay	1 of 4	12/2009	no GSM	
334	326	N	HabSlabB	20	Lay	1 of 4	12/2009	no GSM	
335	326	N	HabSlabB	20	Lay	1 of 4	12/2009	no GSM	
336	326	N	HabSlabB	20	Lay	1 of 4	12/2009	no GSM	
337	326	N	HabSlabB	20	Lay	1 of 4	12/2009	no GSM	
338	326	N	HabSlabB	20	Lay	1 of 4	12/2009	no GSM	
339	326	N	HabSlabB	20	Lay	1 of 4	12/2009	no GSM	
340	326	N	HabSlabB	20	Lay	1 of 4	12/2009	no GSM	
341	326	N	HabSlabB	20	Lay	1 of 4	12/2009	no GSM	
342	326	N	HabSlabB	20	Lay	1 of 4	12/2009	no GSM	
343	326	N	HabSlabB	20	Lay	1 of 4	12/2009	no GSM	
344	326	N	HabSlabB	20	Lay	1 of 4	12/2009	no GSM	
345	326	N	HabSlab Disturbed Control			1 of 3	12/2009	no GSM	
346	326	N	HabSlab Undisturbed Control			1 of 2	12/2009	no GSM	
347	326	N	HabSlabB	45	Slab	1 of 2	12/2009	no GSM	
348	326	N	HabSlabB	45	Slab	1 of 2	12/2009	no GSM	
349	326	N	HabSlabB	45	Slab	1 of 2	12/2009	no GSM	
350	326	N	HabSlabB	45	Slab	1 of 2	12/2009	no GSM	
351	326	N	HabSlabB	45	Slab	1 of 2	12/2009	no GSM	
352	326	N	HabSlabB	45	Lay	1 of 2	12/2009	no GSM	
353	326	N	HabSlabB	45	Lay	1 of 2	12/2009	no GSM	
354	326	N	HabSlabB	45	Lay	1 of 2	12/2009	no GSM	
355	326	N	HabSlabB	45	Lay	1 of 2	12/2009	no GSM	
356	326	N	HabSlabB	45	Lay	1 of 2	12/2009	no GSM	
357	326	N	HabSlabB	45	Lay	1 of 2	12/2009	no GSM	
358	326	N	HabSlabB	45	Lay	1 of 2	12/2009	no GSM	
359	326	N	HabSlabB	45	Lay	1 of 2	12/2009	no GSM	

B	Label								
Nr.	Property number	Direction	Site	Sample depth	Sample Nr.	Vials… of...	Date	ID	Sex
360	326	N	HabSlabB	45	Lay	1 of 2	12/2009	no GSM	
361	326	N	HabSlabB	45	Lay	1 of 2	12/2009	no GSM	
362	326	N	HabSlabB	45	Lay	1 of 2	12/2009	no GSM	
363	326	N	HabSlabB	45	Lay	1 of 2	12/2009	no GSM	
364	326	N	HabSlabB	45	Lay	1 of 2	12/2009	no GSM	
365	326	N	HabSlabB	45	Lay	1 of 2	12/2009	no GSM	
366	326	N	HabSlabB	45	Lay	1 of 2	12/2009	no GSM	
367	326	N	HabSlabB	45	Lay	1 of 2	12/2009	no GSM	
368	335	N	HabSlabG	45	S	1 of 2	01/2010	no GSM	
369	335	N	HabSlabB	20	S	1 of 4	01/2010	no GSM	
370	335	N	HabSlabB	20	S	1 of 4	01/2010	no GSM	
371	335	N	HabSlabB	45	L	1 of 5	01/2010	mostl likely GSM, only parts of the head available for ID	
372	335	N	HabSlabB	45	L	4 of 5	01/2010	no GSM	
373	335	N	HabSlabB	20	L	1of 2	01/2010	no ID possible, only fragments	
374	335	N	HabSlabB	45	L	2 of 5	01/2010	no GSM	
375	335	N	HabSlabB	45	L	2 of 5	01/2010	no GSM	
376	335		HabSlabB	20	S	3 of 4	01/2010	no GSM	
377	335		HabSlabB	20	S	3 of 4	01/2010	no GSM	
378	335	N	HabSlabG	45	L	1 of 2	01/2010	no GSM	
379	335	N	HabSlabG	20	S	1 of 3	01/2010	no GSM	
380	328		HabSlabB	45	Slab	3of 4	12/2009	no GSM	
381	328		HabSlabG	45	L	1 of 3	12/2009	no GSM	
382	328		HabSlabG	45	L	1 of 3	12/2009	no GSM	
383	328		B	20	Slab	1 of 3	12/2009	no GSM	
384	328		B	20	Slab	1 of 3	12/2009	no GSM	
385	328		B	20	Slab	1 of 3	12/2009	no GSM	
386	328		B	20	Slab	1 of 3	12/2009	no GSM	

B	Label								
Nr.	Property number	Direction	Site	Sample depth	Sample Nr.	Vials… of...	Date	ID	Sex
387	328		B	20	Slab	1 of 3	12/2009	no GSM	
388	328		B	20	Slab	1 of 3	12/2009	no GSM	
389	328		B	20	Slab	1 of 3	12/2009	no GSM	
390	328		B	20	Slab	1 of 3	12/2009	no GSM	
391	328		HabSlabB	45	Lay	1 of 3	12/2009	no GSM	
392	328		HabSlabB	45	Lay	1 of 3	12/2009	no GSM	
393	328		HabSlabB	45	Lay	1 of 3	12/2009	no GSM	
394	328		HabSlabB	45	Lay	1 of 3	12/2009	no GSM	
395	328		HabSlabB	20	Lay	1 of 2	12/2009	no GSM	
396	328		HabSlabB	20	Lay	1 of 2	12/2009	no GSM	
397	328		HabSlabB	20	Lay	1 of 2	12/2009	no GSM	
398	328		HabSlabB	20	Lay	1 of 2	12/2009	no GSM	
399	328		HabSlabB	20	Lay	1 of 2	12/2009	no GSM	
400	328		HabSlabB	20	Lay	1 of 2	12/2009	no GSM	
401	328		HabSlabB	20	Lay	1 of 2	12/2009	no GSM	
402	328		HabSlabB	20	Lay	1 of 2	12/2009	no GSM	
403	328		HabSlabB	20	Lay	1 of 2	12/2009	no GSM	
404	328		HabSlabB	20	Lay	1 of 2	12/2009	no GSM	
405	328		HabSlabB	45	Slab	1 of 4	12/2009	no GSM	
406	328		HabSlabG	20	Lay	1 of 2	12/2009	no GSM	
407	328		HabSlabG	20	Lay	1 of 2	12/2009	no GSM	
408	328		HabSlabG	20	Slab	1 of 4	12/2009	no GSM	
409	328		HabSlabG	20	Slab	1 of 4	12/2009	no GSM	

* Highlighted areas indicate that missing information's on the labels.

Appendix C

Habitat Slab Experiment – Adult GSM Survey Results

Table 17: Number of adults observed for the Habitat Slab Replacement experiment for property 326 North

Treatment	Survey 1		Survey 2		Survey 3		Survey 4		Total
	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	
G45 Laydown	0	0	1	1	0	0	0	0	**2**
G45 Slab	0	0	0	1	0	0	0	0	**1**
G20 Laydown	0	0	2	0	0	0	0	0	**2**
G20 Slab	0	0	0	0	0	0	0	0	**0**
B45 Laydown	0	0	0	0	0	0	0	0	**0**
B45 Slab	0	0	2	0	0	0	0	0	**2**
B20 Laydown	0	0	2	0	0	0	0	0	**2**
B20 Slab	0	0	1	0	1	0	0	0	**2**
Control	0	0	7	0	2	0	0	0	**9**
Dist. control	0	0	0	0	0	0	0	0	**0**

Table 18: Number of adults observed for the Habitat Slab Replacement experiment for property 326 South

Treatment	Survey 1		Survey 2		Survey 3		Survey 4		Total
	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	
G45 Laydown	0	0	0	0	0	0	0	0	0
G45 Slab	0	0	0	0	0	0	0	0	0
G20 Laydown	0	0	0	0	0	0	0	0	0
G20 Slab	0	0	0	0	0	0	0	0	0
B45 Laydown	0	0	0	0	0	0	0	0	0
B45 Slab	0	0	0	0	0	0	0	0	0
B20 Laydown	0	0	0	0	0	0	0	0	0
B20 Slab	0	0	0	0	0	0	0	0	0
Control	0	0	0	0	0	0	0	0	0
Dist. control	0	0	0	0	0	0	0	0	0

Table 19: Number of adults observed for the Habitat Slab Replacement experiment for property 327

Treatment	Survey 1		Survey 2		Survey 3		Survey 4		Total
	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	
G45 Laydown	1	0	0	0	0	0	0	0	**1**
G45 Slab	6	0	1	0	0	0	0	0	**7**
G20 Laydown	9	0	4	0	1	0	0	0	**14**
G20 Slab	4	0	1	0	0	0	0	0	**5**
B45 Laydown	2	0	4	0	0	0	0	0	**6**
B45 Slab	3	0	2	0	0	0	0	0	**5**
B20 Laydown	5	0	0	0	0	0	0	0	**5**
B20 Slab	19	0	0	0	0	0	0	0	**19**
Control	147	0	13	0	0	0	0	0	**160**
Dist. control	4	0	1	0	0	0	0	0	**5**

Table 20: Number of adults observed for the Habitat Slab Replacement experiment for property 328

Treatment	Survey 1		Survey 2		Survey 3		Survey 4		Total
	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	
G45 Laydown	0	0	0	0	0	0	0	0	**0**
G45 Slab	0	0	0	0	0	0	0	0	**0**
G20 Laydown	0	0	0	0	0	0	0	0	**0**
G20 Slab	0	0	0	0	0	0	0	0	**0**
B45 Laydown	0	0	0	0	0	0	0	0	**0**
B45 Slab	0	0	0	0	0	0	0	0	**0**
B20 Laydown	0	0	0	0	0	0	0	0	**0**
B20 Slab	0	0	0	0	0	0	0	0	**0**
Control	0	0	0	0	10	0	0	0	**10**
Dist. control	0	0	0	0	0	0	0	0	**0**

Table 21: Number of adults observed for the Habitat Slab Replacement experiment for property 335 North

Treatment	Survey 1		Survey 2		Survey 3		Survey 4		Total
	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	
G45 Laydown	9	0	3	0	0	0	0	0	**12**
G45 Slab	6	0	2	0	0	0	0	0	**8**
G20 Laydown	2	0	1	0	1	0	0	0	**4**
G20 Slab	7	0	7	0	1	0	0	0	**15**
B45 Laydown	9	9	297	0	15	0	10	0	**340**
B45 Slab	10	3	81	1	3	1	1	0	**100**
B20 Laydown	1	0	2	0	0	0	0	0	**3**
B20 Slab	7	0	0	0	0	0	0	0	**7**
Control	0	1	99	0	8	0	0	0	**108**
Dist. control	4	0	0	0	0	0	2	0	**6**

Table 22: Number of adults observed for the Habitat Slab Replacement experiment for property 335 South

Treatment	Survey 1		Survey 2		Survey 3		Survey 4		Total
	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	Fly over, in or out	On ground or veg.	
G45 Laydown	0	0	0	0	0	0	0	0	**0**
G45 Slab	0	0	0	0	0	0	0	0	**0**
G20 Laydown	2	0	0	0	0	0	0	0	**2**
G20 Slab	5	0	0	0	0	0	0	0	**5**
B45 Laydown	1	0	0	0	0	0	0	0	**1**
B45 Slab	2	0	0	0	0	0	0	0	**2**
B20 Laydown	2	0	1	0	0	0	0	0	**3**
B20 Slab	0	0	0	0	0	0	0	0	**0**
Control	0	0	0	0	0	0	0	0	**0**
Dist. control	1	0	0	0	0	0	0	0	**1**

Table 23: Total number of adults observed for the different treatments in the Habitat Slab Replacement experiment (from four visits during the 2009-2010 flight season).

Treatment	Property						Average (± SE)
	326 North	326 South	327	328	335 North	335 South	
G45 Laydown	2	0	1	0	12	0	**2.5 (+ 1.9)**
G45 Slab	1	0	7	0	8	0	**2.7 (+ 3.8)**
G20 Laydown	2	0	14	0	4	2	**3.7 (+2.2)**
G20 Slab	0	0	5	0	15	5	**4.2 (+ 2.4)**
B45 Laydown	0	0	6	0	340	1	**57.8 (+ 56.4)**
B45 Slab	2	0	5	0	100	2	**18.2 (+ 16.4)**
B20 Laydown	2	0	5	0	3	3	**2.2 (+0. 8)**
B20 Slab	2	0	19	0	7	0	**4.7 (+3.0)**
Control	9	0	160	10	108	0	**47.8 (+ 28.1)**
Dist. control	0	0	5	0	6	1	**2.0 (+ 1.1)**
Total	**20**	**0**	**227**	**10**	**603**	**14**	**145.7 (+98.1)**