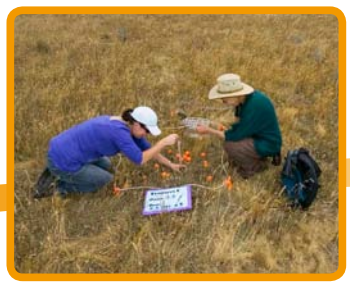
Moths in the Sun

Community Monitoring of the Golden Sun Moth at Derrimut Grassland Reserve, Victoria 2008-2010



NatureWatch is the Victorian National Parks Association's community biodiversity monitoring program

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October 2011

Prepared by Caitlin Griffith and Ada Nano

Based on a report template prepared by Sally Koehler and Daniel Gilmore from Biosis Research Pty Ltd. All text on Golden Sun Moth biology provided by Biosis Research.

Victorian National Parks Association

The Victorian National Parks Association (VNPA) is the leading voice for nature conservation in Victoria. Formed in 1952, we are an independent, not-for-profit membership-based organisation dedicated to the protection of Victoria's unique natural environment and its wildlife. We also run the largest bushwalking and outdoor activities program in Victoria. In 1952, Victoria had just 13 small national parks. Today, largely due to VNPA's efforts, Victoria has 40 nationals parks, 24 marine national parks and sanctuaries, and 55 other parks protecting more than 3 million hectares of Victorian habitat.

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NatureWatch

The Victorian National Parks Association's NatureWatch program is a community-based biodiversity monitoring program which informs, educates and engages the community in conservation management and practice. The NatureWatch program actively builds links between community members, scientists, and land managers, and develops scientifically based, practical projects that contribute to a better understanding of species and ecosystems, threatening processes, and the management of natural areas.

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ABBREVIATIONS

BOM	Bureau of Meteorology
DSE	Department of Sustainability & Environment
EPBC	Environment Protection and Biodiversity Conservation Act 1999
FFG	Flora and Fauna Guarantee Act 1988 (Vic.)
GSM	Golden Sun Moth
DEWHA	Department of the Environment, Water, Heritage and the Arts

SUMMARY

This report presents the results of the VNPA's NatureWatch Golden Sun Moth monitoring program for the 2008/9, 2009/10 and 2010/2011 seasons in the Derrimut Grassland Reserve. The monitoring program was developed by the VNPA's NatureWatch program in partnership with Biosis Research, Merri Creek Management Committee, the Department of Sustainability and Environment, and Parks Victoria.

The objectives of this monitoring were to:

(1) Document the distribution of Golden Sun Moths within the Derrimut Grassland Reserve.

(2) Determine whether there is a relationship between the distribution and abundance of moths and biomass (mown and unmown areas).

The surveys were carried out on a pre-determined 40ha grid that incorporated an area mown regularly by the Victorian Association for Radio Model Soaring (VARMS) as well as unmown areas. The grid comprised a series of four transects (A-D) spaced 100m apart with 10 spot survey points located at 100m intervals along each transect. At each spot point, observers stood for 60 seconds and counted all moths flying within a radius of 30m. Numbers of individual moths observed while volunteers were walking between the points and while at the points, but outside of the 60 second count, were also recorded. These were considered two separate counts of moths – 'point counts' and 'transect counts'.

In addition to Golden Sun Moth data, biomass was measured at each point with a cover abundance technique that uses brightly coloured golf balls.

In November and December 2008, 28 volunteers from the Victorian National Parks Association visited the grassland to take counts of Golden Sun Moths and measure habitat variables. Surveys were conducted on four occasions. A total of 40 Golden Sun Moths were recorded over the four days.

NatureWatch volunteers and local community groups were involved in monitoring the Golden Sun Moths at Derrimut again in November and December 2009. This involved 22 volunteers undertaking counts on three occasions. A total of 30 Golden Sun Moths were recorded over the three days.

There was also a survey of the Ravenhall Grassland Reserve in 2009 to determine if Golden Sun Moths occurs there, but none were observed.

In 2010 two surveys were carried out at Derrimut Grassland with zero moths recorded due to poor monitoring conditions.

As predicted, the Derrimut Golden Sun Moth population appears to be largely associated with the slashed area with scattered records in the surrounding unslashed grassland. This is consistent with the species' preference for grasslands with relatively low biomass. Compared to some other sites around Melbourne, the Derrimut Grasslands Golden Sun Moth population is relatively small.

Biomass (golf ball score) / vegetation cover abundance data recorded in quadrats at each of the point requires analysis by a statistician to determine whether there are any meaningful differences between areas where Golden Sun Moths were recorded and not recorded. At present the dataset is too small to enable analysis. Analysis will be possible following the collection of additional data in 2011.

This report has been prepared for land managers, project partners, volunteers, community groups and interested community members. It will be progressively updated with each year of data collected by the community.

1.0 INTRODUCTION

1.1 Project Background

The Golden Sun Moth (hereafter referred to as the GSM) is listed as threatened in all states and territories in which it occurs (Gilmore et al. 2008). In Victoria it is listed as threatened under the Flora and Fauna Guarantee Act, 1988. The species is also listed as critically endangered under the Federal Environment Protection and Biodiversity Conservation Act, 1999.

In 2008 the Victorian National Parks Association (VNPA) commissioned Biosis Research Pty Ltd to assist the NatureWatch program in developing a community-based monitoring program for the Golden Sun Moth (*Synemon plana*). Biosis developed the monitoring techniques and identified the study area for the program in consultation with Parks Victoria, the Department of Sustainability and Environment (DSE) and the Merri Creek Management Committee. Field-based zoological advice for the 2008 surveys was also provided by Biosis, which has been providing ongoing advice on monitoring, data analysis and reporting since that time.

Volunteers are a vital part of Golden Sun Moth monitoring.
Photo: Michael Williams

1.2 Study Area

The Derrimut Grassland Reserve was selected as the study area on the basis of:

- GSM being previously recorded at the reserve in 2006 (D. Gilmore, Biosis Research, pers. obs.).
- Little being known of the species' abundance and distribution within the reserve as no surveys had been conducted since that time.
- A desire to test GSM distribution in relation to mown and unmown areas. An area of the grassland is leased by the Victorian Association for Radio Model Soaring (VARMS) from Parks Victoria and is mown regularly for the purposes of flying model aeroplanes (take off and landing area). The area outside the mown area is managed by Parks Victoria and is not regularly mown / slashed. This provides an opportunity to look at GSM occurrence in relation to biomass within the reserve.

The Derrimut Grassland Reserve is located approximately 16km west of the Melbourne CBD. It is bounded on the north by the Western Ring Road, on the east by industrial estates, on the south by Boundary Road, and on the west by Fitzgerald Road. The reserve is rectangular in shape and is approximately 200ha in area. The survey area is located in the south-east portion of the reserve and comprises approximately 40ha of mown and unmown grassland habitat.

The study area lies within the Victorian Volcanic Plain Bioregion (Department of Primary Industries, Victorian Resources online: www.dpi.vic.gov.au/vro).

Ravenhall Grassland was also selected as a good site to determine presence of the species. This is based on GSM previously being recorded at the site and an interest in determining if they are still present.

1.3 Objectives

The GSM surveys were undertaken by the VNPA NatureWatch program to give an indication of:

- Distribution of GSM in the Derrimut Grassland Reserve.
- Local abundance of GSM and its variation within the survey area (mown and unmown areas).
- Variation in numbers over the flight season.
- An indication of presence of GSM at Ravenhall Grassland.

The surveys form the basis of a longer-term monitoring program for GSM and provide an opportunity for community involvement in conservation related projects.

1.4 Biology of the Golden Sun Moth

The GSM is a medium sized, diurnal (day flying) moth with clubbed antennae (Edwards 1993).

The species is sexually dimorphic (i.e. males and females are different in size and shape) with the females having an enlarged abdomen and ovipositor that aids for egg laying. Male and female moths can also be differentiated by their wing colour. The forewings of female GSMs are brown and grey while the hind wings are yellow with black spots. Male GSMs have dark brown forewings with grey scales and bronze-coloured hindwings. The underside of both pairs of wings is white with small black spots along the margin in females and pale grey with dark brown spots in the males (DEWHA 2009).

The females, which only fly irregularly, position themselves on the ground in a conspicuous location (usually inter-tussock spaces), flashing their golden hind wings (petticoats) to the males, who fly low over the grasses searching for them.

Potential habitat for the GSM consists of areas across the historical range of the species which previously or currently support native grasslands or grassy woodlands (including derived grasslands) (DEWHA 2009).

Previous studies found that GSM prefer habitat dominated by wallaby grasses *Austrodanthonia* spp. (particularly *A. carphoides*, *A. auriculata*, *A. setacea*, *A. eriantha*, *A. racemosa*). However, more recent surveys have found the GSM to occur in degraded grasslands and patches invaded with weedy species, including exotic Chilean Needle-grass (*Nasella nessiana*), Native Redleg Grass (*Bothriochloa macra*), spear grasses (*Austrostipa* spp.) and Weeping Grass (*Microlaena stipodes*) dominated areas (Braby and Dunford 2006; DEWHA 2009; Gilmore et al 2008).

Inter-tussock spaces (the spaces between tufts / tussocks of grass) are believed to be important in assisting patrolling males to locate females, which display on the ground from a sedentary position (Gilmore et al. 2008). It is assumed this is because open spaces make it easier for the males to see the females. This is supported by higher numbers of male moth observations in relatively open areas with reduced biomass, suggesting females are in turn present in those areas (Gilmore et al. 2008).

Sites considered marginal or unsuitable for GSM include cropped or recently ploughed areas (Gilmore et al. 2008). However, virtually all other grassland and grassy woodland within the species' historic range that support some native grasses, or introduced grasses of the genus *Nassella*, have the potential to support the species.

Female Golden Sun Moth.

Male Golden Sun Moth.
Photos: N. Garvey & D. Gilmore, Biosis Research Pty Ltd

GSM breeding season generally begins in mid October and continues through to early January (DEWHA 2009). However, timing of the breeding season differs slightly between locations and as a consequence of climatic conditions (DEWHA 2009). When conditions are favourable during this period, adult moths emerge continuously in cohorts and males are seen actively flying in search of females.

It was previously thought that GSM only fly on warm (>20 degrees Celsius), calm days with little or no cloud and during the hottest part of the day (between 10.00 hrs and 14.00 hrs) (Clarke and O'Dwyer 2000). However, since 2005 Biosis Research have often recorded active male GSM on cooler days, on days of partial or full cloud cover, on days within 24 hours following rainfall, during times of moderate to strong wind conditions, and also at times earlier and later in the day than previously thought

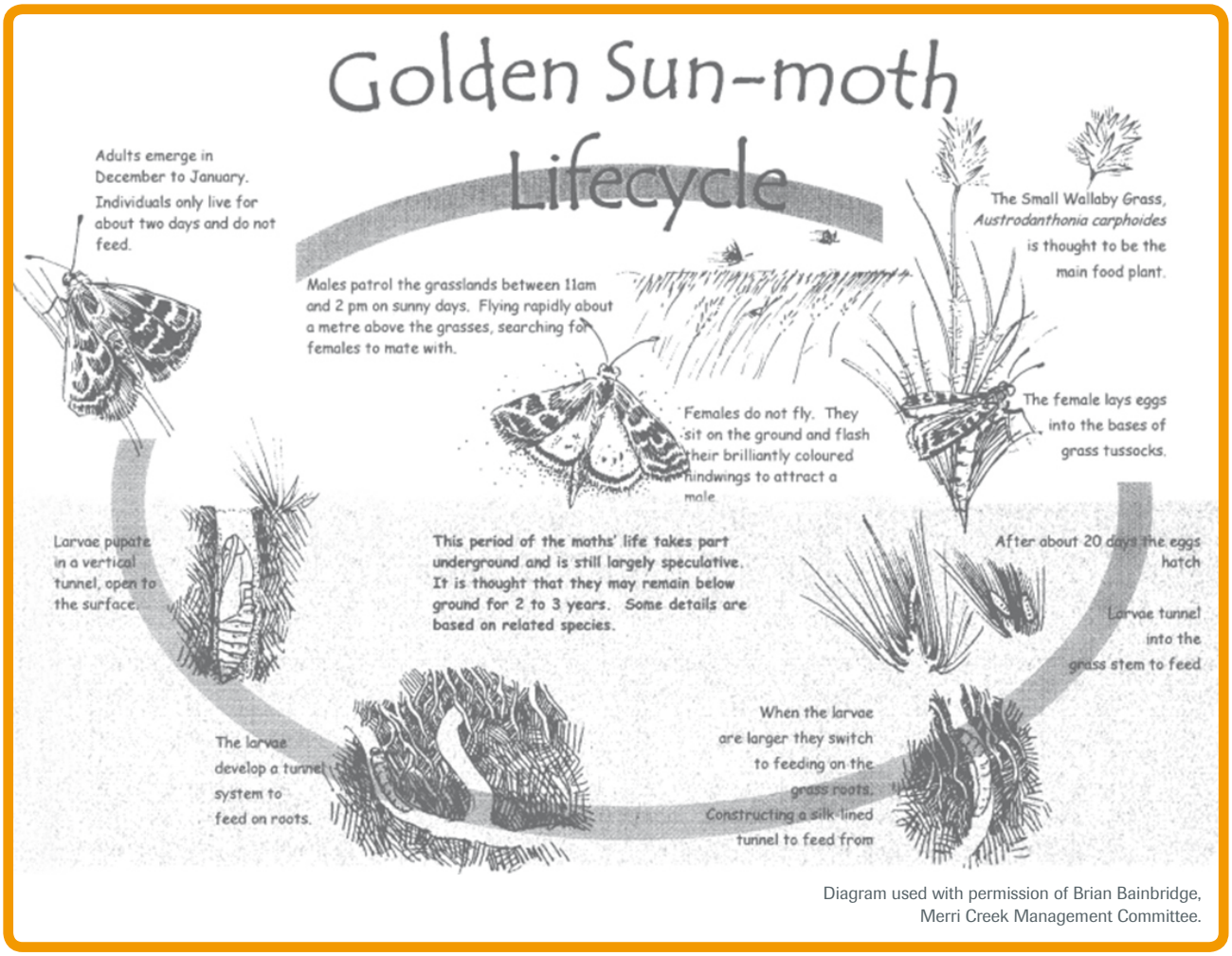

Diagram used with permission of Brian Bainbridge, Merri Creek Management Committee.

suitable. Some observations of moth activity outside of 'optimal' conditions have involved large numbers of individuals, but more typically smaller numbers of moths are observed under these conditions. Surveys conducted when conditions are less than optimal can be sufficient to determine presence / absence of the species at locality, but are considered less reliable when trying to determine population abundance and extent at a site.

Male flight is low, to about a metre, fast and typically in a zig-zag pattern as they 'patrol' for females. Females have been observed flying without provocation and are capable of flying distances of > 40m. However, compared to males they are relatively sedentary, and when laying eggs females typically walk from tussock to tussock. They lay between 100 and 150 eggs either between the tillers of a grass tussock or between the tillers and the soil (Gibson 2006).

GSM larvae are thought to spend 1-4 years underground feeding on the roots of native perennial grasses. The diet of GSM was previously thought to exclusively consist of the roots of wallaby-grasses (*Austrodanthonia* spp.) but this has never been proven (Gibson 2006). Recently it has been suggested that GSM larvae may also feed on the roots of spear-grasses (*Austrostipa* spp.), Red-leg Grass *Bothriochloa macra* and even the introduced Chilean Needle-grass *Nassella nessianta* due to the presence of cast pupa shells found protruding from Chilean Needlegrass tussocks (Braby and Dunford 2006; Gilmore et al. 2008). Their preferred food plants are currently being investigated in a collaborative study by Biosis Research and the University of Canberra.

Adult moths do not have functional mouthparts and therefore are unable to feed. This generally reduces their adult life to just a few days (O'Dwyer and Attiwill 2000).

The Merri Creek Management Committee has produced a useful diagram to illustrate the life cycle of the GSM (pictured above).

2.0 SURVEY METHODS

The following GSM survey methodology was devised on the basis of current literature, observations by Biosis Research since 2005, direction from the VNPA NatureWatch program, advice from the Department of the Environment, Water, Heritage and the Arts (DEWHA) and discussions with Tamara Karner (Parks Victoria) and Brian Bainbridge (Merri Creek Management Committee).

2.1 Methods

Field surveys were undertaken during the 2008, 2009 and 2010 flight seasons of the GSM.

To determine the beginning of the flight season, known populations around Melbourne were monitored by Biosis Research. When male moths began flying in good numbers at known sites, it was assumed the species would be flying at Derrimut Grassland Reserve and the VNPA commenced surveys.

Derrimut Grassland Reserve was visited on four suitable days between 30 November and 11 December 2008, three days between 6 November and 15 December 2010, and two days in November and December 2010. Surveys were generally spaced a week apart to allow for variations in emergence patterns.

Ravenhall Grassland has been surveyed twice in November and December 2009.

Surveys took place when conditions were suitable for male flight (generally >20°C, bright, clear days, full sun, absence of rain and wind other than a light breeze) generally between 10.00 hrs and 14.00 hrs. Each survey generally took between one and three hours to complete. Suitable survey days were determined by examining weather conditions on the Bureau of Meteorology (BOM) website.

Representatives from Biosis Research (Sally Koehler and Daniel Gilmore) attended the first survey day in 2008 to provide an outline of the ecology of GSM and training for the NatureWatch volunteer team leaders in the survey techniques. The NatureWatch Coordinator and volunteer team leaders coordinated subsequent monitoring by volunteers during 2009 and 2010.

Point counts/'spot surveys'

On suitable days, a series of 'spot surveys' were led by a NatureWatch team leader with up to eight volunteers.

The site was surveyed systematically by a pair of observers walking a series of four transects spaced 60m apart with 10 spot survey sites located at 60m intervals along the transect. Spot points were located using a GPS containing pre-designated waypoints on the "go to" function. Team leaders marked each spot with temporary flags in the morning prior to the survey commencing. Permanently marking each spot survey point was not possible given the survey grid is partially within a model aircraft runway area.

Observer pairs stood at each spot point for 60 seconds and Volunteer 1 counted all moths flying within a radius of 30 m (reflecting the greatest distance at which the moths can be detected easily while flying over grassland with vegetation up to about 0.5 m tall). Observers took care to minimise double counting any individual moths. Volunteer 2 completed the data sheet and also timed the observations, recorded GPS coordinates and took photo points from the spot. Each team completed one transect.

Transect counts

Moth observations were also recorded while walking between spot points (recorded as 'sightings in intervening transect') and at each spot point outside of the count times (recorded as 'incidental sightings'). These observations were not added to the timed spot counts as this could lead to double counts of individual moths. A data sheet was used to record the survey information including number of male and/or female moths observed, weather conditions at the time of the survey and vegetation quadrat data.

Quadrats

In an attempt to note any variation in distribution or abundance of GSM within the grid (mown and unmown areas), grassland biomass accumulation was measured.

On the return walk back along each transect after the GSM survey was completed, the teams established a 1m x 1m quadrat at each of the spot count locations. Eighteen bright orange golf balls were then scattered (dropped from shoulder height) within the quadrat and a photo taken for reference. The number of golf balls visible from a fixed vantage point was then recorded.

The 'score' of the quadrat was then determined on the basis of how much of each ball was visible as follows:

- if more than 90% of a golf ball is visible the ball scores 1;
- if less than 90% of the golf ball but more than 33% is visible, the ball scores 0.5;
- if less than 33% of the golf ball is visible, the ball scores 0.

The total score for a quadrat is then calculated adding the scores for each ball together. A total score of 0 to 4 is equivalent to 'high biomass', 5 to 13 is equivalent to 'medium biomass' and 14 to 18 is equivalent to 'low biomass'.

The number of balls in each category in the quadrat

NatureWatch volunteers conducting Golden Sun Moth surveys. Photo: Caitlin Griffith, VNPA

is then added up to give a total score of biomass. This method was devised by the VNPA on the basis of information provided by Parks Victoria (M. Keatley, Parks Victoria) on work by John Morgan and Nick Schulz from La Trobe University:

Other habitat measurements were taken within the quadrats as follows:

- Percentage cover of vegetation (including dead plant matter) within increments of <5%, 6-25%, 26-50%, 51-75%, 75-100%.
- Percentage cover of bare ground/rock (including dead plant matter) within increments of <5%, 6-25%, 26-50%, 51-75%, 75-100%.
- Approximate grass height using a tape measure. Five measurements of grass height were taken within each quadrat and averaged.
- Percentage cover of *Austrodanthonia* spp. and *Nasella* spp. only by those Team Leaders or volunteers experienced in identifying grasses.

2.2 Limitations

In 2008, Melbourne GSM populations were first observed flying on 5 November 2008 and finished in late December 2008 (Biosis Research unpublished data). As such, the surveys were conducted within the known flight season.

The difficulties of estimating abundance and variations in numbers of GSM (both spatially and temporally)

NatureWatch volunteers conducting quadrat survey. Photo: Caitlin Griffith, VNPA

are acknowledged by DEWHA and are documented in Gibson and New (2007). Because of the very short adult life span any one individual will be present over a few days only. They effectively exist as a series of cohorts which emerge progressively during the flight season. The extent of each cohort seems to be variable so a census on any one day can differ appreciably from that taken a few days later.

Therefore the numbers of GSM recorded during the VNPA NatureWatch surveys do not represent the number of individuals present on the site; rather they give a 'snapshot' of the number of adults flying on the days surveyed. However, the results do give an indication of whether the population is relatively large or small compared to other known populations.

NatureWatch volunteers included a mix of people from the community including skilled ecologists and others with no formal ecology training.

3.0 SURVEY RESULTS

Derrimut Grassland

In November and December 2008, 28 volunteers visited the grassland to take counts of GSM and measure GSM habitat variables. Surveys were conducted on four occasions.

Data collected during the surveys is provided in Appendix 4 (summary data) and Appendix 5 (raw data). The total number of GSM recorded is summarised in Table 1.

The average number of moths recorded during the 2008 surveys was 10 individuals on a given day. A total of 40 moths were recorded across the four surveys; no female moths were recorded. When compared with other populations around Melbourne, the population within the Derrimut Grassland Reserve is small.

In November and December 2009 the survey was repeated with 14 volunteers. Surveys were conducted on three occasions.

The average number of moths recorded during the 2009 surveys was 10 individuals on a given day. However, unlike the 2008 season most moths were recorded on one of these days rather than evenly spread across the three. A total of 30 moths were recorded across three surveys; no female moths were recorded.

Table 4 outlines the records of GSM by survey method with incidental observations having the highest number of recordings. This may be because these records can be taken at any time (e.g. when doing habitat assessments), giving a longer period of time for which records can be taken.

The population appears to be largely associated with the mown area with scattered records in the surrounding unmown grassland. Average biomass score and biomass categories are outlined in Table 5. This data requires further analysis by a statistician. The

	30/11/2008	4/12/2008	6/12/2008	11/12/2008
Transect A	3	3	0	2
Transect B	4	7	9	8
Transect C	2	0	1	0
Transect D	0	1	0	0
Total	9	11	10	10

Table 1. Summary of results of GSM monitoring, 2008 season, Derrimut Grassland Reserve.

	6/11/2009	14/11/2009	15/12/2009
Transect A	1	13	1
Transect B	0	10	5
Transect C	0	0	0
Transect D	0	0	0
Total	1	23	6

Table 2. Summary of results of GSM monitoring, 2009 season, Derrimut Grassland Reserve.

	6/11/2010	13/11/2010
Transect A	0	0
Transect B	0	0
Transect C	0	-
Transect D	0	-
Total	0	0

Table 3. Summary of results of GSM monitoring, 2009 season, Derrimut Grassland Reserve.

Method	Number of moths 2008	Number of moths 2009	Number of moths 2010	Total Number of moths
Point counts	13	4	0	17
Intervening transect	8	3	0	11
Incidental observation	19	23	0	42
Total	40	30	0	

Table 4. Number of moths record by survey method.

Point No.	Average biomass score and biomass category 2008	# GSM recorded 2008	Average biomass score 2009	# GSM recorded 2009	Point No.	Average biomass score 2008	# GSM recorded 2008	Average biomass score 2009	# GSM recorded 2009
1A	13.5 low	0	15.3 low	0	1C	17.8 low	0	18	0
2A	15.2 low	0	16.8 low	0	2C	15.2 low	1	17.8	0
3A	15.5 low	1	16.7 low	0	3C	14.3 low	0	17.3	0
4A	N/A (carpark)	0	16 low	0	4C	16.2 low	0	17.3	0
5A	17.2 low	0	16.7 low	1	5C	15.3 low	0	17.8	0
6A	14.8 low	0	17.3 low	1	6C	14.8 low	0	17.3	0
7A	16.5 low	1	18 low	0	7C	14.3 low	0	17.7	0
8A	14.2 low	2	17.5 low	0	8C	14.3 low	1	17.2	0
9A	15.7 low	1	17.8 low	0	9C	15.2 low	1	16.5	0
10A	14.0 low	0	16 low	0	10C	17.2 low	0	17.3	0
1B	17.8 low	1	17.8 low	0	1D	15.3 low	0	18	0
2B	15.8 low	0	15 low	0	2D	14.5 low	0	17.6	0
3B	16.0 low	5	17.2 low	0	3D	15.5 low	0	17.8	0
4B	18.0 low	1	18 low	4	4D	16.0 low	1	17.8	0
5B	15.5 low	4	18 low	1	5D	14.5 low	0	16.8	0
6B	15.5 low	0	17.8 low	0	6D	15.2 low	0	15.8	0
7B	13.3 low	0	17.5 low	0	7D	15.0 low	0	17.8	0
8B	13.3 low	0	16.5 low	0	8D	15.8 low	0	17	0
9B	12.3 medium	0	16.5 low	0	9D	12.3 medium	0	13	0
10B	16.0 low	1	14.3	0	10D	15.5 low	0	15.3	0

Table 5. Average biomass (golf ball) score for 3 quadrats and number of . Note: # GSM recorded includes number at point count and intervening transect, not incidental counts.

biomass scores and categories show that the biomass across the area surveyed at Derrimut Grassland Reserve was generally low in 2008 and 2009. Biomass data was not recorded in 2010.

While GSM records are predominantly found in the mown area, based on the survey method, the biomass across the full study area is generally low. This method does not appear to have picked up differences in biomass between the mown and unmown areas, which can be seen on observation.

Other records

Ecology Australia observed 10-15 individuals in the south-west corner of the Derrimut Grassland Reserve (west of Anderson's Swamp) during surveys in the local area in November 2008 (C. Renowden, Ecology Australia, pers. comm.). The species is therefore more widespread in the reserve than previously thought

Ravenhall Grassland

Two surveys took place at Ravenhall Grassland Reserve in 2009. No GSM were recorded. Further surveys will need to take place at this site as survey effort to date has been low.

4.0 DISCUSSION

Derrimut Grassland Reserve

The GSM monitoring project confirmed the presence of GSM within Derrimut Grassland Reserve. The area supporting the largest number of GSM appears to be the mown area. The population is small compared with others around Melbourne.

Ravenhall Grassland Reserve

While surveys have not yet had any records of GSM at Ravenhall Grassland Reserve, further surveys still need to be conducted at the site on days where GSM are known to be flying at other sites.

Subsequent surveys

Surveys in future years may require greater repetition i.e. each site surveyed more times. This will be determined in future discussions.

Recommendations for surveys

Given GSM have now been recorded elsewhere in the Derrimut Grassland Reserve, future monitoring could be expanded to incorporate other areas of the reserve to determine the extent of the population. A statistician could be engaged to analyse the quadrat data.

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