Aurora Reserves:

Golden Sun Moth monitoring 2017–18 season

FINAL REPORT

Prepared for Lendlease Communities

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- Daniel Gilmore, Andrea Fullagar, Caitlin Potts, Imogen Merlo, Kym Oataway, Lauren Stoot (Fieldwork)
- Kristin Campbell (Project management)
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1. Introduction

Biosis Pty Ltd was commissioned by Lendlease Communities to conduct annual monitoring of Golden Sun Moth *Synemon plana* throughout the Aurora residential development area at Epping, Victoria (Figure 1). Golden Sun Moth (GSM) is a listed Matter of National Environmental Significance (MNES) under the *Environment and Protection Biodiversity Conservation Act 1999* (EPBC Act).

1.1 Golden Sun Moth Background

GSM is a medium sized, diurnal (day flying) moth with clubbed antennae (Edwards 1993). The species is sexually dimorphic, with the females having an enlarged abdomen and ovipositor that aids in egg laying. The species is also sexually dichromatic in wing colour. The forewings of females are brown and grey while the hind wings are yellow with black spots. Male GSM have dark brown forewings with grey scales and bronze-coloured hind wings. Females, which only fly irregularly, position themselves on the ground in a conspicuous location (usually in inter-tussock spaces), flashing their golden hind wings (petticoats) to the males, who fly low over the grasses searching for them.

GSM prefer warm, dry conditions (above 20°C with little to no wind and cloud) and are usually observed flying during the warm part of the day between 10:00 and 14:00 (Clarke and O'Dwyer 2000). Since 2005, Biosis have often observed GSM active on cooler days, with cloud cover and moderate to strong wind conditions and also at times earlier and later in the day than generally accepted as optimal observation times.

GSM breeding season begins in mid-October and continues through to early January (Commonwealth of Australia 2009). The breeding season differs slightly from year to year depending on climate and location. Adult moths emerge continuously in cohorts and males are seen actively flying in search of females.

Potential habitat for GSM consists of areas which support or had supported native grasslands or grassy woodlands (including derived grasslands) across the historical range of the species. Previous studies found that GSM display a preference for Wallaby Grasses *Rytidosperma* spp. (particularly *R. carphoides*, *R. auriculata*, *R. setacea*, *R. eriantha* and *R. racemosa*). However, more recent surveys have found GSM present in degraded grasslands and patches invaded with weedy species, including areas dominated by Red-leg Grass *Bothriochloa macra*, Spear Grasses *Austrostipa* spp. and Weeping Grass *Microlaena stipoides* and the introduced Chilean Needle-grass *Nassella neesiana* (Braby and Dunford 2006, Gilmore *et al.* 2008).

1.2 Aurora residential development background

Fourteen conservation reserves were initially established within the Aurora residential development. The reserves contain patches of native vegetation and fauna habitat that are being managed for the protection of biodiversity values, including threatened flora and fauna species. The reserves provide offsets which contribute to the project's net gain targets, which are part of the requirements of the Aurora development Conservation Management Plan (CMP) (Biosis Research 2008).

All reserves were initially surveyed to determine the distribution of Golden Sun Moth within Aurora and provide management advice for the reserves. Monitoring throughout these reserves began in 2007–2008 and are scheduled to continue for 10 years under the CMP, as per the condition of approval under the EPBC Act referral for Aurora (EPBC 2007/3524).

Eleven of the reserves were sold to Lendlease in 2015; hence the requirement to continue monitoring of these reserves was transferred from Development Victoria to Lendlease Communities. The conservation

reserves that are currently owned and managed by Lend lease Communities include: 1,2,3,4,5,6,7,8,9,12 and 13.

Based on the results of previous monitoring commissioned by Development Victoria, reserves 1, 2, 3, 4, 5, 8, 10 and 11 have been excluded from monitoring as they do not contain suitable habitat, or Golden Sun Moth has not been recorded within the reserve over consecutive years. The five remaining reserves (6, 7, 9, 12 and 13) contain key populations of Golden Sun Moth within the Aurora development area and constitute the study areas for this report.

This report presents the monitoring results for the 2017–18 flight season. This is the ninth year of annual monitoring and builds on annual monitoring undertaken since the 2007–08 season.

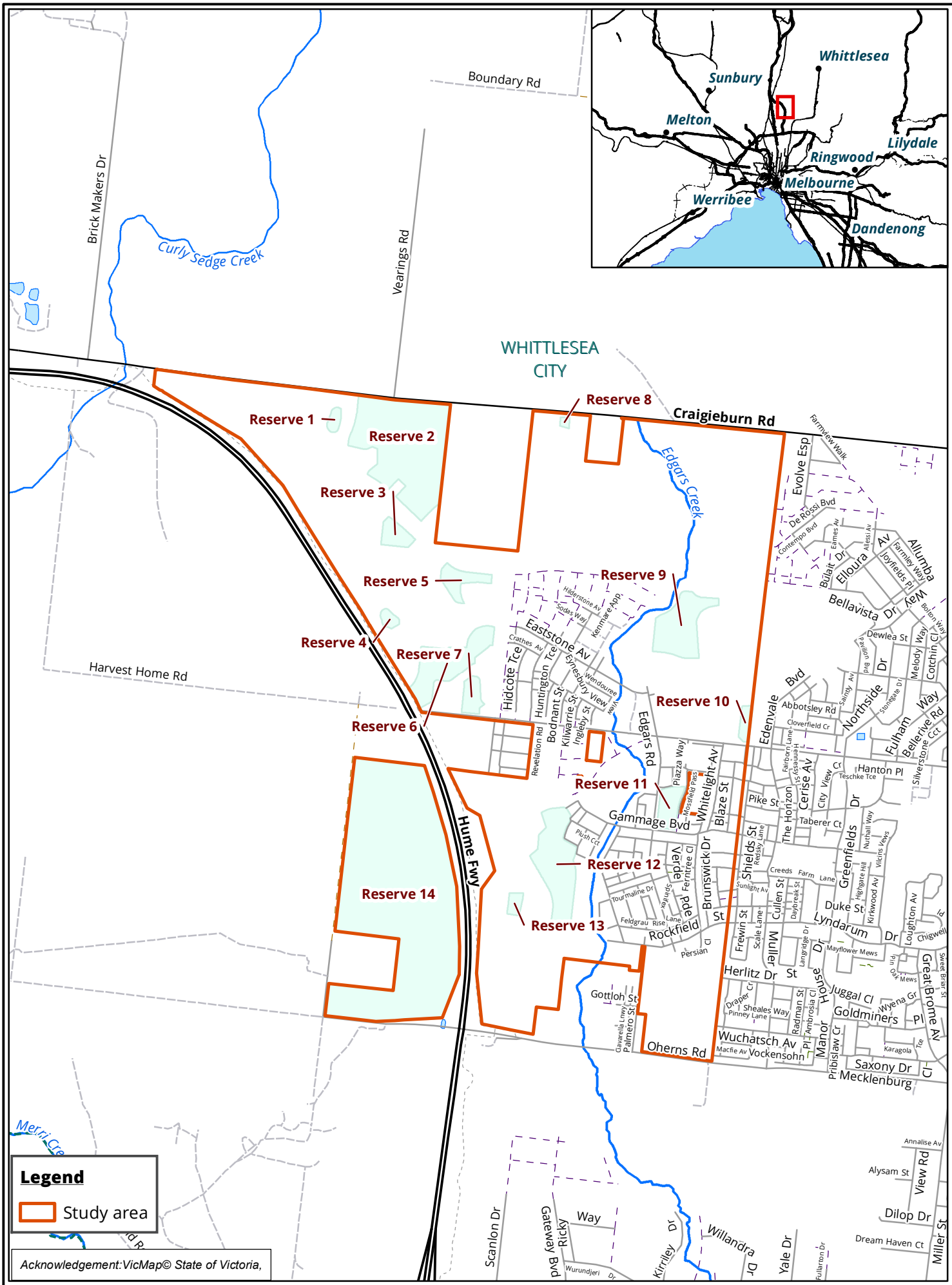

Figure 1: Location of the study site, Epping Victoria

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2. Methods

2.1 Determining flight season commencement

The commencement of the flight season varies according to location and weather conditions, therefore commencement of the flight season needs to be confirmed within reference populations before surveys can commence. Reconnaissance surveys were conducted at Reserve 12 (the largest known population at Aurora) and in the south of Aurora, adjacent to O'Herns Road, as part of widespread reference site checks to determine flight season commencement. Golden Sun Moths were first seen flying at O'Herns Road on 29 November 2017.

2.2 Transect counts

During the 2017–18 flight season walking transect counts were used to detect Golden Sun Moth presence and population distribution within the reserves. This method has been employed since the 2014–15 flight season. Point count methods, employed for the initial 6 years of survey, were abandoned after statistical analysis determined this method to be less reliable than walking transect counts.

Two monitoring surveys were undertaken on 13 and 27 December 2017 when conditions were suitable for male flight (above 20°C, minimal cloud cover and wind). Survey commenced at 11:00am and concluded around 2:00pm. An additional third survey was undertaken at reserves 6, 7 and 9 where no Golden Sun Moth had been recorded by the previous two surveys for the season. The surveys were at least one week apart to capture variation in emergence patterns. See Permits for weather conditions at the beginning and end of each completed survey.

Survey consisted of suitably qualified zoologists walking a series of transects approximately 50 m apart through reserves 6, 7, 9, 12, and 13. Tracks were recorded using a Garmin GPS and a waypoint was taken for each location where Golden Sun Moths were observed.

Each reserve was surveyed a minimum of two times during the flight season. Reserves 6, 7 and 9 were surveyed three times to determine species presence for the season. This level of survey effort was considered sufficient to achieve the objective of confirming continued presence of Golden Sun Moth within the reserves and to obtain an estimated population size.

Biosis undertook the Golden Sun Moth surveys under a Research Permit/Management Authorisation and Permit to Take Protected Flora & Protected Fish issued by the Department of Sustainability and Environment under the *Wildlife Act 1975*, *Flora and Fauna Guarantee Act 1988* and *National Parks Act 1975* (Permit number 10007569, expiry date 30 April 2018).

2.3 Mapping

Mapping was conducted using hand-held (uncorrected) GPS units (GPSMap 64) and aerial photo interpretation. The accuracy of this mapping is therefore subject to the accuracy of the GPS units (generally ± 7 metres) and dependent on the limitations of aerial photo rectification and registration.

Table 1 Weather conditions during Golden Sun Moth surveys, Aurora reserves, 2017–18 flight season

Date	13/12/2017	27/12/2017	04/01/2018
Start time	13:30	11:40	11:00
End	14:20	13:55	12:55
Golden Sun Moth recorded	Y	Y	Y
Site temperature (°C) (start/end)	36/36	29.9/32.5	23/24
Cloud cover (%)	15	5/5	15
Wind direction (start/end)	NE/NE	NW/NW	WSW
Average wind speed (km/hr) (start/end)	6/11	17/10	11
Ground conditions	dry	dry	dry
Humidity (%) (start/end)	21/20	40/37	51/51
Reference site where moths were recorded on day of survey	Altona Reference Site	Altona and Sunbury Reference Sites	O'Herns Road Reference Site

3. Results

Golden Sun Moth were observed at reserves 9, 12 and 13 this season, with the majority of individuals recorded at reserve 12. Golden Sun Moth were not observed at reserves 6, 7 and 9 after two monitoring surveys and consequently, were surveyed a third time in early January 2018. Only three Golden Sun Moth were recorded at reserve 9 and no individuals were recorded at reserves 6 and 7 for the entire season. The total number of GSM recorded for reserve 12 was the largest since 2013–14 flight season (Table 2).

There was a decrease in the number of Golden Sun Moth recorded in the current flight season compared to the 2015–16 season. However, the 2017–18 season recorded 196 moths, which is the median abundance across the nine survey years. Numbers of moths observed during the 2017–18 surveys are shown in Table 2 and spatial distribution is displayed in Figure 1. A comparison of the number of moths observed over the years of annual monitoring is provided in Table 3.

Table 2 Golden Sun Moth monitoring counts, 2017–18 flight season

Reserve	Golden Sun Moth 13 December 2017	Golden Sun Moth 27 December 2017	Golden Sun Moth 04 January 2018 (Reserves 6,7, 9 only)
6	0	0	0
7	0	0	0
9	0	0	4
12	183	7	n/a
13	2	0	n/a
Total	**185**	**7**	**4**

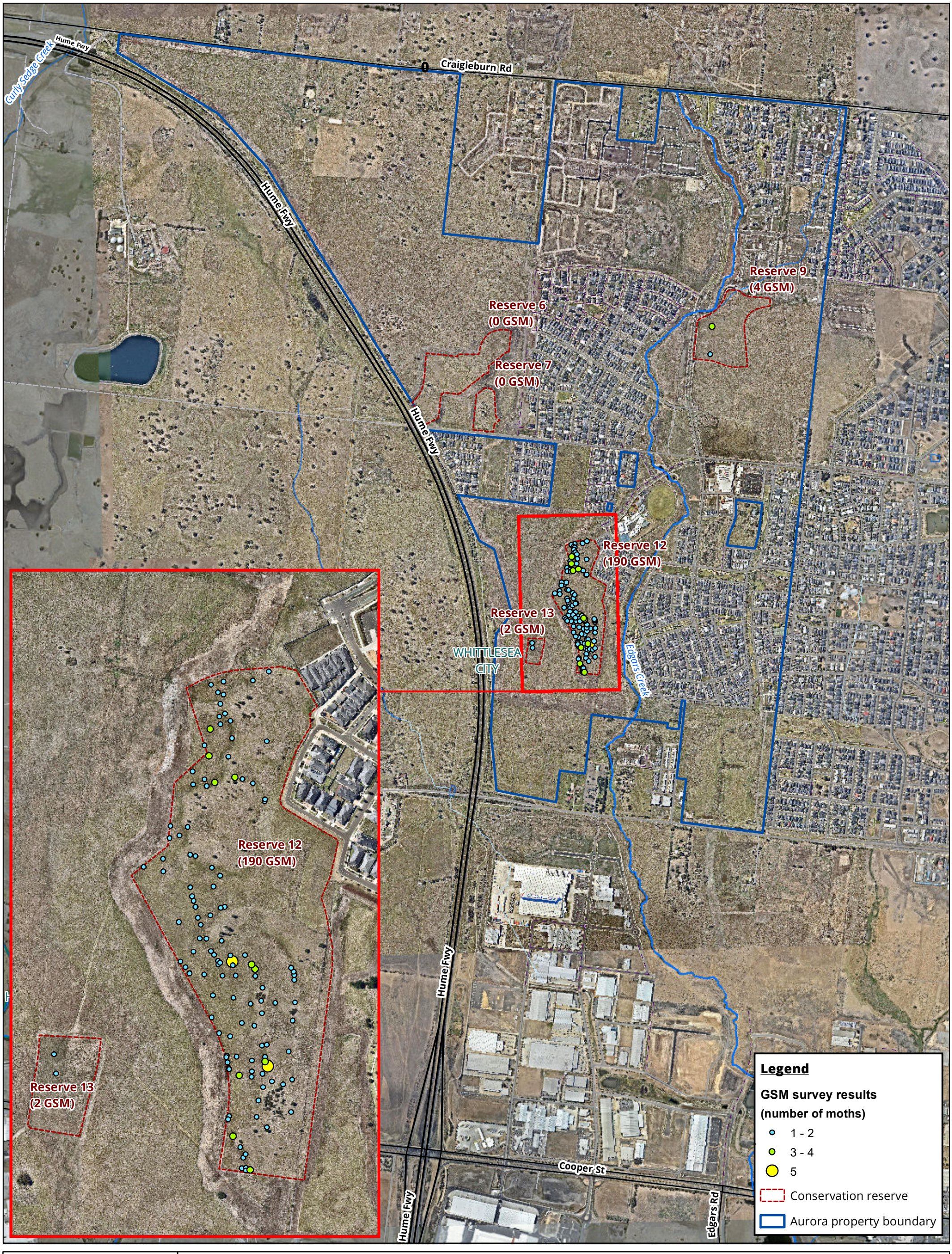

Figure 2: Aurora Golden Sun Moth survey results for the 2017–2018 flight season

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Acknowledgements: Imagery: NearMap

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Table 3 Historical Golden Sun Moth monitoring (GSM) data, Aurora Reserves

Reserve	Monitoring point	GSM 2009–10	GSM 2010–11	GSM 2011–12	GSM 2012–13	GSM 2013–14	GSM 2014–15	GSM 2015–16	GSM 2016-17	GSM 2017-18
1	1.1	-	0	0	Survey discontinued after two years of absence					
	Incidental observations	-	0	0						
	Total	**-**	**0**	**0**						
2	2.1	-	0	0	Survey discontinued after two years of absence					
	2.2	-	0	0						
	2.3	-	0	0						
	2.4	-	0	0						
	Incidental observations	-	0	0						
	Total	**-**	**0**	**0**						
3	3.1	-	0	0	Survey discontinued after two years of absence					
	3.2	-	0	0						
	Incidental observations	-	0	0						
	Total	**-**	**0**	**0**						
4	4.1	0	-	0	0	Survey discontinued after two years of absence				
	Incidental observations	1	1	0	0					
	Total	**1**	**1**	**0**	**0**					
5	5.1	-	0	0	Survey discontinued after two years of absence					
	5.2	-	0	0						
	Incidental observations	-	-	0						
	Total	**-**	**0**	**0**						

Reserve	Monitoring point	GSM 2009–10	GSM 2010–11	GSM 2011–12	GSM 2012–13	GSM 2013–14	GSM 2014–15	GSM 2015–16	GSM 2016-17	GSM 2017-18
6	6.1	0	2	0	0	0	Point count method no longer used			
	6.2	0	0	0	0	0				
	6.3	0	0	0	0	0				
	Incidental observations	0	19	2	0	9	1	1	7	0
	Total	**0**	**21**	**2**	**0**	**9**	**1**	**1**	**7**	**0**
7	7.1	0	0	0	1	0	Point count method no longer used			
	7.2	0	0	0	0	0				
	Incidental observations	0	3	0	5	0	1	0	0	0
	Total	**0**	**3**	**0**	**6**	**0**	**1**	**0**	**0**	**0**
8	8.1	-	-	0	-	-	Survey discontinued after two years of absence			
	Incidental observations	-	-	0	-	-				
	Total	**-**	**-**	**0**	-	-				
9	9.1	0	2	0	0	1	Point count method no longer used			
	9.2	0	3	0	1	0				
	9.3	0	4	0	0	1				
	Incidental observations	2	2	3	10	10	26	3	6	4
	Total	**2**	**11**	**3**	**11**	**12**	**26**	**3**	**6**	**4**
10	10.1	0	0	Survey discontinued after two years of absence						
	Incidental observations	0	0							
	Total	**0**	**0**							
11	11.1	0	0	Survey discontinued after two years of absence						

Reserve	Monitoring point	GSM 2009–10	GSM 2010–11	GSM 2011–12	GSM 2012–13	GSM 2013–14	GSM 2014–15	GSM 2015–16	GSM 2016-17	GSM 2017-18
	Incidental observations	0	0							
	Total	**0**	**0**							
12	12.1	8	41	0	0	4	Point count method no longer used			
	12.2	50	60	0	0	3				
	12.3	5	38	0	1	2				
	Incidental observations	161	394	101	85	427	116	8	393	190
	Total	**224**	**533**	**101**	**86**	**436**	**116**	**8**	**393**	**190**
13	13.1	8	20	1	0	57	Point count method no longer used			
	Incidental observations	57	42	18	23	84	0	0	8	2
	Total	**65**	**62**	**22**	**49**	**141**	**0**	**0**	**8**	**2**
14	14.1	6	3	0	3	33	Point count method no longer used			
	14.2	68	2	0	0	6				
	14.3	3	0	0	1	6				
	14.4	0	0	0	2	0				
	14.5	13	10	0	15	0				
	Incidental observations*	90	184	13	133	257	152	74	748	303
	Total	**180**	**199**	**13**	**154**	**302**	**152**	**74**	**748**	**303**
GRAND TOTAL		**472**	**830**	**141**	**306**	**900**	**296**	**86**	**1162**	**499**

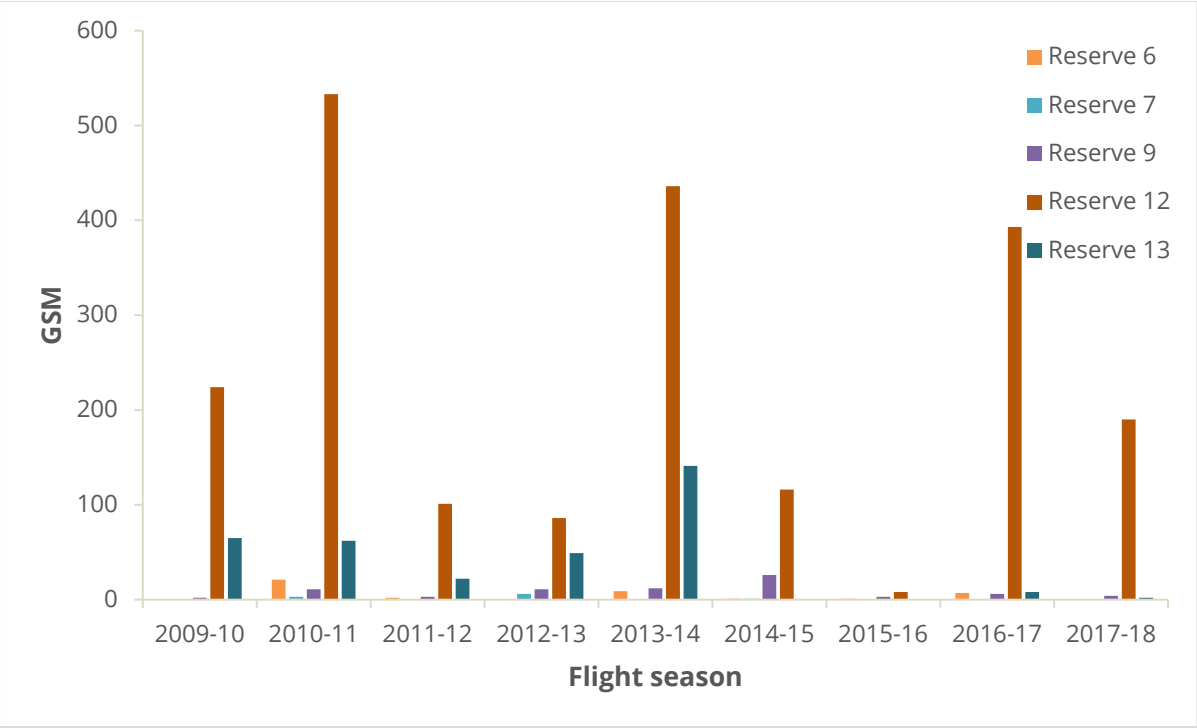

Figure 3 Annual abundance monitoring of Golden Sun Moth, Aurora reserves

4. Discussion and conclusions

Reserve 12 recorded the greatest abundance of Golden Sun Moths this season, compared to the other reserves surveyed. There was a decline in the number of Golden Sun Moth recorded in Reserve 12 compared to the previous 2016 - 17 season, although it had the third highest abundance of Golden Sun Moth across the nine flight seasons surveyed (Table 2). Golden Sun Moth presence (190 individuals) this season was only slightly less than the average population size for Reserve 12 across the nine survey years (average = 232). A possible explanation for Reserve 12 continuing to support high numbers of Golden Sun Moth, may be in response to biomass reduction which was implemented as part of Matted Flax-lily *Dianella amoena* translocation management. In addition, the presence of stony knolls and likely food plants such as Dense Spear-grass *Austrostipa densiflora* at Reserve 12, naturally limits biomass.

The variability in species presence throughout the ongoing monitoring program can be attributed to natural population fluctuations driven by environmental conditions. A consistent positive or negative trend in population numbers over three successive monitoring seasons is necessary to reflect a true indication of change in population size (Clarke 1999).

The degree to which the populations depend on the surrounding landscape is unknown. As the area becomes further developed, populations in some of the smaller reserves may decline as habitat and connectivity become more limited. Appropriate management strategies, such as biomass reduction, should be undertaken, especially in these small reserves, to ensure optimal habitat conditions for populations that are small and isolated from one another.

Of the five study sites, Reserves 6, 7 and 9 have consistently yielded very low to no Golden Sun Moth over the last nine years in comparison to other reserves where the species is present. Compared to other reserves with more established populations, such as Reserve 12, Reserves 6, 7 and 9 are not as large and are unable to support an increased area of favourable habitat (e.g. dominated by Spear Grass *Austrostipa* spp., Wallaby Grass *Rytidosperma* spp. and Needle Grass *Nassella* spp.) which is optimal for a relatively stable population.

There was a decrease in the number of Golden Sun Moth recorded in the current flight season compared to the 2016–17 season. However, the 2017–18 season recorded 196 moths, which is the median abundance across the nine survey years. These results, along with the results over the past nine years of monitoring highlight the widely acknowledged view that Golden Sun Moth numbers at any given site vary widely both within and between seasons. Furthermore, this demonstrates the importance of long term monitoring and inability to draw conclusions based on minimal data.

Conclusions and recommendations

The stronghold for Golden Sun Moth within the Aurora reserves remains Reserve 12. Despite small to non-existent populations within Reserves 6, 7 and 9 and 13, monitoring should continue throughout these reserves. Ongoing management of the reserves should continue to incorporate biomass reduction measures as a means of maintaining and/or increasing the availability of suitable habitat structure for Golden Sun Moth. Monitoring for the next flight season in 2018–19 should continue transect monitoring, as this method adequately surveys the full extent of each reserve.

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