

**West Belconnen Golden Sun Moth surveys, October to  
December 2012**

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## **1. Background**

The West Belconnen study area straddles the ACT/NSW border and is bounded by the Murrumbidgee River corridor to the west, Ginninderra Creek to the north, West Macgregor and Belconnen Golf Course to the east and Stockdill Drive to the south (Figure 1). Mills (2009) identified the majority of the area as containing cleared or highly modified vegetation. There is a small area of Yellow Box-Red Gum Grassy Woodland in the south, and most of the rest of the site has been subject to pasture improvement. There are scattered patches of native grasses throughout the area, but native diversity is low except in parts of ground layer of the remnant woodland.

The aim of this study is to identify on the West Belconnen site any potential habitat for or populations of a threatened insect, the Golden Sun Moth (GSM).

## **2. Golden Sun Moth *Synemon plana***

### **2.1 Status of the species**

The Golden Sun Moth *Synemon plana* is listed as a critically endangered species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and as endangered under the ACT *Nature Conservation Act 1980* (NC Act). A critically endangered species is considered to be facing an extremely high risk of extinction in the wild in the immediate future.

Nationally threatened species and communities are identified as Matters of National Environmental Significance under the EPBC Act. Any proposed action on or near a site which may have a significant effect on such values, must be referred by the proponent to the Minister for Sustainability, Environment, Water, Population and Communities, for assessment as to whether the action requires approval under the Act.

### **2.2 Habitat and Distribution**

Prior to European settlement the species was widespread in native grasslands in south-eastern Australia (Edwards 1993, 1994). The current understanding of habitat (various authors in DEWHA 2009) is that GSM occurs in primary or secondary native grassland, or clearings in open woodland, especially habitats containing a moderate component of Wallaby Grasses (various species of *Austrodanthonia*, recently renamed *Rytidosperma*). GSM has also been found in association with other native grasses, and the exotic Chilean Needlegrass *Nassella neesiana*. Sites are usually flat or gently sloping, with northerly aspects favoured. Sites are generally low in phosphorus (unimproved) and have bare ground between the tussocks. High biomass appears to make the habitat less suitable, as females use bare ground to bask and display, and males tend to search for females in areas of relatively low open grassland.

The species is now only found in a few relatively small areas due to habitat loss, fragmentation and degradation. Possibly less than one percent of the original habitat now remains, much of it degraded by weed invasion (Clarke & O'Dwyer 1997, O'Dwyer & Attiwill 1999, ACT Government 2005).

### **2.3 Description and life history**

The GSM is a medium sized day-flying moth in the family Castniidae. The male has a wingspan of about 34 mm, the female slightly less. The upper forewings of both are grey/brown with paler patterns. The male has dark brown upper hindwings, and in the female these are bright yellow/orange edged with black spots.

GSM larvae feed on the underground parts of Wallaby Grasses (Edwards 1993, O'Dwyer & Attiwill 1999) and some other native and introduced grasses (Braby & Dunford 2006, Richter *et al.* 2010). Recent dietary studies have confirmed that the larvae feed on plants that use the C3 carbon-fixing metabolic pathway, and that the C3 plants found on GSM sites are predominantly native Speargrasses *Austrostipa* species, Wallaby Grasses and the exotic Chilean Needlegrass. Larval development time (and thus generation time) appears to be longer than 12 months (Richter *et al* 2010).

The adults live for only 1–2 (-4) days after emerging during spring, and do not feed as they have no functional mouth parts. In the middle of the day when conditions are sunny and warm, males patrol the grassland in search of the females, which have reduced hindwings and are poor fliers. The limited flight ability of the female moths makes the species vulnerable to extinction on small sites, and makes natural re-colonisation from other sites unlikely.

The starting date and duration of the flight season vary from year to year, probably depending on spring weather conditions, with the season starting earlier in a warm dry spring (Cook & Edwards 1993).

### **2.4 Golden Sun Moth populations near the study site**

There are several GSM populations known in the Belconnen area, mostly along Ginninderra Creek and its tributaries. The main populations are at the former Belconnen Naval Transmission Station in central Belconnen, and adjacent to Ginninderra Creek in West Macgregor. There are others from Florey to Dunlop and in the Jarramlee lease near the north-western ACT border (Clarke & Dunford 1999, ACT Government 2005, Braby 2005, Hogg 2010, Biosis 2010).

The population on the Ginninderra Creek floodplain as it crosses the ACT border (recorded in 2009, Biosis 2010) is on the north-eastern boundary of the West Belconnen survey site, and is the western limit of the known distribution of GSM in the ACT.

The *Draft Strategic Assessment Report of the Molonglo Valley Plan for the Protection of Matters of National Environmental Significance* (Eco Logical 2010) reported that targeted surveys for GSM in 2008 in suitable habitat in the southern part of the current study area did not find GSM. Mills (2009) found no primary native grassland on the site, but there were patches native-dominated grassland in association with Box-Gum woodland in the southern part of the site, being the residual ground layer of cleared woodland.

### 3. Methods

A number of local consultants, researchers, students and NSW and ACT government staff shared their daily observations of GSM activity in the district during the 2012 season. Sites were often not identified, but the reports gave all workers useful information about the beginning and end of the season, and days of peak flying activity.

Site assessment at West Belconnen for potential Golden Sun Moth (GSM) habitat began in mid-October. GSM were first reported flying elsewhere in the ACT in early November. A period of cool wet weather delayed further emergence of GSM until mid-November, then moths were reported flying on most warm sunny days until late December.

Table 1 shows the dates of surveys, locations surveyed, and weather on days of survey, as well as other records of GSM activity in the district during the survey period. Figure 1 shows the areas referred to by numbers 1 to 12 in this report.

Access was not permitted to Area 7 (Parkwood lease), and permission to enter Areas 6 and 9 (Belconnen Blocks 1621 and 1622) was not received until mid-December. Block 1621 could only be reached on foot through Block 1622.

The West Belconnen site was visited over eight days of suitable weather in November and December. Periods before and after the peak daily activity period of the moth were used to locate potential habitat, which was then surveyed in the middle of the day. All potential habitat was surveyed on two to four separate occasions. Where there were fewer than four surveys, a late season survey was also undertaken to search for spent pupal cases as a recent study has found that most GSM pupal cases persist for longer than three weeks after emergence of the adult moths (Richter *et al.* 2012).

Potential habitat was identified as areas of flat or gently sloping primary or secondary grassland or open woodland, where the perennial ground layer was dominated by native grasses. By this definition potential habitat may contain a moderate component of annual weeds. The different levels of habitat quality were defined by some or all of the following characteristics:

#### **Very low quality potential habitat:**

- dominated by Chilean Needlegrass
- significant pasture improvement (Subterranean Clover, Ryegrass, Phalaris)
- high component of annual weeds

#### **Low quality potential habitat:**

- isolated patches of unimproved native grassland smaller than 0.25 ha
- larger areas of partially improved native grassland

**Moderate quality potential habitat:**

- patches greater than 0.25 ha and dominated by native grasses
- low weed cover
- some bare ground between the tussocks and
- little evidence of pasture improvement

**High quality potential habitat:**

- dominated by native grasses, including a moderate component of Wallaby Grasses
- a diversity of native forbs
- low cover of weeds
- moderate amount of bare ground

Much of the low quality potential habitat in Areas 1, 2, 4, 5 and 12 was only lightly grazed during the survey, and vehicle access was partly restricted to tracks and mown perimeters of paddocks due to tall dense native grasses and patches of Phalaris. Under such conditions, male GSM will congregate in areas of shorter grasses around tracks, fire breaks, knolls etc, so observations from a slow-moving vehicle can be an efficient way to sample large areas of low quality habitat. Where large areas were surveyed by vehicle, frequent stops (every 100 metres or less) were made to allow spot searches of smaller areas on foot.

Larger and less weedy patches dominated by native grasses were surveyed on foot, with the observer crossing the patch in repeated traverses about 20 metres apart.

## 4. Results

### 4.1 Habitat

Figure 2 and Table 2 show the locations and extent of potential GSM habitat identified at West Belconnen. No high quality potential habitat was identified anywhere on the study site. There were areas of very low to low quality potential habitat in cleared parts of Area 1 and in Area 12 (clearings in woodland), and along Ginninderra Creek in Area 6 (creek flats with a high component of Chilean Needlegrass).

There were paddocks in Area 1 which did not meet the usual definition of GSM habitat, being dominated by Tall Speargrass with Phalaris sub-dominant in the upper layer, with Ryegrass, Subterranean Clover, Wallaby Grasses and annual weeds in the lower layer. They have been included as very low quality potential habitat, because they resemble a group of horse paddocks in central Canberra which had low to moderate numbers of GSM in a dry year when the Phalaris biomass was low, and very low numbers in a subsequent wet year when the pasture was tall and dense (Rowell 2010, 2011). The exotic pasture species in Area 1 are likely to have been more prominent than usual in spring 2012 after three years of good rains.

The Pony Club paddock in Area 8 was dominated by native Speargrasses and Wallaby Grasses, with a moderate amount of bare ground and low to moderate weed cover. The low biomass, very low native species diversity and predominance of grazing-tolerant species suggested a long history of grazing and probably some overgrazing, so the habitat in this paddock was given a low rather than moderate habitat quality rating.

One 2 ha area of moderate quality habitat was found in Area 4. This patch was dominated by Speargrasses, and Wallaby Grasses and some other native forbs and grasses were present. This patch may be primary native grassland (i.e. not cleared from woodland). It was surrounded by improved pasture and cropped areas, and may previously have been part of a fenced-off strip along the creek. A similar higher quality patch was found in Area 6 on the eastern bank above Ginninderra Creek in Block 1621.

The Wallaby Grasses in the lowest quality habitat areas (in Areas 1, 4, 5 and 8) were mostly those that persist in grazed native pastures, such as *Austrodanthonia caespitosa* and *A. racemosa*. The more diverse ground layer found in parts of the Area 12 woodland, the moderate quality patch in Area 4 and the slope above Ginninderra Creek in Area 6 contained a larger variety of Wallaby Grasses, including. These included *A. eriantha* and *A. laevis*, as well as some smaller species often lost when sites are disturbed or pasture improved, such as *A. carphoides* and *A. auriculata*.

#### **4.2 Golden Sun Moth**

No GSM were recorded on the site, despite repeated surveys of potential habitat under suitable weather conditions, and during the period when there were many records of GSM activity in the north of the ACT and adjacent parts of NSW. No pupal cases were found in ground searches of the better quality potential habitat in December and January.

There are previous records of GSM from the Ginninderra Creek flats in Block 1621, Area 6 (Biosis 2010), but none were seen there in 2012. This area was dominated by tall dense Phalaris and Chilean Needlegrass and had not been recently grazed at the time of the surveys. GSM were recorded several times at a similar (but grazed) site 1.5km to the east in the 2012 season, including one week before and two weeks after our surveys (Bill Sea, University of Canberra, pers. comm.).

**Table 1. Timeline of West Belconnen GSM surveys, and GSM activity in the ACT district**

| <b>Date</b> | <b>Daily max. T °C</b> | <b>Areas visited</b> | <b>Surveys</b>   | <b>Other reported GSM activity in ACT and nearby NSW</b> |
|-------------|------------------------|----------------------|--|--|
| 11 Oct 12   |                        | 1,4,5,12             | Pre-survey site inspection, overview of Riverview properties ACT/NSW                 | -  |
| 5 Nov 12    | 29.6                   | -                    | -  | First GSM recorded flying in ACT                         |
| 28 Nov 12   | 25.5                   | 1,4,5,12             | Driving and walking surveys of potential habitat                                     | 26 and 29 November, low numbers at 4 sites               |
| 29 Nov 12   | 33.7                   | 1,2,4,5,12           | Driving and walking surveys of potential habitat.                                    | Moderate numbers at Macgregor                            |
| 8 Dec 12    | 31.5                   | 1,3,12               | Driving and walking surveys of potential habitat (3 viewed from outside only)        | Moderate numbers in Majura Valley                        |
| 13 Dec 12   | 31.9                   | 1,2,2a,3,5,7,8,9,12  | Driving and walking surveys of potential habitat (2a, 3, 9 viewed from outside only) | Low to high numbers at 10 sites                          |
| 19 Dec 12   | 34.0                   | 6,7,8                | Walking surveys of potential habitat   | Low to high numbers at 4 sites                           |
| 20 Dec 12   | 28.7                   | 11                   | Driving and walking surveys in search of potential habitat                           | -  |
| 21 Dec 12   | 29.3                   | 6                    | Walking surveys of potential habitat   | -  |
| 22 Dec 12   | 33.1                   | 8,11                 | Walking surveys of potential habitat   | 23 December to 4 January, low numbers at 3 sites         |
| 3 Jan 13    | 32.1                   | -                    | -  | Last GSM recorded flying in ACT                          |

**Table 2. Summary of Golden Sun Moth survey results in Western Belconnen, Oct-Dec 2012**

| Area               | Date  | Potential habitat  | GSM notes  |
|--------------------|---|--|--|
| 1                  | 11 October<br>28/29 November<br>8 December<br>13 December | <b>Medium areas of low/very low quality potential habitat</b> , with moderate component of Speargrass and occasional Wallaby grasses, but all partially improved (Phalaris, Ryegrass, Subterranean Clover). Smaller patches of low diversity native pasture, unimproved.   | <b>No GSM observed</b> despite surveys under suitable conditions on four days. Surveys included repeat searches on foot of patches dominated by native grasses |
| 2                  | 29 November<br>8 December<br>13 December                  | <b>Low quality potential habitat in weedy native pasture</b> in open woodland SW of Strathnairn. Patches of native grasses on hill in weedy paddock S of Strathnairn not habitat, too disturbed, and cleared from open forest.   | <b>No GSM observed</b> despite walking and driving surveys under suitable conditions on three days   |
| 2a,3               | 8 December<br>13 December                                 | <b>No potential habitat seen.</b> Viewed from road and over Riverview fences, grassland is exotic and/or disturbed.  | <b>No GSM observed</b>   |
| 4                  | 11 October<br>28/29 November<br>8 December<br>13 December | Most not GSM habitat, being pasture improved or cropped, with occasional scattered native grasses. One <b>2 ha patch of moderate quality potential habitat</b> dominated by native grasses.  | <b>No GSM observed.</b> 2 ha patch surveyed on foot on four days under suitable conditions   |
| 5                  | 11 October<br>29 November<br>13 December                  | <b>Very little potential habitat.</b> Most is improved pasture, some cropped. Occasional scattered native grasses, Wallaby Grasses rare. One <b>very small patch dominated by native grasses</b> including Wallaby Grasses, but surrounded by disturbed vegetation.  | <b>No GSM observed.</b> Native dominated patch (< 0.1 ha) visited twice under suitable survey conditions   |
| 6                  | 19 December<br>21 December                                | Most of area ungrazed improved pasture (Phalaris). <b>Very low to moderate quality known habitat in paddock each side of Ginninderra Ck.</b> Creek flats exotic but contain Chilean Needlegrass, parts of eastern bank dominated by native grasses.  | <b>No GSM observed.</b> Visited twice under suitable survey conditions. <b>GSM records from creek paddock (2009 survey)</b>                                    |
| 7                  | 13 December<br>19 December                                | <b>No potential habitat</b> , grazed and ungrazed improved pasture.  | <b>No GSM observed</b>   |
| 8                  | 13 December<br>19 December<br>22 December                 | <b>Small area low quality potential habitat</b> at Pony Club. Paddock dominated by native Speargrasses and Wallaby Grasses, not pasture improved. Very low diversity and species composition suggests long history of grazing and occasional overgrazing.  | <b>No GSM observed.</b> Potential habitat searched twice on foot under suitable conditions, extensive search for pupal cases also made late in season          |
| 9<br>Park-<br>wood | 29 November<br>13 December<br>19 December                 | <b>No potential habitat seen.</b> Observed with binoculars from outside fences to east, south and west.  | <b>No GSM observed</b>   |
| 11                 | 20 December<br>22 December                                | <b>No potential habitat seen.</b> Some patches of native grasses, mainly on steep slopes, and apparently cleared from open forest.   | <b>No GSM observed</b>   |
| 12                 | 28/29 November<br>8 December<br>13 December               | <b>Patches of low quality potential habitat</b> in understorey of open woodland. Native grasses including Wallaby Grasses common, but most also pasture improved (Phalaris, Ryegrass, Subterranean Clover). Narrow strip of more diverse native grassland on S bank of creek, but too small and eroded to be high quality potential habitat. | <b>No GSM observed</b> despite four surveys in good conditions   |

## **5. Summary of results**

The survey identified several areas of very low quality and low quality potential habitat for the Golden Sun Moth on the West Belconnen site, two hectares of moderate quality potential habitat, and no high quality potential habitat.

No GSM were found on the West Belconnen site in 2012, while GSM were recorded elsewhere in the ACT at the survey times.

## **6. Discussion**

The West Belconnen site lies just west of the estimated area of pre-settlement natural grassland in the north west of the ACT (ACT Government 2005). These primary grasslands were the preferred habitat of GSM. Open areas in woodland adjoining the original grassland may have also contained patches of GSM habitat, which could have become more extensive with the continued clearing of the woodland. Whether GSM do come to occupy such secondary habitat probably depends on the sequence of events in the alteration of the grasslands and woodlands. The distance separating habitat remnants is also important, as the female moths are almost flightless and the males do not move far from areas likely to contain females.

Pasture improvement appears to degrade and eventually destroy GSM habitat, probably due to the replacement of preferred food plants and also to the increased biomass following fertilizer use which changes the open grassland structure preferred by GSM. When GSM are lost from fragmented habitat they are unlikely to return, due to their poor powers of dispersal.

The known GSM habitat in other parts of Belconnen consists of small or large remnants of native dominated grassland with little pasture improvement, and areas of Chilean Needlegrass along creek lines. The areas of potential habitat in the survey area were degraded, fragmented and/or secondary habitat, separated by larger areas of unsuitable vegetation.

Due to the habitat condition and the negative survey results it is therefore unlikely that GSM still occurs in the study area, except along Ginninderra Creek in Block 1621 and the adjacent paddocks in NSW. Although not recorded on Block 1621 in 2012, the 2009 records and the 2012 records just upstream suggest that GSM may still be present at low density in Chilean Needlegrass on the creek flats, or may reoccupy the area by moving along the creek flats from the West Macgregor population. The creek flats are unsuitable for development, and GSM are likely to continue to survive there if the biomass is controlled by occasional grazing.

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