

Results and Review from three *Synemon plana* survey activities for volunteers at Craigieburn Grassland Reserve Epping/Wollert

Brian Bainbridge, Ben North



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Abstract

Surveys have been carried out that seek to describe distribution patterns of the Golden Sun-moth, *Synemon plana* at Craigieburn Grassland Reserve, in the summers of 2004-5, 2005-6 and 2006-7. These surveys have used volunteers as the main observers, making possible simultaneous observation across wide areas. This species was proven to be nearly ubiquitous across the whole of the 342 hectare reserve. Patchiness in density of the moths was identified and distribution patterns provide some support for the observation that moth activity tends to be concentrated on slopes of low rises or other structures that influence ground temperature and wind speed. The data to date provides weak evidence that areas of high activity are consistent from year to year.

These surveys help the characterisation of preferred habitat and core habitat for *S. plana* in the *Heavier-Soils* Plains Grassland Ecological Vegetation Community of the Victorian Volcanic Plains bioregion near Melbourne. The suitability of survey technique and employment of volunteer observers for this species is discussed.

Introduction

The Golden Sun-moth, *Synemon plana*, is listed as Critically Endangered nationally. Extant populations of the species have been identified at several remnant *Heavier-soils* Plains Grassland sites in the Merri Creek valley since 2003.

There are serious threats to the continued survival of *S. plana* in the area. Intense development pressure for industry and housing exists at and between almost all identified sites in the Merri Creek valley. These sites are mostly within the Victorian State Government's *Melbourne 2030* 'Urban Growth Boundary' and the 'Hume Growth Corridor'. Many of the areas where the moth exists are subject to proposals for changed vegetation management regimes with implications for moth survival. The need to identify the distinctive range of topographical and vegetative features and existing land management found at local *S. plana* sites soon became urgent as many areas where recently identified *S. plana* populations occur overlap with areas proposed for immanent development. In the four years since the original identification at Craigieburn and Cooper Street Grasslands there have been a steadily increasing number of *S. plana* populations found in the north and west of Melbourne and a corresponding number of clashes between development and conservation.

The need to identify further *S. plana* populations that may be involved in gene flow between the existing known populations in the Merri Creek valley is a critical task identified by van Praagh (2004). However, the short and erratic periods when moths may be directly observed each season makes identification of moth habitat problematic. Indirect identification of potential habitat requires the characterisation of favoured vegetation and topographical parameters. Such characterisation is essential for efficient searches and habitat protection measures.

Existing studies defining habitat characteristic for *Synemon plana* were summarised in van Praagh (2004). *Synemon plana* is identified as requiring a '...specialised habitat of grasslands dominated by *Austrodanthonia* spp. Many species of *Austrodanthonia* are low growing tussock grasses, usually separated by bare ground. The species composition of the grassland as well as density cover is important for moth survival. Whilst it is uncertain exactly which species are food plants, it appears that the larvae probably feed on a variety of species which may vary at different localities.'

The Merri Creek populations occur in a markedly different bioregion (Victorian Volcanic Plains) to those in which earlier studies have occurred (e.g. Mt Piper, the subject of many studies is in Central Victorian Uplands). While some earlier identified parameters provided valuable clues to the distribution and habitat preference of the moth, other parameters appeared to not be as critical.

Because of the short and variable nature of emergence of the moth across a short diurnal and seasonal period it was realised that it would be difficult to investigate some spatial characteristics of distribution without the assistance of a large group of observers working simultaneously. Under a grant awarded to the Friends of Merri Creek (FOMC), an informal working group for the Golden Sun-moth was convened by Merri Creek Management Committee (MCMC) in early 2004 to develop a survey method for the *S. plana* populations and their habitat that would involve the committed and enthusiastic volunteers of the FOMC.

The surveys have been valuable in developing deeper awareness of the moth and its habitat among the volunteers, which is an important factor in the community-based projects of the FOMC and MCMC. A number of useful lessons and limitations in effectively using volunteers for *S. plana* survey were also realised during the three surveys. This report documents of these achievements and limitations to assist in designing future *S. plana* survey projects.

Aim

This report aims to present results from surveys of Golden Sun-moths at the Craigieburn Grassland Reserve over three consecutive years and document the limitations and achievements of volunteer based *Synemon plana* surveys at Craigieburn Grassland reserve in 2004 to 2007

Objectives

- To identify the extent of Golden Sun-moths across the Craigieburn Grasslands (2004)
- To identify whether patterns of moth patchiness correlate with differences in topography and vegetation of the Craigieburn Grassland reserve (2005 and 2006)
- To identify whether patchiness of moth occurrence remains consistent over different years. (2005 and 2006)
- To describe potential and shortcomings of the trialled approaches to involving community volunteers in surveys of Golden Sun-moths.

Site Description

Craigieburn Grassland Reserve occupies 342 ha managed by Parks Victoria for conservation in conjunction with an additional 50 ha of privately owned land. A major aspect contributing to flora and fauna significance status of the site, Craigieburn Grassland is of National significance for conservation, is its size and connectivity.

Vegetation communities were mapped by Frood in 1992. This mapping has formed the base for the vegetation communities in the maps included in Appendix 1. The occurrence of Stony Knoll Shrubland, escarpment and creek line vegetation communities generally correlates with topographical features. Finer resolution mapping to identify further sub-communities has been identified as a requirement to fully characterise the vegetation in the reserve (Frood, 2007 pers. comm.).

Under the Ecological Vegetation Community (EVC) system of vegetation characterisation, the two main vegetation communities across the reserve are *Heavier-soils* Plains Grassland (EVC 132_61) and Stony Knoll Shrubland (EVC 649). This last is identified as 'Stony Knoll Grassland' in Frood's report. The current low level of woody vegetation on stony knolls in the reserve is thought to be at least partly a result of the grazing history of the site. (Frood 1992)

A detailed grazing history of the reserve is included in a report commissioned by Parks Victoria (Milne & Ross, 2003). In the years leading up to the discovery of *S. plana* at the reserve 700 to 950 sheep were grazing in the reserve. Milne and Ross detail earlier periods of higher and lower stocking including periods of overgrazing and de-stocking during droughts. Approximately fifty Eastern grey Kangaroos and some horses have also been grazing in the reserve in recent years.

Method

2004 Survey

The survey method for the first date was not highly detailed as it was impossible to confirm in advance unknowns relating to the site, number and skill level of participants and other logistics. Experience from the first survey was used to develop techniques for further surveys. Surveys were conducted on 12th and 19th December 2004. These dates were chosen to coincide with the peak of the moth activity based on observations in summer 2003-4. Two survey dates were chosen to increase the chance of having suitable weather conditions on at least one survey day.

The grassland was divided into six zones (See Appendix 1, Map 1). Each zone was allocated to a group leader who was given instructions in how to carry out the survey and was shown flying moths immediately prior to the survey to ensure that they were confident in identifying flying male moths. The groups were provided with a detailed map and aerial photograph to assist in locating their observations and making notes. A survey sheet was provided for recording information including time of observation, number of moths observed, sex (assumed male unless a female was located on ground), a location (generally drawn on map with a corresponding code), GPS coordinate where this was available and any notes, especially relating to vegetation. Group leaders were asked to follow a route marked on the map that attempted to distribute observation transects evenly across the grasslands during the one hour survey period.

On completion of the first survey it was found that group leaders had developed diverse survey and recording technique variations resulting in a varying survey effort across the grassland. This was a result of differing interpretation of the instructions and different skills between different group leaders. Difficulty in navigation meant that some groups crossed the same ground. The various techniques used by each group are included against the results obtained in Table 1.

For the second survey, a technique based on what were considered the most successful and repeatable approaches observed in the first survey. These instructions are described below:

- Groups to split into two sub-groups and walk approximately 20m apart.
- Groups were to follow a trail marked on their map. The prescribed routes were plotted with the aim of covering ground not covered in the first survey (See Appendix 1, Map 1).
- Groups to count moths continually. The sub-groups to negotiate how to record moths that both sub-groups have seen to avoid double counting.
- Every two minutes the recorder will record number, time and locality (on map)
- Note anything that seems to correspond with a change in moth numbers (e.g. changes in vegetation type, grass height, or topography including stony knolls, creek lines, etc)
- Recording started at approximately 11am. All counting was to finish by midday.

2005 Survey

Surveys were carried out on the 11th and 18th of December. The method was proposed by Dr Tim New of Latrobe University to give a 'contour map' of abundance that could then be related to topographic/vegetation features associated with differing abundances. The survey was also designed to support a study by Honours Student, Lucinda Gibson.

Observers were split into 12 groups that spread out in a single east-west line 10m apart and were then numbered off. Experienced observers who had taken part in the 2004 survey were distributed through the groups to assist newcomers in identification. The line chosen was the southern boundary fence of the reserve from the western corner. This was chosen for ease of replication, ease of logistics (close to entrance) and because the chosen north trajectory crosses a range of topographical and other features of interest including knolls, tracks, drystone walls and variations in vegetation.

At 11am the whole line commenced walking at steady rate, with each individual counting moths seen and numbers recorded every five minutes (a 30 second period was allowed for recording results). Observers were to count all moths up to the midpoint of the next observers in line. The line was to be maintained with help of experienced GPS users and a 'supervisor' who moved through the observer groups giving directions. A time-keeper with a whistle was used to co-ordinate the recording periods. The survey continued for 1 hour. This ultimately produced a transect belt of 120m by approximately 2000m made up of 144 individual transects.

The second survey that took place on the second week followed the same survey line, attempting to provide a comparison between different weather and possibly reinforcing/confirming results from the first survey. Weather conditions in the second survey period proved to be so poor that no moths were recorded. Locations were marked using the Geographic Positioning System units and locations mapped using Mapinfo 7.5 Professional geographic information system.

2006 Survey

An identical method to 2005 was followed with the exceptions;

- That 6 groups were spaced at 20m intervals
- Groups counted the moths observed in the 20m band between themselves and the group to the east.
- A survey was not run on the first of the two survey dates (the 3rd of December as this was a day of unsuitable weather for moth activity).
- Three GPS units were used (Group 1, 4 and 6) to assist in keeping groups in line. Each of the GPS users used the navigation function of their units to attempt to maintain a due north trajectory across the landscape. The co-ordinates from the units were used to provide an accurate 'envelope' of the transect belt.

A notable difference in the surveys between 2005 and 2006 was that observers walked more rapidly reaching the end of the transect belt with just 7 survey periods (approximately 30-40 minutes). This may have resulted from easier walking conditions, inconsistent supervising or possibly increased confidence from the experienced surveyors with walking across the uneven terrain. The longer transect lengths that resulted from faster walking, combined with the wider spacing of the groups, led to transects that were wider and longer were subject to lower survey effort per unit area compared with the 2005 survey.

Results

2004- Surveys to determine the extent of moth population across the reserve.

Survey results were recorded on field survey sheets. Results have been tabulated are also represented on the Appendix 1, Map 1.

12th December 2004

Ideal conditions for moth emergence and flight were present. The weather was hot and about 27° C at the start of the survey period with a light northerly breeze. Moths were observed flying up to half an hour prior to the survey starting. Temperature increased during the survey period though heavy thunder clouds had gathered by the end of the survey period.

Survey results have been tabulated (Table 1 below) and mapped (Appendix 1. Map 1).

Group	Length travelled	Number of moths seen	notes
1	1.8 km	61	Group of approx 12 walking as a single group
2	1.5 km	97	Group of about 10 as 'emu bob' across the landscape approximately 200m wide
3	2.8 km	78	Group of four observing as a single group
4	1.5 km	78	Group of 5 observing as a single group
5	3 km	154	Group of 5 spread out up to 200m across and compiling figures
6	3 km	349	Group 4 spread out up to approximately 200m across and compiling figures
TOTAL	13.6km	798	

Table 1. Survey techniques and results - 12th December 2004

19th December 2004

There were very poor conditions for moth activity on this day, with a prevailing blustery south-westerly wind, strong overcast cloud and temperature ranged from 20°C to 25°C. Few moths were recorded till late in the survey period. Conditions improved somewhat towards the end of the survey period. Several moths were observed as surveyors drove out of the grassland at about 1pm.

The revised technique developed following the first survey was successfully applied with little variation in technique being reported. However, lack of moths meant that the technique was not thoroughly tested and some participants found the method too exhausting.

Survey results have been tabulated (Table 2 below)

Group	Length travelled	Number of moths seen	notes
1	1.7 km	0	Group of 2 Standard technique
2	2.3 km	1 (+2?)	Group of 3 Standard technique
3	1.8 km	1?	Group of 1 Standard technique
4	2.4 km	5	Group of 2 Standard technique
5	2.8 km	1?	Group of 4 Standard technique
6	3.5 km	3	Group of 5 Standard technique
TOTAL	14.5km	9 (+4?)	

Table 2. Survey techniques and results - 17th December 2004

Some observations on density variation during these surveys were volunteered by the observers but the wide variation in survey effort between different groups precluded detailed analysis of the observations.

A summary of the results from the 2004 surveys are;

- Moths were found to be ubiquitous across the Craigieburn Grassland
- Distinct gaps were noticed in the distribution across the grassland. From questioning of the participants these seem to correspond with *Poa* tussock grassland, dense *Themeda* grassland and the tops of stony knolls. Finer scale and more accurate recording of vegetation and topography was identified as necessary to accurately determine moth habitat preferences in Craigieburn Grasslands
- Distinct hotspots in moth numbers were observed. People's impression was that these often corresponded to slopes around Stony Knolls.

2005. Survey to determine distribution 'patchiness'.

The results from the 11th of December survey are shown on Map 2 in Appendix 1. The map shows that moth density differed strongly along the transect belt. One hundred and forty-four transects of approximately 20m x 100m were observed. The lowest count in the transect unit was 0, the highest were 36. The data from this survey was the subject of an analysis by L. Gibson (2006). She made the following observations;

- That of the 144 transects only 3% had no moths recorded.
- That 37% of transects had between 1 and 5 moths which made this the most common density class.
- That the number of transects with higher density classes decreased steadily to the 21-25 moth class.
- Only 2 samples had more than 30 moths. These outliers represented two distinct 'hot-spots'.

The 18th of December survey was unsuccessful due to unsuitable weather conditions (overcast, cold wind, temperature less than 20 degrees Celsius) and only a handful of moths were seen. The data from this survey date were not examined further.

Mapping that overlaps the transect results with stony knoll areas is shown on Map 2, Appendix 1. It is difficult to discern obvious correlations between the moth counts and the existing vegetation mapping and elevation but combined with observations in the field the following distribution features are supported by this data;

- Some high counts appear to correspond with 'saddles', grassy dips occurring between knoll areas.
- A 'hotspot' in the northern-most transect appears to correspond with a knoll top.
- The highest count was found on a hotspot on the western edge of the transect belt near the middle. It is a flat area of grassland sheltered by knolls and drystone walls that had been colonised by shrubs forming effective wind-breaks from southerly and westerly winds. The area was intensively grazed by sheep and kangaroos.
- Areas of low counts in the south of the transect belt coincide with lower lying areas dominated by dense *Themeda triandra* and *Poa labillardierei*. Some similar low count areas are found in the north of the transect belt, associated with dense *Poa labillardierei*.

2006 Survey to determine distribution patchiness

On the first of the two scheduled survey dates, (3rd December) weather conditions were unsuitable at the beginning of the survey period (22 degrees Celsius and gusty wind to 15 km/hour, no moth emergence apparent). No moth survey was carried out though moths were later observed flying and a mating pair was observed towards noon.

The second survey on the 17th of December took place in suitable weather conditions (temperature in the mid-high twenties and light breezes).

Results from this survey are included in Map 3, Appendix 1.

Some features of the results include;

Of the 42 transects, 42%, (18 transects) had no moths detected

54% of transects had 1 to 5 moths recorded making this the most common count class.

Only one transect had a higher count (11-15 moths). This transect was in the same area as the area with the highest count in 2005 although numbers were markedly lower than in 2005.

It is important to point out that transects in these cases were approximately 4 times larger than the transects in 2005 so the count figures for moths are not directly comparable. A density analysis would show an even more marked contrast in the numbers of moths between the two years.

Discussion

2004

The results from the successful survey day in 2004 firmly established that Golden Sun-moths occur widely over the grassland reserve. The grassland that was visited in the second survey is generally similar in topography and vegetation to the area that was visited on the successful survey date, suggesting that the moths would occur in similar numbers in these areas. An exception is the Curly Sedge Swamp, approximately 50ha, in the north-east corner which consists largely of Grey-clay drainage-line Complex surrounded by degraded grassland and Stony Knoll Shrubland. It appears that this distinctive area has still not been visited during conditions suitable for moth emergence to assess its status as habitat (W. Moore pers. comm., March 2007).

Interpretation of the results from 12th December 2004 needs to take into account the variation in survey techniques and data recording, leading to variable survey effort across the site. The technique used by groups 2, 5 and 6 effectively amplified the survey effort compared with groups 1, 3 and 4. A multiplication of effort also occurred where groups 5 and 6 inadvertently crossed the same area. While this reduces the value of the map as a means of determining the overall variation in the moths' distribution, definite 'hotspots' were noticed in the survey area (maps 1 and 2).

The position of any 'sighting' symbol on the maps should also take into account the limitations posed by:

- scale of the map
- Capacity of group members to accurately locate themselves on maps provided and to document precise locations was limited by volunteer orienteering experience and access to GPS units.
- This had little bearing on the capacity of the survey to identify presence across the site but limited the use of the data for population estimates or discerning patchiness across the site as a whole.
- ability of groups to accurately locate themselves on a map for particular sightings
- relative position of the moth in relation to the observer (moths are able to be identified up to twenty-five metres or more by experienced observers) I
- only one of the two scheduled field days provided suitable flying weather for *S. plana*. Thus coverage of the total grassland was limited to the initial survey

2005 and 2006

The results from the 2005 survey provide strong data of moth density variation in any given time. The data provides weak evidence that the density variation is associated with topographical or vegetative features although the overlap of moth counts with vegetative and contour mapping is suggestive that high moth numbers are associated with the slopes of knolls and that low numbers are associated with lower-lying areas. Lower lying areas at Craigieburn tend to be associated with dense *Themeda triandra* or *Poa labillardierei* sward.

Observations in the field suggest that the hotspots may be limited to quite small, tight areas. Higher resolution survey techniques would be needed to identify the features associated with these hotspots. The observation of multiple females at hotspots, together with the limited dispersal ability of female *S. plana* suggests that they represent 'core' or optimal habitat areas.

Stronger statements on the correlation of moth numbers with particular terrain and vegetation would rely on extra data gathering (reliable observation on changes in topography and vegetation gathered during the survey). A finer detailed survey technique (perhaps point sampling) combined with higher resolution mapping of vegetation would also increase confidence in statements. There were repeated observations, investigated further by Gibson (2006) that moths did not favour the tops of knolls. Confirmation of this observation would require finer survey resolution, as transects generally included knoll tops with adjacent slopes suspected to be favoured habitat. Identification of aspect would also require this finer scale mapping. Repeated surveys within the same season would be desirable identifying possible changes in the distribution over a flight season as only a single successful survey has been carried out in each year.

Other limitations that affected the results are summarised below;

- Skill in using GPS units varied across the users. Discrepancies were apparent in the coordinates provided, apparently relating to varying datum used. The location of some transects thus had to be approximated resulting in loss of resolution of the transect results with associated topography.
- The uneven transect areas probably increased variations in survey effort per unit area.
- Notable differences in concentration were apparent with some observers anxious to record the maximum number of moths while others concentration would wander, especially when moth sightings were sparse.
- The need to get consistent and even survey effort across the observer groups and for the duration of the survey needed to be emphasised, particularly for volunteers who had not had scientific training.
- Survey method was interpreted differently by different groups unless very tight prescriptions are enforced regarding counting, and survey method.

- The ability of the groups to describe relevant habitat features was variable, and little data was recorded during the surveys. Having trained observers with each group, capable of describing vegetation and topographical features would greatly increase the quality and usefulness of the data generated by this kind of survey.

The variations in survey method used in the 2006 survey had the effect of reducing resolution of the survey, further reducing its capacity to correlate density with habitat features. The presence of the only hotspot identified in 2006 in the same location as one identified in 2005 appears significant. The low numbers recorded from this survey do however limit the correlations across the wider transect belt with the results from 2005. The low numbers in the 2006 survey are suspected to be caused by seasonal differences in the emergence pattern. It is suspected that the larger number of hot early summer days may have produced a 'peak' in emergence at an earlier time of the season, possibly exhausting the 'cohort' of pupating moths available to emerge on the 17th of December as compared with the similar date a year earlier. Alternatively the conditions on the 2006 survey date may have represented a less optimal emergence conditions than the 2005 survey. The variation in moth numbers (several dozen in 2006 compared with over a thousand in 2005) highlight the desirability to repeat surveys at a higher frequency than has been possible to date.

Recommendations

1. Continue to cover the same transect belt in future surveys allowing surveys to develop into a monitoring series capable of identifying population trends.
2. Follow a standard survey technique such as identified in the second survey in 2005.
3. Attempt to increase the transect density by reducing the time interval between recording periods.
4. Carry out a thorough induction process for supervisors and group leaders to ensure techniques and data recording is consistent between groups.
5. Induction for participants needs to emphasise that the quality of the data relies their diligent concentration during the survey period. Given this, participants should be notified prior to the survey that the activity is not appropriate for children or those with limited mobility. Also participants need to be adequately equipped for the survey. The usual expectation is that voluntary weekend activities are social/recreational occasions so inductions may highlight that the discipline of the survey period will be followed by social or recreational opportunities during the walk returning to the starting point. Participants might be provided with an information sheet on the technique to ensure they are well prepared for the survey.
6. Continue to hold multiple survey dates in the middle of December to increase possibility of having a survey on a day of appropriate weather.
7. Investigate possibility of getting additional surveys carried out on suitable survey days. Perhaps undertaken by a tertiary student with assistance of volunteers drawn from a university, possibly offer it as an option to corporate volunteer groups.
8. Consider establishing point surveys in grids at areas of particular interest to provide high resolution data on female density, vegetation changes and emergence patterns within and between seasons.
9. Include with each group an observer capable of recording basic habitat parameters in the areas where moths are observed. Having trained observers with each group, capable of describing vegetation and topographical features would greatly increase the quality and usefulness of the data generated by this kind of survey.
10. Ideal size for the group is probably 4: a group leader/observer/navigator, a second person primarily observing and two scribes, one to record observations and another to record habitat notes.
11. Use GPS units for survey wherever possible to map group locations.
12. Resource pre-survey set-up of flags or other markers to assist in creating repeatable transect intervals.

Acknowledgements

The Friends of Merri Creek member, Wendy Moore has been active in all aspects of the discovery, verification and subsequent projects relating to the Golden Sun-moth in the Merri Creek area and her efforts are particularly acknowledged. I am also grateful to members of the Golden Sun-moth 'taskforce' including Professor Tim New (Latrobe University), Alan Webster (DSE), Judy Bush and Barb Miles (MCMC) Ray Radford (FOMC), Ian Endersby, Beverley O'Dwyer, and the many enthusiastic Friends of Merri Creek and MCMC staff who participated. Lucinda Gibson (Latrobe University student) has also been instrumental in developing this project. Feedback from a presentation of the results to the Victorian Entomological Society in February 2007 was valuable in developing the discussion and recommendations in this report.

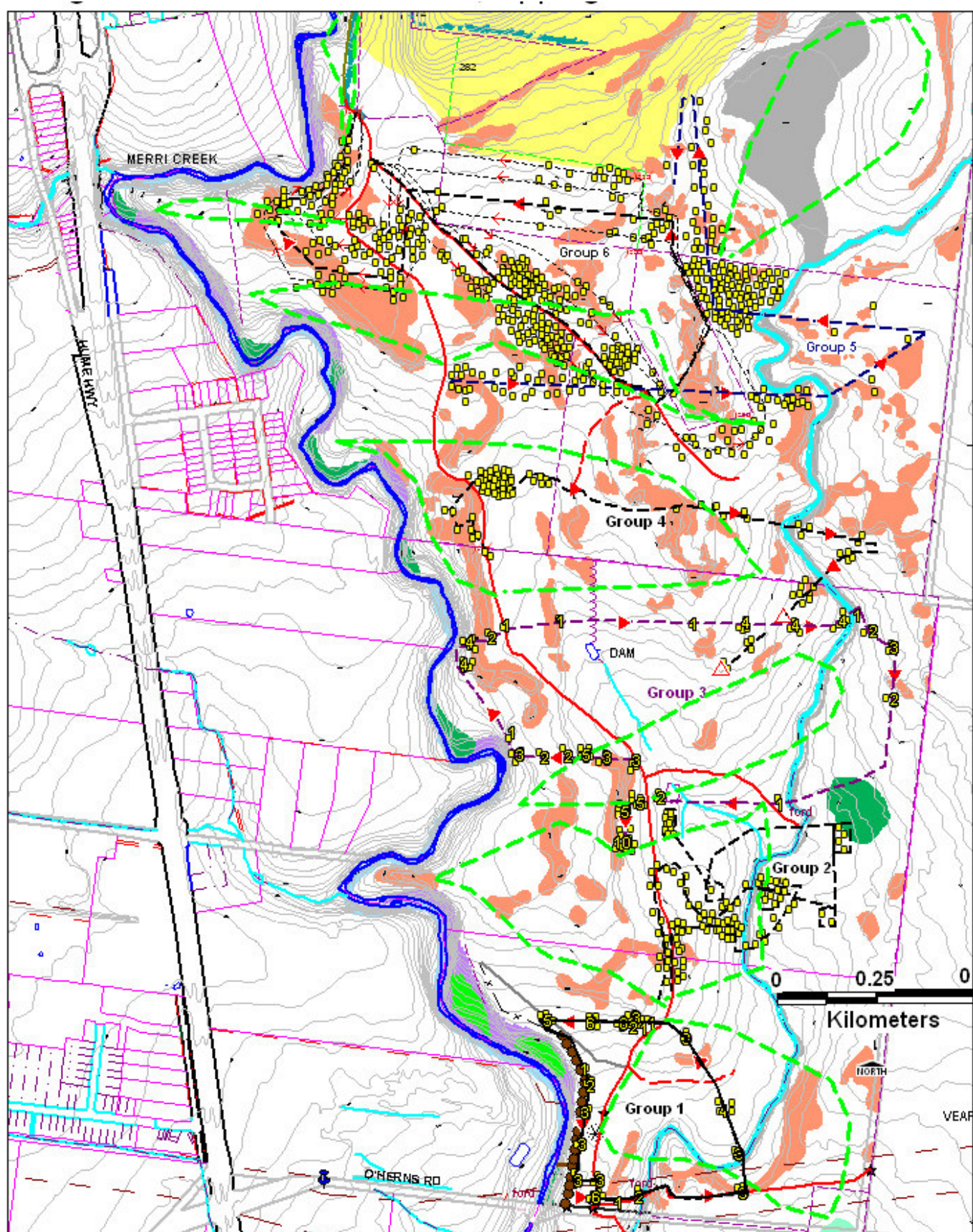
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Appendix

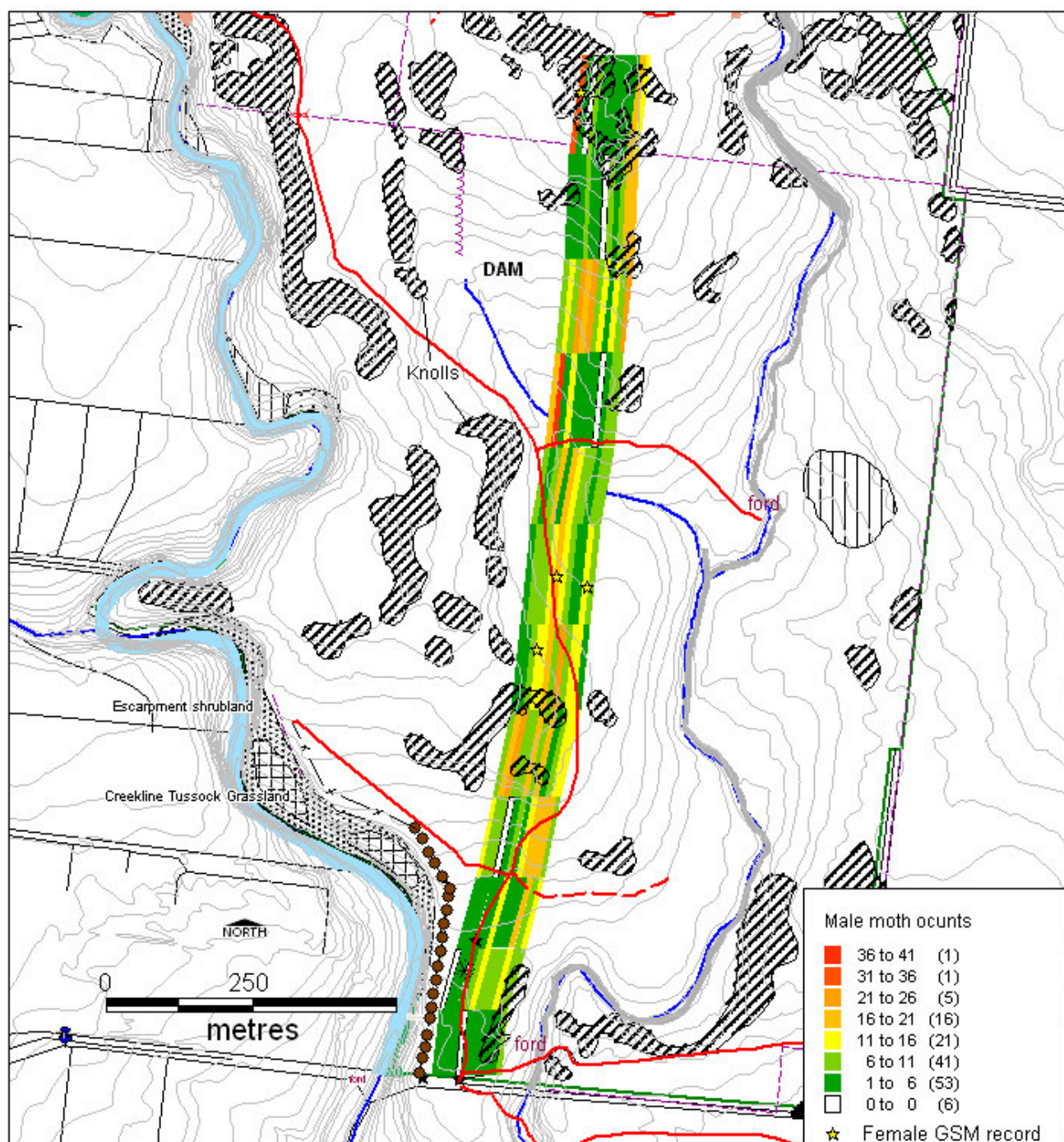
Appendix 1

Map 1 Survey sites at Cooper St Grassland



Map 2. Survey Craigieburn Grassland December 12th 2005

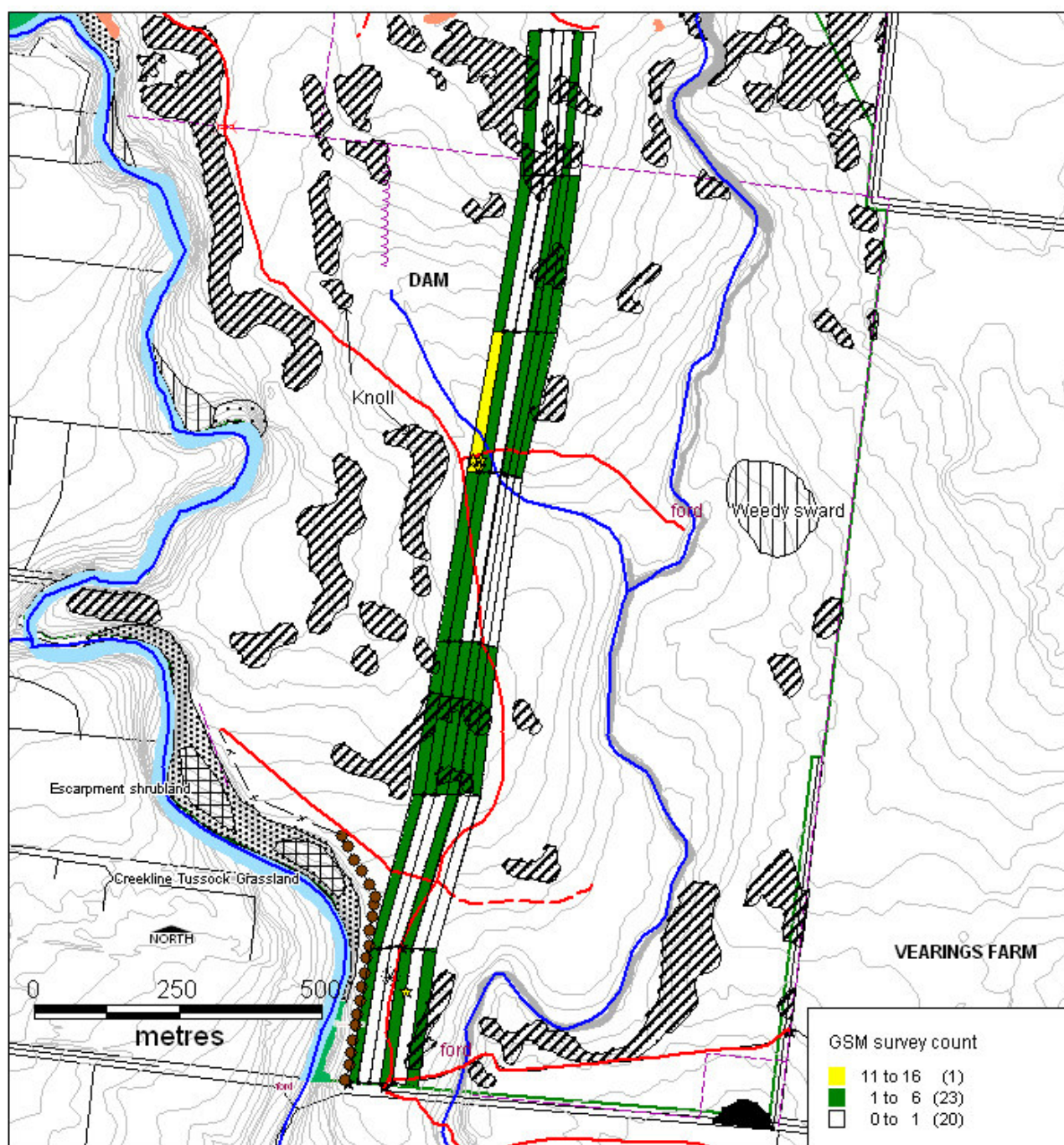
Craigieburn Grassland Reserve, Epping/Wollert



Golden Sun-moth survey results, 11/12/05

Map 3. Survey on December 17th 2006

Craigieburn Grassland Reserve, Epping/Wollert



Golden Sun-moth survey results, 17/12/2006

★ Female GSM record

Appendix 2, Photos of surveys



Survey on the 11th December 2005.



Survey on the 17th December 2006 in the south of the survey