

Throsby East Offset GSM monitoring report

Golden Sun Moth habitat mapping 2017

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Executive Summary

SMEC Australia Pty Ltd and Alison Rowell, Biologist and Environmental Consultant, have prepared this monitoring report on behalf of Parks and Conservation Service (PCS), Environment and Planning Directorate, ACT Government.

This report presents the findings of Golden Sun Moth (*Synemon plana*, GSM) habitat mapping conducted at Throsby East Offset during summer 2017/2018.

The key outcomes of GSM habitat mapping at Throsby East Offset were:

- The site supports 49 ha of GSM habitat, comprising:
 - 30 ha of low quality GSM habitat
 - 19 ha of medium quality GSM habitat
- Recent grazing has changed the structure and composition of the habitat in a direction that is likely to be beneficial to GSM.
- The box-gum woodland conservation area to the east of the GSM management area currently contains GSM habitat, but dense eucalypt plantings and natural tree regeneration will reduce the extent and quality of the habitat over the next five years if most of the trees establish well.

A review of habitat mapping in relation to previous habitat mapping indicated:

- The assessment of condition of GSM habitat appears to have declined substantially from that recorded in 2010 (Eco Logical 2011), with the majority of the site recorded as supporting low quality habitat in 2017, rather than moderate or high quality habitat. This apparent decline in habitat condition may be associated with the following:
 - The criteria for GSM habitat quality assessment differed between 2010 and 2017-18.
 - Some areas mapped as GSM habitat in 2010 were dominated by phalaris and subterranean clover in 2017-18, and consequently were not mapped as GSM habitat in 2017-18.
 - Some areas mapped as GSM habitat in 2010, including dams, swales, patches of box-gum woodland and areas dominated by exotics, were excluded from the 2017-18 mapping.

The following recommendations should be considered in future management and monitoring of GSM habitat at Throsby East Offset:

- Grazing by stock should continue, with the aim of keeping biomass within a range appropriate to GSM habitat.
- GSM numbers and distribution should be monitored to assess population recovery.
- If habitat continues to appear suitable but GSM numbers remain low, Throsby East may be suitable for larval translocation.
- Management of tracks (i.e. slashing and location) within the box – gum woodland conservation area to the east of the GSM habitat area could be planned to facilitate improved connectivity with scattered habitat to the east in Gorooyarroo Nature Reserve.

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1. Introduction

1.1. Background

SMEC Australia Pty Ltd (SMEC) and Alison Rowell, Biologist and Environmental Consultant, prepared this report on behalf of the Parks and Conservation Service (PCS), Environment and Planning Directorate, ACT Government as one component of the contract '*North Canberra Golden Sun Moth Population Monitoring and Habitat Mapping 2017/1*'. SMEC was engaged to monitor Golden Sun Moth (GSM) populations at six sites and to map GSM habitat at nine sites in and adjacent to the ACT. These sites have been, or are proposed as, offsets for development of GSM habitat.

The GSM is listed as critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and listed as endangered under the *ACT Nature Conservation Act 2014* (NC Act). In the ACT region, GSM occur in an area about 100 km long and 30 km wide, extending from the Queanbeyan district in the south-east to the Boorowa area in the north-west (ACT Government 2017). In the ACT, the species is known to occur at approximately 78 lowland grassland and derived grassland sites in and adjacent to the city of Canberra.

GSM population monitoring and habitat mapping was required at the following sites:

- Jarramlee Offset Nature Reserve (Jarramlee)
- Kinlyside Offset Nature Reserve (Kinlyside)
- Throsby North Offset (Throsby North)
- Yass Valley Lot 2 Offset (Yass Valley Lot 2)
- West MacGregor Offset Nature Reserve (West MacGregor)
- Woolshed Creek (Woolshed Creek).

In addition, habitat mapping was required at the following offset sites:

- Jerrabomberra East (Jerrabomberra East)
- Throsby East Offset (Throsby East)
- West Majura (West Majura).

This report relates to GSM habitat mapping conducted at Throsby East.

1.2. Survey Site

The Throsby East Offset is a 102 ha extension to Goorooyarroo Nature Reserve and is situated between Goorooyarroo Nature Reserve and Horse Park Drive (**Error! Reference source not found.**). Throsby East was established as an offset under the Gungahlin Strategic Assessment (Umwelt 2013). The site supports exotic, native, and mixed grassland, and areas of open box-gum woodland.

The Extension to the Mulligans Flat and Goorooyarroo Nature Reserves Offset Management Plan (For the Throsby North, Throsby East, and Kenny Broadacre Offset Areas; ACT Government 2015), established as required under the EPBC Act approvals, specifies measures to conserve the offset area and details the monitoring program for the golden sun moth and golden sun moth habitat.

The Extension to the Mulligans Flat and Goorooyarroo Nature Reserves Offset Management Plan (ACT Government 2015) requires that PCS and Conservation and Research (CR) re-evaluate strategies used to manage golden sun moth and natural temperate grassland in Throsby East if, as a result of the monitoring program, it is determined that there is a measured decline in the population of the golden sun moth. The eastern portion of Throsby East is management primarily for restoration of box-gum woodland values (ACT Government 2015).

Results were analysed with reference to the following previous surveys:

Rowell, A. 2010. *Brief survey of Throsby for Golden Sun Moth, December 2009*. Report to Territory and Municipal Services Directorate.

Eco Logical Australia. 2011. *Golden sun moth surveys at One Tree Hill, Kinlyside and Throsby*, Prepared for Conservation Planning and Research, ACT Government, Department of Territory and Municipal Services, February 2011.

Rowell, A and O'Sullivan, T. 2017. *Golden Sun Moth Population and Habitat Monitoring, 2016. Bonner, Throsby North and Kinlyside Environmental Offsets*. Prepared for Parks and Conservation Service. March 2017.

GSM populations at Throsby East were previously surveyed in 2009 (Rowell 2010) as part of broader surveys for the proposed Throsby Development. Low levels of GSM activity were recorded, in accordance with activity levels described by Hogg (2010). These records included very few GSM in the main part of Throsby East, but more numerous sightings in the north-western extension and in the area to the west now covered by housing (ACT Government 2015, Rowell 2010). It was noted in 2009 that Throsby East section contained mainly low diversity native pasture/secondary grassland dominated by wallaby *Rytidosperma spp.* and speargrasses *Austrostipa spp.*, with phalaris *Phalaris aquatica*, ryegrass *Lolium sp.* and subterranean clover *Trifolium subterraneum* being common (Rowell 2010).

Eco Logical (2011) surveyed two 100 metre transects for GSM in Throsby East in 2010 and no GSM were recorded. Much of the site was mapped as moderate-high quality GSM habitat, with high quality habitat on the western edge and in the north-east, and a low-moderate patch in the south-east. The descriptions of the vegetation were combined with Throsby North, with moderate to high areas described as 'dominated by *Austrostipa bigeniculata* and *Austrostipa scabra* in the upper layer of the understorey with *Austrodanthonia spp.* often occurring in large patches in a lower understorey layer. These sites often contained greater than 90% native understorey coverage. Small patches of box-gum woodland and scattered trees occur across the site'.

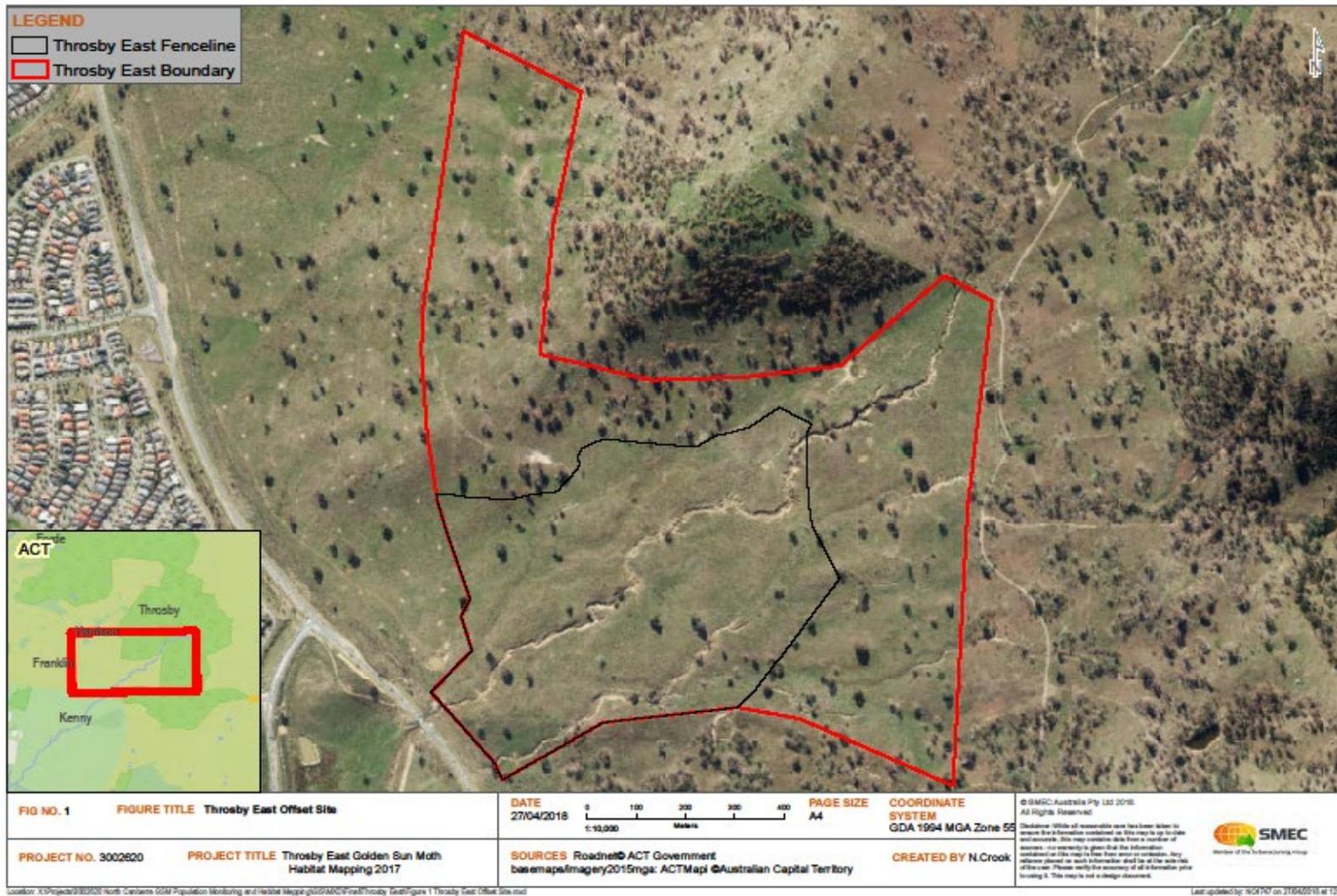
GSM habitat was monitored in 2016 (Rowell and O'Sullivan 2017). The site was noted to support predominantly moderate to high biomass.

1.3. Objectives

This report presents the findings of habitat mapping conducted during summer 2017/2018 at Throsby East. The purpose of this monitoring is to meet the monitoring requirements specified in the Extension to the Mulligans Flat and Goorooyaroo Nature Reserves Offset Management Plan (ACT Government 2015), to inform management of potential management requirements and to provide the ACT Government with information to determine whether corrective actions are triggered.

The objective of habitat mapping conducted at Throsby East was to determine the extent and condition of GSM habitat at this site. The data collated would assist long term monitoring and inform future management decisions by determining a baseline level of the extent and/or quality of the GSM habitat.

Figure 1.1 Throsby East Offset Site



2. Methods

The habitat assessment scope comprised of two components:

- Mapping habitat condition classes
- Habitat monitoring transects.

2.1. Mapping and monitoring

2.1.1. Habitat mapping

The following criteria for classifying GSM habitat were followed in this survey. Alison Rowell developed this approach to provide a repeatable method, which can be used across multiple sites in the ACT by different users. Four condition classes of GSM habitat were defined based on relatively stable habitat features such as density of larval food plants, weed cover and physical characteristics such as soil type, slope and aspect.

- HIGH quality GSM habitat
 - Primary NTG or native pasture dominated by native larval food plants (i.e. *Rytidosperma* sp. and/or *Austrostipa* sp.), with low weed cover and some bare ground.
 - MEDIUM quality GSM habitat
 - Primary or secondary grassland, with a moderate component of *Rytidosperma* sp. and/or *Austrostipa* sp., and/or moderate weed cover.
- or
- Native-dominated grassland with a high component of *Rytidosperma* sp. and/or *Austrostipa* sp., but less than High quality habitat because of one or more of the following conditions:
 - On a steep slope or hill top
 - On a south or east-facing slope
 - Soil very shallow and/or stony, rock outcrops present
 - Secondary grassland or contains scattered trees.
- LOW quality GSM habitat
 - Larval food plants (*Rytidosperma* sp., *Austrostipa* sp. and/or Chilean needle grass) are a minor component of the ground layer, growing sparsely or in patches among unsuitable vegetation such as:
 - Exotic species (excluding Chilean needle grass)
 - Native C₄ grasses (such as *Themeda triandra*)
 - Other unsuitable native ground cover (e.g. *Poa labillardieri*, rushes / sedges)
 - Trees, shrubs, regeneration, plantings.
 - CNG (Chilean needle grass) dominated GSM habitat
 - Grassland dominated by Chilean needle grass.

Across the sites surveyed, several different types of grassland were put into the medium and low habitat classes, with the differences often resulting from past land uses. Areas classified as high quality habitat were generally less disturbed grasslands, and often the critically endangered Natural

Temperate Grassland community. Grasslands which have not been ploughed, heavily grazed or pasture-improved tend to retain cryptogams, bare ground and native forbs, contain fewer exotic species, and have lower and more stable biomass. They also retain the shorter species of *Rytidosperma* (*R. carphoides*, *R. auriculatum*, *R. laeve*), while more disturbed grasslands contain more robust 'native pasture' species such as *R. caespitosum* and *Austrostipa bigeniculata*. Where relevant to management, differences were recorded.

Biomass was not included as a component of GSM habitat measurement due to the high variability in response to short term management measures or seasonal conditions. While an important feature of GSM habitat condition, this makes it unsuitable for monitoring long-term change. Biomass was mapped as a separate overlay independent of the underlying habitat quality.

General characteristics of biomass classes were:

- Low biomass: tussocks up to 10 cm high, bare ground common between tussocks, litter layer sparse.
- Medium biomass: tussocks up to 20 cm high, little bare ground between tussocks, litter common but not continuous.
- High biomass: tussocks greater than 20 cm high and closely spaced, little or no bare ground, litter layer continuous and thatchy, often including subterranean clover.

For all condition classes, the ideal biomass condition for each site would be low to medium, i.e. most areas without dense thatch or tall dense tussock grasses over 10 cm high.

This approach provides information on the habitat quality and current management needs on the same map, without giving undue importance to what may be temporary changes in apparent quality. It should also avoid having greatly differing habitat quality maps for a site from year to year, which could be confusing viewed together, or misleading about underlying habitat quality if only one year's mapping was viewed.

Habitat mapping was undertaken through review of aerial photographs, followed by a detailed site walk-over to identify habitat zone boundaries.

2.1.2. Habitat monitoring

One 100-point habitat transect was established in each identified habitat zone, i.e. a maximum of three (4 when Chilean needle grass was present) transects at each site. Transects were 100 metres, except where a habitat zone was less than 100 m across, in which case 100 points were sampled on a 50 m transect. Data was collected according to the GSM Habitat Transect datasheet (Attachment L to the RFQ), specifically recording the presence of GSM larvae food plants at each point on the transect. The following data was collected for each transect:

- Reserve name
- Date
- Habitat Zone
- Transect
- Transect co-ordinates (start and end point)
- Dominant feature present at each point:
 - Cryptogams
 - Bare Earth
 - Rock

- Litter / Dead Vegetation
- Chilean Needle Grass
- Serrated Tussock
- Annual Exotic Grass
- Perennial Exotic Grass
- Exotic Broadleaf
- Rytidosperma sp.
- Austrostipa sp.
- Other Perennial Native Grass
- Other native plants.

Notes were made of other relevant habitat characteristics, including soil types, grazing type and pressure, fire, slashing, erosion, site damage, pupal case locations, presence of trees / shrubs, etc.

Reference photographs were taken of each transect using the method in the Draft ACT Golden Sun Moth Monitoring Plan (Attachment D to the RFQ).

3. Results

3.1. GSM Habitat Mapping and Monitoring

3.1.1. Habitat mapping

GSM habitat at the Throsby East offset was mapped in January 2018 (Table 1, Figure 2). Biomass was low throughout the areas managed as GSM habitat, following a relatively dry summer and cattle grazing. The eastern box-gum management zone had slightly higher biomass, possibly as stock grazing has been lower to encourage natural regeneration of eucalypts and to protect plantings. Kangaroo grazing was moderate in the western half and higher in areas adjacent to denser woodlands. The management zones are shown in the Offset Management Plan (ACT Government 2015).

The north-western extension of the offset contained a small patch of medium quality habitat at its northern end, adjacent to box-gum woodland. This patch contained short species of wallaby grasses, bare ground and native forbs. There were patches of low quality habitat further south, containing weedy native pasture. These were interspersed with damper areas containing woodland, weeds and weeping rice grass *Microlaena stipoides*.

The south-western habitat area consisted of native pasture on low rises adjacent to drainage lines that run WSW through the site. The medium quality habitat in this area was dominated by short wallaby grasses and spear grasses, with patches of bare ground, few exotics and little evidence of pasture improvement. The low quality habitat also contained wallaby grass, but had moderate cover of phalaris and subterranean clover, little bare ground and a dense litter layer.

Annual grasses were not visible as a major component of the vegetation, probably because they had become part of the litter layer or had been grazed off in the low quality habitat and had not been common in the medium quality habitat. No Chilean needle grass *Nassella neesiana* was seen on the site, and serrated tussock *Nassella trichomata* had mostly been controlled.

Gully erosion along Sullivan's Creek is being addressed by fencing off the creek and planting eucalypts, wattles and other native shrubs. The plantings are doing well, but the areas were not mapped as GSM habitat. This was because phalaris has increased in parts with the exclusion of stock, the deeper and more fertile soils along the creek support more weeds, disturbance from the plantings has favoured exotic forbs and the dense plantings (3-4 m apart) will soon shade out native grasses. Weeping rice grass was common along the upper part of the creek, but this species is not generally associated with GSM habitat.

The vegetation east of the GSM conservation area is managed for box-gum woodland values, and also contains dense tree plantings. Approximately 25% of this area contains small established trees, some planted over low quality GSM habitat. Within two years (one GSM generation) it is anticipated that this area will not be suitable for GSM. Holes have been prepared for new plantings over approximately another 25% of the eastern area, which will also become unsuitable for GSM if the plantings are successful. The areas mapped as low quality GSM habitat in this zone contained native pasture dominated by tall speargrass *Austrostipa bigeniculata* and rough speargrass *A. scabra*, but subterranean clover and other annual exotic forbs were common in intertussock spaces, phalaris was occasional and the litter layer was relatively dense and thatchy. The medium quality habitat was shorter and contained more wallaby grasses and bare ground, and fewer weeds.

Table 1. Mapped GSM habitat area at Throsby East.

GSM Habitat Classification	2017 Surveyed Area (ha)
Low Quality GSM Habitat	30.0
Medium Quality GSM Habitat	19.0
Not GSM Habitat	53.6
Plantings	4.1
Total	106.6

3.1.2. Habitat transects

Habitat transects were measured in early April 2018. A summary of the transect data is shown in Table 2, and photographs are presented in Appendix B. Both transects had similar cover of wallaby grasses. In the medium quality transect these were short species (*Rytidosperma carphoides* and *R. auriculatum*), while *R. caespitosum*, a variable species which tolerates disturbance, grazing and pasture improvement, was more common in the low quality transect. Both transects had similar litter cover, but this was shallow in the medium quality habitat and deep and thatchy in the low quality habitat where it appeared to be derived from phalaris, subterranean clover, other exotic forbs and the remains of tall annual grasses.

The medium quality transect had low cover of exotic species and bare ground was common, while the low quality transect contained more exotic forbs and pasture species and little bare ground.

3.1.3. Other observations

Two Superb Parrots *Polytelis swainsonii* (listed as vulnerable in the ACT and nationally) flew into a tree on 7 April 2018 (*species location data removed*).

Table 2. Habitat transects at Throsby East Offset.

Transect/ QUALITY	Crypt	Bare	Rock	Litter	CNG	Serrated Tussock	Annual Exotic Grass	Perennial Exotic Grass	Exotic Broadleaf	Wallaby	Stipa	Perennial Native Grass	Other Native	NOTES
1/Medium	5	15	0	33	0	0	0	4	2	22	15	4	0	Short native grassland, litter layer not dense. Biomass low.
2/Low	0	0	0	31	0	0	4	21	15	25	1	0	3	Short weedy native pasture, dense litter, phalaris subterranean clover. Biomass low.

Figure 3.1. GSM habitat mapping at Throsby East Offset.



4. Discussion

4.1. GSM Habitat Mapping

The extent and quality of GSM habitat cannot be directly compared between the current mapping and that conducted in 2010 (Eco Logical 2011), as different criteria were used to define habitat and habitat quality types. Eco Logical (2011) identified five quality categories based mainly on the estimated cover of 'suitable native species', but habitat transects were not measured. The definition used in the current report does not classify habitat as high quality if it occurs as patches among woodland, as such areas generally support lower densities of GSM than areas of primary native grassland. This follows the Gungahlin Strategic Assessment Report (Umwelt 2013) which stated that 'populations within the Plan area in Gungahlin are characterised by low to moderate population sizes and habitat type 'D' – secondary grassland. These populations are considered less significant than those within natural temperate grassland... and have a likelihood of reverting back into woodland following the cessation of grazing'.

Most of Throsby East was assessed as containing moderate to high quality GSM habitat in 2010, but no high quality GSM habitat was identified at Throsby East in 2017-2018 and large areas were mapped as low quality habitat. Some of the areas mapped as moderate or high quality in 2010 lie in swales which were dominated by phalaris and subterranean clover in 2017-18. After several years of drought phalaris and subterranean clover had virtually disappeared from many native pastures in the ACT by 2009, reappearing after the drought broke in 2010. These exotic pasture species may not have recovered by the time mapping took place in 2010. Some other areas included as GSM habitat in the Eco Logical (2011) mapping were excluded from the 2017-18 mapping. These included dams, swales, patches of box-gum woodland and areas dominated by exotics, especially phalaris.

The biomass across the site in 2017-18 was lower than in 2016 (Rowell and O'Sullivan 2017), due to a drier summer and grazing by cattle. The phalaris in particular was reduced in the south-western GSM habitat areas, improving the habitat structure for GSM. The box-gum woodland conservation area to the east of the GSM management area currently contains GSM habitat, but the dense eucalypt plantings and natural tree regeneration will reduce the extent and quality of the habitat over the next five years if most of the trees establish well.

The areas mapped as medium quality GSM habitat in 2017-18 based on species composition and habitat structure have had only occasional GSM sightings in the past. No GSM were recorded in Throsby East in 2016 and there was no GSM survey in 2017-18. Past records show very few GSM in the main part of the site, but numerous sightings in the north-western extension and in the area to the west now covered by housing (ACT Government 2015, Rowell 2010).

The 2017-18 habitat quality assessment should be regarded as provisional, due to the large change that has taken place in a short period, and the uncertainty that the condition observed in 2017-18 will be sustained. Plate 2 (Appendix B) shows medium quality habitat in 2017-18, while Plate 5 (Appendix C) shows a nearby transect 100 m ENE in 2016. Remarkably, the measured cover of both wallaby grasses and phalaris was similar in these transects, but the tall dense grasses in summer 2016 would have had a negative effect on GSM emergence, displaying, mate detection, mating and egg-laying, while the habitat structure in 2017-18 was much more favourable.

4.2. Management Observations

Throsby was heavily grazed by sheep near the end of the millennium drought in 2009, and it was noted then that Throsby East section contained mainly low diversity native pasture/secondary grassland dominated by wallaby and speargrasses, with phalaris, ryegrass and subterranean clover being common (Rowell 2010).

After 2009, reduced stock grazing and increased rainfall resulted in a large increase in biomass as phalaris became dominant. This situation continued for several years, and it is likely that the GSM population on the site is now very sparse. Kangaroo grazing at Throsby East appears to be relatively low in the western areas but higher in areas adjoining denser woodlands. Even if kangaroo grazing increases this will not control the growth of phalaris as kangaroos preferentially graze native grasses and the subterranean clover will continue to add nitrogen to the soil, favouring exotic species. Appropriately targeted and timed grazing by stock will therefore continue to be necessary in the medium term to maintain the biomass within a range that favours GSM.

GSM habitat may eventually be reduced to small scattered or linear patches within the box – gum woodland conservation areas and these may provide links to the areas of scattered habitat recorded in adjacent parts of Goorooyaroo Nature Reserve. The location and width of slashed tracks could be adjusted to facilitate these connections.

The reduction in phalaris at Throsby East has greatly improved GSM habitat structure, but the improvement may not be reflected in GSM numbers for several years due to the probable two-year larval period. The distribution and numbers of GSM at Throsby East should be monitored annually, to assess whether population recovery is occurring. If the population is still very sparse or apparently locally extinct after three years of successful biomass management, the GSM management area may be suitable for translocation of larvae.

5. Conclusion

The key outcomes of GSM habitat mapping at Throsby East Offset were:

- The site supports 49 ha of GSM habitat, comprising:
 - 30 ha of low quality GSM habitat
 - 19 ha of medium quality GSM habitat
- Recent grazing has changed the structure and composition of the habitat in a direction that is likely to be beneficial to GSM.
- The box-gum woodland conservation area to the east of the GSM management area currently contains GSM habitat, but dense eucalypt plantings and natural tree regeneration will reduce the extent and quality of the habitat over the next five years if most of the trees establish well.

A review of habitat mapping in relation to previous habitat mapping indicated:

- The assessment of condition of GSM habitat appears to have declined substantially from that recorded in 2010 (Eco Logical 2011), with the majority of the site recorded as supporting low quality habitat in 2017, rather than moderate or high quality habitat. This apparent decline in habitat condition may be associated with the following:
 - The criteria for GSM habitat quality assessment differed between 2010 and 2017-18.
 - Some areas mapped as GSM habitat in 2010 were dominated by phalaris and subterranean clover in 2017-18, and consequently were not mapped as GSM habitat in 2017-18.
 - Some areas mapped as GSM habitat in 2010, including dams, swales, patches of box-gum woodland and areas dominated by exotics, were excluded from the 2017-18 mapping.

The following recommendations should be considered in future management and monitoring of GSM habitat at Throsby East Offset:

- Grazing by stock should continue, with the aim of keeping biomass within a range appropriate to GSM habitat.
- GSM numbers and distribution should be monitored to assess population recovery.
- If habitat continues to appear suitable but GSM numbers remain low, Throsby East may be suitable for larval translocation.
- Management of tracks (i.e. slashing and location) within the box – gum woodland conservation area to the east of the GSM habitat area could be planned to facilitate improved connectivity with scattered habitat to the east in Goorooyarroo Nature Reserve.

6. References

- ACT Government.** 2015. *Extension to the Mulligans Flat and Goorooyaroo Nature Reserves Offset Management Plan (For the Throsby North, Throsby East and Kenny Broadacre Offset Areas)*. Commitments 10 within the Gungahlin Strategic Assessment Biodiversity Plan. Prepared by Territory and Municipal Services Directorate on behalf of the ACT Government.
- ACT Government.** 2017. *Golden Sun Moth Action Plan*, Environment, Planning and Sustainable Development Directorate, Canberra.
- Eco Logical Australia.** 2011. *Golden sun moth surveys at One Tree Hill, Kinlyside and Throsby*, Prepared for Conservation Planning and Research, ACT Government, Department of Territory and Municipal Services, February 2011.
- Rowell, A.** 2010. *Brief survey of Throsby for Golden Sun Moth, December 2009*. Report to Territory and Municipal Services Directorate.
- Rowell, A. and O'Sullivan, T.** 2017. *Golden Sun Moth Population and Habitat Monitoring, 2016. Bonner, Throsby North and Kinlyside Environmental Offsets*. Prepared for Parks and Conservation Service. March 2017.

Appendices

Appendix A Habitat Transect Data

Refer to “Appendix A – SMEC 2018 Throsby East - Attachment L - Habitat Transect Data.xlsx”

Appendix B Habitat Transect Photographs



Plate 1. Transect 1, 0-1 metres. Medium quality habitat.

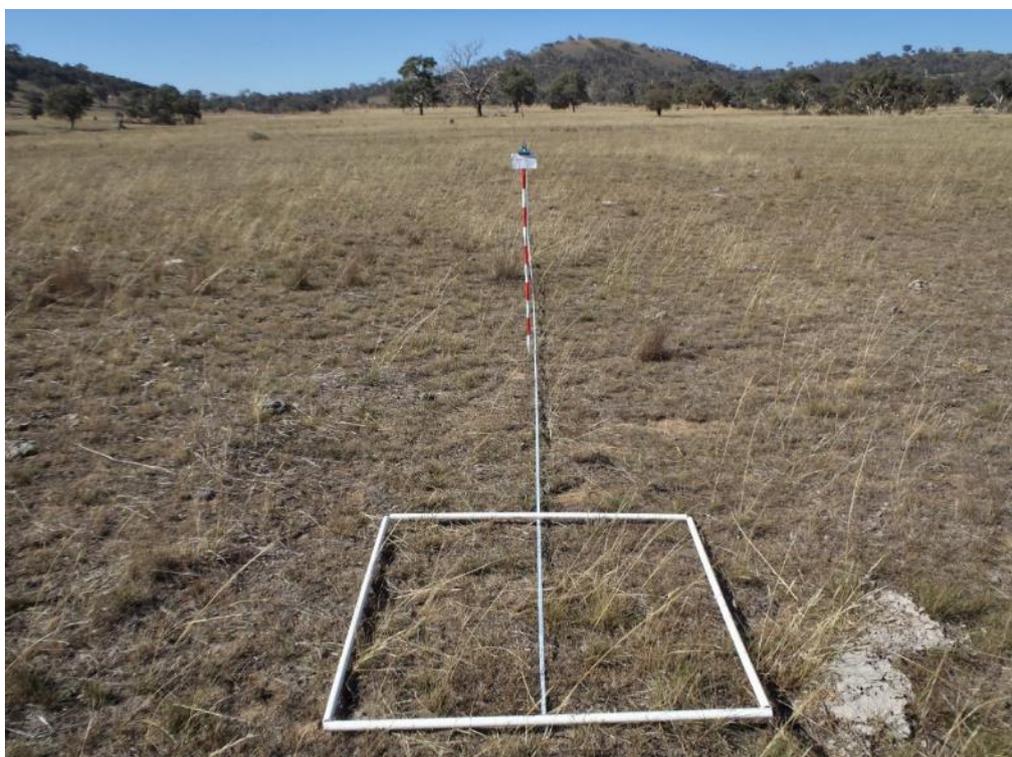


Plate 2. Transect 2, landscape view. Open native grassland dominated by wallaby and Speargrasses, with other native grasses, some bare ground and few forbs.



Plate 3. Transect 2, 0-1 metres. Low quality habitat.



Plate 4. Transect 2, landscape view. Weedy native pasture containing wallaby grass, grazed phalaris and dense litter from exotic annual species.

Appendix C Site Condition Photographs



Plate 5. Landscape view of transect 12 C, December 2016. Tall dense pasture with phalaris, annual exotic grasses and wallaby grasses. This transect is 100 m ENE of transect 1, in an area categorised as medium quality GSM habitat in 2017-18.



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