ACT Government

Environment, Planning and Sustainable Development

Golden Sun Moth Research Plan

Advancing restoration of ACT Golden Sun Moth habitat.

October 2019

Project Details

Project Name:	Golden Sun Moth Research Plan - Advancing Restoration of ACT Golden Sun Moth habitat.
Funding:	$100,000 contributed by Doma Group (in compliance with Condition 13 of the EPBC referral 2014/7372). $100,000 contributed by Department of Finance (in compliance with Condition 7 of the EPBC referral 2017/8028).
Project Manager:	Ben Croak, Ecologist, Environmental Offsets Planning, Monitoring and Research.
Project team members:	Maree Gilbert – Ranger in Charge, Environmental Offsets Urban Reserves South. Wade Young – Ranger in Charge, Environmental Offsets Urban Reserves North. Greg Baines – Senior Ecologist, Conservation Research. Renee Brawata – Senior Fauna Ecologist, Conservation Research. Richard Milner – Ecologist, PCS Projects. Brett Howland – Ecologist, Environmental Offsets Planning, Monitoring and Research.
Relevant legislation:	*Environment Protection and Biodiversity Conservation Act 1999, Nature Conservation Act 1980.*
Document location:	fA9218298

Circulation

This draft Plan has been circulated to the following sections for information and comment:

Version no.	Issue date	Amendment details	Author
1.0	04/09/2019	First draft	Ben Croak
1.1	06/09/2019	Incorporated comments from Michael Mulvaney	Ben Croak
1.2	12/09/2019	Incorporated comments from Paul Downey	Ben Croak
1.3	25/09/2019	Incorporated comments from Alison Rowell	Ben Croak

Version no.	Issue date	Amendment details	Author
2.0	30/09/2019	Incorporated comments from Laura Rayner and Karen Ikin	Ben Croak
2.1	04/10/2019	Incorporated comments from Bianca Jameson	Ben Croak

Procurement Capital Works Involvement

Is an exemption required to procure this project without Procurement and Capital Works (PCW) involvement? No **Yes**

- The project does not involve complex construction and consequently considered to have low risk in terms of WH&S.
- The project proposes to manage these low risks by the application of ACT WH&S Guidelines directly by the PCS project manager. Contractors will be required to provide Safe Work Method Statements (SWMS) and submit monthly WHS Checklists in accordance with the ACT Gov WHS policy for construction
- Simple procurement
- Project team experienced in ACT Government procurement processes

Research Plan Approval

This research plan represents the final agreed version, subject to approval by the Minister responsible for administrating the *Environment Protection and Biodiversity Conservation Act 1999 (*EPBC Act).

Justin Foley, Executive Branch Manager, Parks and Conservation Service.
Date: 31/10/2019

Antonio Mozqueira, Senior Manager, Research and Evidence.
Date: 31/10/19

Background

Native species are disappearing faster than at any time in human history, reducing biodiversity in Australia and across the globe at alarming rates (Di Marco et al. 2019). Anthropomorphic activities, most notably habitat degradation and destruction, have been identified as the leading cause of increasing extinction rates (Lindenmayer et al. 2000).

One such habitat that has suffered severe decline is the natural temperate grasslands (hereafter NTG) and grassy woodlands of south-eastern Australia. This biome is home to a variety of endemic floral and faunal assemblages and has experienced a range reduction of 99.5% since European settlement (O'Dwyer and Attiwill 1999). The main causes of this reduction, and the ongoing threats faced by this system, include increased urbanisation, exotic weed invasion, altered grazing and fire regimes resulting in reduced natural vegetation structure and components and faunal assemblages (Prober and Thiele 2005).

There are several plans and actions in place to manage and maintain the remaining grassland habitat and specific grassland components. However, in such a restricted and degraded system, active habitat restoration will be critical to ensure biodiversity values persist in situ (Prober and Thiele 2005).

The Golden Sun Moth (*Synemon plana*, hereafter 'GSM') is a threatened faunal component endemic to NTG. GSM is listed as **critically endangered** under the *Environment Protection and Biodiversity Conservation Act 1999* and **endangered** under the ACT *Nature Conservation Act 1980*. To minimise the chance of this species becoming extinct, GSM and their grassy ecosystem habitats are being managed across the ACT conservation estate. Current threats to GSM include habitat fragmentation and degradation, isolation of populations, agricultural practises and weed invasion.

To date research and monitoring of GSM and its habitat is largely based on population estimates of emerging adults and the distribution of grasses that provide food for caterpillars. A 'condition class assessment' has been developed to identify suitable habitat and to designate such areas as high quality, medium quality, low quality or Chilean Needle Grass (*Nassella neesiana*, hereafter CNG) dominated. However the distribution of moths throughout these areas is not uniform and it appears that even areas deemed to be high quality habitat are not utilised in a predictable manner. Additionally, emergent GSM show a strong sexual dimorphism in appearance, behaviour and habitat use that is largely un-studied.

Further investigation is needed to assess fine scale habitat use even within areas deemed to be highly suitable, and the dimorphic sexes need to be considered separately. This will yield greater predictive power and more effective management strategies.

Interestingly, GSM show some benefits from exotic CNG invasion with larger sized and greater numbers of individuals detected in CNG dominated areas (Sea and Downey 2014). This confounds endangered species management and exotic weed control and raises many questions about managing this relationship. The current strategy is to contain CNG within areas where GSM occur and prevent CNG spreading out of those areas. This is not an ideal situation as efforts should be to eradicate CNG. Therefore a greater understanding of the GSM reliance on this invasive species warrants investigation.

Components of this research project intend to bridge some of the gaps in our understanding outlined above, and will achieve the following specific goals:

- Assist ecologists and land managers to identify and assess the condition of GSM habitat with evidence-based guidance for ongoing protection and recovery efforts. Specifically, we aim to develop a management tool for assessing, monitoring and restoring GSM habitat using quantitative step-by-step procedures.

- Experimentally investigate the relationship between GSM and CNG and identify methods to transition areas in early stages of CNG invasion back to native habitat while maintaining GSM in those areas. This also has implications under climate change scenarios for the species as CNG is not drought tolerant whereas native food grasses (*Rytidosperma spp.*, Wallaby grass, hereafter WG) are much more resilient in dry conditions.

This research plan aligns with the priorities identified in the Conservation Advice for GSM and the CEMP (Conservation effectiveness monitoring program developed by the environment division EPSDD) for GSM in several ways:

- This work will increase the knowledge of GSM life history, demographics and habitat requirements,
- Provide insight into GSM relationship with native and introduced grassland flora species, soils and moisture,
- Aid in the development of standardised sampling and restoration methods,
- Further research into GSM relationship with CNG and WG and,
- Investigate GSM response to control of CNG.

Objectives

Project-specific objectives

This project involves two components:

Component 1. Factors influencing local scale habitat use, consists of two parts:

1. Identification of fine-scale factors influencing local-scale habitat suitability. Data will be compared across habitat quality types and related to pupal, female and male occurrence.
    - Habitat data collected will include: ground layer vegetation and composition, soil structure and condition, slope and aspect.
    - Thermal characteristics will be measured at several levels: soil, within grass layer and above grass.
2. Development of minimum condition thresholds for the maintenance and restoration of GSM habitat.
    - Use existing occurrence data in conjunction with the findings above to develop a minimum condition threshold to quantitatively guide the maintenance and restoration of GSM habitat.

Component 2. Experimental restoration of CNG dominated grassland, consists of two parts:

1. Experimentally restore CNG dominated areas with high densities of GSM to native WG.
    - Set up control plots in WG dominated areas and in CNG areas. Set up treatment plots in CNG areas and assist in transition to WG with manual CNG removal.
    - Determine if small areas of CNG can be transitioned into native WG.
    - Assess the effects of restoration on GSM in situ over successive emergent events.

2. Identify GSM seed-stock for habitat restoration.
    - Determine if GSM seed-stock is appropriate (or cost-effective) for WG restoration.

Outcomes

- Improved knowledge of the role of vegetation structure and complexity on the occurrence of GSM.
- Improved knowledge of the relationship between GSM and soil type/attributes.
- Improved knowledge of the role of thermal regimes experienced by GSM larvae below ground, and the effect on dispersal and habitat use by adults at the grass level.
- Greater understanding of the relationship between GSM and CNG and the effects of CNG replacement on GSM populations.
- Seed/tube stock species for GSM habitat restoration defined.
- Enhanced ability to predict GSM occurrence based on fine scale habitat attributes.

Output(s)

- Peer-reviewed research manuscript on habitat requirements for GSM.
- Peer-reviewed research manuscript on habitat restoration for GSM.
- Decision tool (i.e. minimum threshold assessment) for GSM habitat/restoration.
- Revisions to CEMP for GSM/NTG management.
- Revisions to the approved conservation advice for GSM.
- Guidelines for the control and restoration of CNG areas produced.
- Guidelines for the restoration of GSM habitat produced.

Scope of Work

Component 1 – Factors influencing local-scale habitat suitability.

The majority of research to date has focussed on the emergent adult life stage, particularly the male which is easily detectable (Richter et al. 2013). The exact habitat requirements of GSM have been extremely difficult to determine due to a non-uniform use of areas deemed to be suitable (good, medium or low quality) habitat for GSM. This research component aims to investigate habitat characteristics associated with the dimorphic male, female and pupal life stages individually. By assessing habitat use by the sedentary female and the location of pupation, fine scale habitat suitability may be more indicative of actual habitat use (vegetation species and soil attributes) than for that of the larger range occupied by the dispersing male. Data collected from females and pupal case locations will include: soil measurements (type, nutrient levels), vegetation structure (species, bare ground cover and vegetation height), slope, aspect and pupal size. Thermal regimes below ground and at grass level as well as ambient air temperature at will also be collected in these areas. These will be compared to data collected at random sites. From these data we will develop mixed models that isolate important habitat variables which will allow the development of a decision making tool (minimum condition threshold). This tool will be structured as a decision making flow diagram informing land managers via a step-by-step decision making process how to assess areas as GSM habitat and how to restore areas that are degraded.

Component 2 – Experimental habitat restoration.

The second component of this plan is an experimental approach to restoring areas of CNG into WG with GSM in situ. A series of treatment and control plots (approx. $9m^2$) will be constructed using Colorbond garden beds, embedded 10cm into the ground and projecting 20cm above the ground to provide a mechanical barrier to lateral CNG re-invasion. Control plots will be of two types; the first (n=10) will consist of CNG and the second (n=10) will consist of WG. Treatment plots (n=10) will consist of CNG that has been burnt to ground level. Treatment plots will have WG seeds (approx. 110g per $9m^2$ plot) and seedlings (n=approx. 80 individuals per $9m^2$ plot) planted within them and will be monitored twice monthly to measure WG growth and CNG regrowth and to provide manual removal of CNG as needed. Prior to succeeding emergent periods, plots will be caged and during the peak emergent window all moths and pupal cases will be collected and counted to assess the effects of the restoration attempt. Pupal cases will be measured to assess any dimorphism under different plot types. After the first emergent period gravid females can be added to all plots to increase larvae numbers within plots to ensure that larvae are present at each plot. At the conclusion of the experiment plots may be dug up (pending further approval) and GSM caterpillars assessed and compared for growth and survival at different site types.

Assumptions and Constraints

Habitat suitability

Data collection on habitat suitability for male, female and pupal GSM (Component 1) will be collected as part of standard surveys that are currently undertaken by ACT offsets and will be expanded on by the P02 position created by this project.

Site selection

Restoration sites (Component 2) have not been chosen and will be picked based on 2019 emergence data. Sites will be chosen based on having relatively high levels of CNG and relatively high GSM in the 2019 emergence.

Adaptive Management

An adaptive management approach is advised, where objectives can be reviewed annually, and priorities reassessed in collaboration with relevant stakeholders and authorities to determine if changes to the research plan are required. The research plan will be reviewed each year following the reporting period. This will include a program status update and will review how research findings to date relate to upcoming project objectives. As required, the plan will be updated/amended, and a copy provided to the Minster responsible for administering the EPBC Act.

Governance

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Sam Toole.
Development Manager
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Craig Todd.
Director
National Divestment, Property Projects Branch, Property and Construction Division, Department of Finance

Reporting

Progress reports will be submitted to stakeholders annually.

Results and recommendations for management will be outlined in a final project report.

Schedule

This project will be completed by June 2023

Task/ milestone (bold)	Scheduled date
In-principle approval	05/10/2019
Plan approved by the Minister for Environment and Energy	Pre-Dec 2019
First Billing cycle ($50,000 from each contributor)	15/12/2019
Experimental plots burned	31/02/2020
Experimental and control plots in place	31/03/2020
Experimental plots planted with native grass	31/04/2020

First annual report	31/08/2020
Second billing cycle ($16,667 from each contributor)	31/08/2020
Recruitment P01	15/10/2020
First emergence data collection completed	31/12/2020
Second report	31/01/2021
Third billing cycle ($16,667 from each contributor)	31/01/2021
Recruitment P01	15/10/2021
Second emergence data collection completed	31/12/2021
Third annual report	31/01/2022
Fourth billing cycle ($16,667 from each contributor)	31/01/2022
Recruitment P01	15/10/2022
Third emergence data collection completed	31/12/2022
Analysis, Final report, manuscript preparation	31/05/2023

Proposed time line for GSM research plan

Jan 2020	Feb 2020	Mar 2020	Apr 2020	May 2020	Jun 2020	Jul 2020	Aug 2020	Sep 2020	Oct 2020	Nov 2020	Dec 2020
Experimental set-up			P02 - One day per week monitoring/maintenance							First emergence – data collection. – P01 FT	
Jan 2021	Feb 2021	Mar 2021	Apr 2021	May 2021	Jun 2021	Jul 2021	Aug 2021	Sep 2021	Oct 2021	Nov 2021	Dec 2021
P02 - One day per week monitoring/maintenance										Second emergence – data collection. P01 FT	
Jan 2022	Feb 2022	Mar 2022	Apr 2022	May 2022	Jun 2022	Jul 2022	Aug 2022	Sep 2022	Oct 2022	Nov 2022	Dec 2022
P02 - One day per week monitoring/maintenance										Third emergence – data collection. P01 FT	
Jan 2023	Feb 2023	Mar 2023	Apr 2023	May 2023							
Data analysis/Final report/Manuscript writing											

Budget

Item	Cost GST Inclusive
Colorbond garden beds x 40	$2,400
Colorbond corners	$640
Installation of Colorbond plots	$6,500
WG seedlings	$2400
WG seeds	$600
Shade cloth	$1,400
Soil testing	$1,000
PPE	$500
Staff FTE 0.2 x 3.5 years (P02)	$83,834
Staff FTE 0.2 x 3 years (P01)	$65,521
Vehicle	$5,000
Manuscript allowance	$10,000
Contingency (10%)	$20,205
Total budget	**$200,000**

Stakeholders & Communication Strategy

Stakeholder	Area of influence or interest in the project and role
ACT Government	*Internal consultation with government stakeholders including asset owners, approval bodies, the planning directorate and other agencies as identified.* *Communication via email or scheduled meetings on as needs basis. Draft and final drawings issued to asset owners to discuss design, maintenance, opportunities and constraints.*
PCS Projects	Communication via email and scheduled meetings on as needs basis.
Environmental Offsets	Communication via email and scheduled meetings on as needs basis.

Urban Reserves	Communication via email and scheduled meetings on as needs basis.
External Stakeholders	*Communication with key stakeholder groups identified below will be undertaken on an adhoc basis to gain their contribution to the design where considered appropriate and to inform them on the design and project progress.*
Sam Toole (Doma Group)	Annual reports. Communication via email and scheduled meetings on as needs basis.
Craig Todd (Dept. of Finance)	Annual reports. Communication via email and scheduled meetings on as needs basis.

Risk Management

The key risks to the successful delivery of project Outcomes and Outputs are:

Major risks include		**Strategies in place to treat against these risks**	
1	Poor/nil GSM emergence in planned regions	1	Identify alternate sites, rely on previous years data
2	Delays to project schedule due to adverse weather conditions or concerns relating to ecological impacts	2	Flexibility to project schedule
3	Unable to burn due to hazards risk	3	Mow or slash plots
4	Vandalism	4	Contingency money set aside
5	Drought	5	Use contingency money to provide water
6	Livestock	6	Ensure that livestock are excluded when necessary though management communication
7	Not enough sun moths at plots	7	Habitat/vegetation study only (cannot assess impact on GSM populations)
8	Flooding	8	Use past flooding data when choosing plots
9	Vehicular destruction of plots	9	Clearly flag/identify plots
10	Aboriginal heritage (artefacts)	10	Have protocol in place to assess and hand over sites/artefacts if discovered.

References

Di Marco, M., Ferrier, S., Harwood, T.D., Hoskins, A.J., Watson, J.E.M. 2019. Wilderness areas halve the extinction risk of terrestrial biodiversity. Nature. 573, 582-585.

Faithful, I., Hocking, C., McLaren D. 2010. Chilean needle grass (Nassella neesiana) in the native grasslands of south-eastern Australia: biodiversity effects, invasion drivers and impact mechanisms. Seventeenth Australasian Weeds Conference. 431-434.

Lindenmayer D.B., McCarthy M.A, Parris K.M, Pope. M.L. 2000. Habitat Fragmentation, Landscape Context, and Mammalian Assemblages in Southeastern Australia. Journal of Mammalogy. 81 (3) 787–797.

O'Dwyer C., Attiwill P.M., 1999. A comparative study of habitats of the Golden Sun Moth Synemon plana Walker (Lepidoptera: Castniidae): implications for restoration. Biological Conservation. 89 131-141.

Prober S., Thiele K., 2005. Restoring Australia's temperate grasslands and grassy woodlands: integrating function and diversity. Ecological Management and Restoration. 6 (1) 16-27.

Richter, A., Weinhold, D., Robertson, G., Young, M., Edwards, T., Hnatiuk S., Osbourne, W. 2013. More than an empty case: a non invasive technique for monitoring the Australian critically endangered golden sun moth, Synemon plana (Lepidoptera: Castniidae). Journal of Insect Conservation. 17, 529-536.

Sea, W., Downey, P. 2014. Chilean needle grass and golden sun moth Macgregor West development offset project. Final report to Village Building Company.