



Australian Government

Department of Finance

ARCHIVAL RECORD OF GOLDEN SUN MOTH RESEARCH

York Park Conservation Area, Barton ACT

March 2020





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FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Department of Finance

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Report No. 8189 / R01
Date: March 2020



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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
1	Karina Carwardine	6 December 2019	Karina Carwardine	6 December 2019
2	Karina Carwardine	25 February 2020	Karina Carwardine	25 February 2020
3	John Merrell	25 March 2020	John Merrell	25 March 2020

Table of Contents

1.0	Introduction	1
1.1	Background	1
1.2	Scope of This Report	1
1.3	Qualifications of the Project Team	3
1.4	Lodgement	4
1.5	Limitations	4
1.6	Acknowledgements	4
2.0	Methodology	5
2.1	Inventory of Archival Documents	5
2.2	Collation of Archival Documents	5
2.3	Stakeholder Consultation	5
2.4	Oral Histories and Expert Engagement	7
3.0	Site Description and History	9
3.1	Site Description	10
3.2	Historical Overview of the Site	10
3.3	History of Research Undertaken at the Site	13
4.0	Heritage Values	16
4.1	Understanding Scientific Heritage Value	16
4.2	Key Scientific Heritage Values	18
4.2.1	Important to the course of the ACT's cultural or natural history	18
4.2.2	Uncommon, rare or endangered aspects of the ACT's cultural or natural history	19
4.3	Qualifications to Scientific Heritage Value and the Site	20
5.0	Scientific Review	21
5.1	Ecological Values	21
5.1.1	Natural Temperate Grassland	21
5.1.2	Striped Legless Lizard	22
5.1.3	Golden Sun Moth	23
5.2	Research Themes	25
5.2.1	Golden Sun Moth Species and Population Issues	28
5.2.2	Broader Conservation Issues	29
5.2.3	Conservation Management Decision-Making	33
5.3	Stakeholder Consultation	37
5.5	Scientific Review Summary	40
6.0	Conclusion	41
7.0	References	42

Figures

Figure 1	Location of the Site	9
Figure 2	1950 Aerial Photograph of the site(red) and 'York Park' (blue)	10
Figure 3	Aerial view of Canberra looking North across Lake Burley Griffin, showing limited development around the Site	11
Figure 4	Development around the site in the early 1990s	12
Figure 5	Golden Sun Moth Habitat on Site and Surrounding Area	15
Figure 6	Natural Temperate Grassland at York Park Conservation Area	22
Figure 7	Striped Legless Lizard in York Park Conservation Area	23
Figure 8	A male golden sun moth in York Park Conservation Area	24
Figure 9	Golden sun moth larvae from soil under native grassland, Canberra ACT	24
Figure 10	Grassland Structure and Habitat Suitability for Some Threatened Grassland Fauna	29
Figure 11	Volunteer ratings of their enjoyment of the 'Sun Moth Count' Project	31
Figure 12	Article from the Sunday (Canberra) Times on the 'Sun Moth Count' Project	31
Figure 13	Poster from the 'Sun Moth Count' Project	32
Figure 14	Known distribution of golden sun moth in Canberra in 1991	35
Figure 15	Publicly Available Data on the Distribution of Golden Sun Moth in Canberra in 2019	36

Tables

Table 1.1	Archival Record Report Layout	2
Table 1.2	Qualifications of the Project Team	3
Table 2.1	Stakeholder Consultation Method	6
Table 3.1	Historical Timeline for The YPCA And Local Region	12
Table 3.2	Known Golden Sun Moth Surveys That Have Been Undertaken at the Site	13
Table 3.3	Golden Sun Moth Habitat at the Site and Surrounds	14
Table 4.1	Commonwealth and ACT Heritage Criteria	17
Table 5.1	Publication Types within the Archival Record	26
Table 5.2	Stakeholder Responses from Scientific Heritage Assessment	37

Appendices

Appendix 1	Archival Record Catalogue
Appendix 2	Full Archival Record

SECTION 1

Introduction



1.0 Introduction

Umwelt (Australia) Pty Limited (Umwelt) has been engaged by the Commonwealth Department of Finance (Finance) to prepare an archival record on the historic scientific research of the critically endangered species, golden sun moth (*Synemon plana*) at Blocks 3 and 15, Section 22 in Barton, ACT (the Site). The majority of this site is known as York Park Conservation Area (YPCA).

This report has been prepared to provide evidence to the Commonwealth Department of Agriculture, Water and the Environment (DAWE) that an archival recording, in accordance with Condition 6 of the *Environment Protection Biodiversity Conservation Act 1999* (Cth) (EPBC Act) approval 2017/8028, has been undertaken within 12 months of the commencement of the approved action. This report includes a description of the Site, its EPBC Act values, a historical review, a scientific review and collection of all previous scientific studies having been undertaken on the Site for the species.

1.1 Background

In 2017, Umwelt, on behalf of Finance prepared a Referral under the EPBC Act for the proposed divestment of Blocks 3 and 15, Section 22, Barton, Australian Capital Territory (ACT) 2600. This property is also known as the York Park Conservation Area. Prior to sale, the land was proposed to be cleared, resulting in a full impact to all environmental values present on the property.

The proposed action was referred to DAWE under the EPBC Act on 25 August 2017, reference 'EPBC 2017/8028'.

On 2 November 2017, DAWE determined that the proposed action was a Controlled Action due to impacts to 'threatened species and communities' and as a 'Commonwealth action' and would be assessed on Preliminary Documentation. The Preliminary Documentation was submitted on 29 June 2018 and was subsequently placed on public exhibition from 4 to 17 August 2018.

On 21 February 2019, Finance received approval from the Minister of DAWE to clear and divest the Site, subject to a number of conditions. Condition 6 stated that:

To compensate for the loss of heritage values as a result of the action, within 12 months of commencement of the action, the approval holder must submit to the Department [of the Environment and Energy] and the National Archives of Australia, an archival record of GSM [sic] research conducted in the YPCA, comprising a scientific review of previous research conducted at the site and a database of previous research reports and datasets. The archival record must be prepared in compliance with How to Prepare Archival Records of Heritage Items (1998) issued by the New South Wales Heritage Office or relevant ACT standard (where available).

Condition 6 is the basis of this report.

This archival recording exercise has been completed to ensure compliance with the above condition and best practice standards, in particular, *How to Prepare Archival Records of Heritage Items* (NSW Heritage Office, 1998) (Archival Records Guidelines).

1.2 Scope of This Report

The scope of this report has been determined by the requirements set out in EPBC Act Approval Condition 6 (2017/8028) and the Archival Records Guidelines.

The following table describes the scope of this report with reference to each section and appendix.

Table 1.1 Archival Record Report Layout

Section/Appendix	Description of Contents	Reference Document
1.0 Introduction	This section includes background details including purpose of archival recording, and authorship and acknowledgements.	The Archival Records Guideline requires that the archival record include details of the author, client, date and subject; and a statement about why the record has been made.
2.0 Methodology	Summary of the methodologies employed in compiling the archival record including photography, collation of archival photos and a database of previous studies and datasets.	The Archival Records Guidelines states that a written and/or diagrammatic description of the processes should be a minimum requirement for the recording for more complex sites.
3.0 Site Description and History	Description of the site and a chronological summary of its history. This will aim to provide context for the interpretation of the site and as a basis for the heritage assessment.	The Archival Records Guideline require that the archival record include a statement of heritage significance. While this will be further described in Section 4.0 , this section will establish the heritage context of the site.
4.0 Heritage Values	Description of the natural scientific heritage values of the York Park Conservation Area, and statement of significance.	The Archival Records Guideline require the archival record to includes a statement of heritage significance. This section describes in detail the heritage values of the Site.
5.0 Scientific Review	Consolidated synopsis of the Site's ecological values and of the overarching research themes and outcomes from the reports contained in the archival record in Appendix 2 .	Condition 6 requires a scientific review be included within the archival recording.
6.0 Conclusion	Summary of report.	N/A
7.0 References	Reference list for the Archival Record Report.	N/A
Appendix 1	Archival Record Catalogue An inventory of documents that guides the reader to the information available in the appendices. This is accompanied by a complete bibliography of all documents contained within the Archival Record.	Condition 6 requires a database of reports and datasets.
Appendix 2	Full reports making up the archival record.	N/A

1.3 Qualifications of the Project Team

This document has been prepared by Umwelt who is one of Australia's leading multidisciplinary environmental consulting companies, with over 130 environmental and heritage specialists, providing a wide range of integrated services to public and private sector clients throughout Australia and internationally for over 25 years.

Umwelt has extensive experience with the site and the overarching project, having prepared the original referral application, subsequent preliminary documentation, and associated ecological and heritage investigations.

The project team responsible for preparing the archival record are as follows.

Table 1.2 Qualifications of the Project Team

Team	Role/Qualifications	Relevant Experience
Karina Carwardine Project Director, Reviewer	Manager Canberra, Principal Environmental Consultant Bachelor Marine Science	Karina has over 12 years' experience across a diverse range of projects that have included environmental impact assessments; Commonwealth, state and territory approvals; and management for major infrastructure projects. She has particular experience in the application of the EPBC Act for project approvals and compliance.
Caitlin Adcock Project Manager, Principal Author	Senior Environmental Planner Bachelor of Law Bachelor of Town Planning	Caitlin has over 9 years' experience in environmental planning for a range of projects, including infrastructure, Defence and telecommunications. She has experience in a range of environmental assessments and approvals at all levels of government.
Pam Dean-Jones Consultation	Principal, Strategic Planning for Communities and Landscapes Bachelor of Arts: Geomorphology and regional planning Post Graduate Diploma in Social Sciences	Pam has over 30 years' experience in natural resource management, strategic environmental planning and stakeholder engagement. She has conducted stakeholder and community engagement for complex environmental values and issues in a range of settings.

1.4 Lodgement

As per Condition 6 of the EPBC Act Approval noted in **Section 1.1**, this archival record and attachments will be lodged to DAWE and the National Archives of Australia. In addition, the archival record and attachments will also be lodged with the National Library of Australia.

1.5 Limitations

Umwelt was able source 55 reports relevant to the archival recording which are annexed to this report. There are an additional four reports which could not be located by the relevant authors. Refer the Archival Record Catalogue at **Appendix 1**. Additionally, not all stakeholders were available or could be contacted to contribute to the record.

It is also noted that many historical photographs of the Site remain under copyright restrictions. As such, some of these photographs could not be included in the archival record at the time of its preparation.

In addition, the framework upon which the document was prepared – the Archival Records Guideline – is primarily intended for use with historic and built heritage. As such, while general consistency with the Guidelines was achieved, many specific components of the Guidelines were not applicable or appropriate for the archival of research.

1.6 Acknowledgements

Umwelt would like to thank the various contributors of this Archival Record, particularly Will Osborne, University of Canberra and Geoff Robertson, Friends of Grasslands.

SECTION 2

Methodology



2.0 Methodology

2.1 Inventory of Archival Documents

The archival record has been prepared to comply with EPBC Act Approval Condition 6 (EPBC 2017/8028) and provides a thorough record of the golden sun moth research that has been undertaken at the YPCA. The archival record consists of:

- A scientific review of previous research conducted at the site.
- Historical photographs and mapping – this report includes historical photographs from the National Library Australia and from reports included within the archival record.
- An archival record catalogue – this includes a data spreadsheet including the references of each document, an abstract, key research themes and associated spatial data (if relevant) (refer to **Appendix 1**).
- Full archival record – this includes copies of publications identified within the archival record catalogue (refer to **Appendix 2**).

2.2 Collation of Archival Documents

Umwelt collected all known reports, including associated datasets, photographs and spatial files, with reference to golden sun moth research at YPCA. The reports were identified by:

- Liaising with relevant contacts that have been associated with the site, including:
 - Doma Property Group
 - Australian National University (ANU)
 - Commonwealth Scientific and Industrial Research Organisation (CSIRO)
 - ACT Government
 - University of Canberra
 - Friends of Grasslands
- Searches of available catalogues, including academic journals, Trove (National Library Australia) and Government publications.
- ‘Snowballing’ reference checks, a technique that identifies additional resources using the references from available reports.

All reports collected were reviewed and prepared for inclusion in the archival record. This included preparing abstracts, key terms and referencing within a data spreadsheet.

2.3 Stakeholder Consultation

Umwelt conducted consultation with the above listed stakeholders on 10 September 2019. Ongoing conversations and emails have been had with the ACT Government, Will Osborne (University of Canberra) and Geoff Robertson (Friends of Grasslands). **Table 2.1** outlines the method and outcomes of this consultation.

Table 2.1 Stakeholder Consultation Method

Organisation	Name	Email	Phone	Method	Outcome
Reports, spatial data, other documentation					
Doma Property Group	Gavin Edgar, General Manager Development	gavin@domagroup.com.au	02 6163 4724	1. Email	SMEC reports previously provided to Umwelt.
ACT Government	Mr James Bennett, Environment, Planning and Sustainable Development Directorate Terri-Ann English, Assistant Director, Impact Assessment and Business Improvement	JamesP.Bennett@act.gov.au Terri-Ann.English@act.gov.au	02 6205 4877	1. Phone 2. Email	Information being circulated through the ACT Environment, Planning and Sustainability Development Directorate. No further response.
Historical photographs, oral histories					
ANU	Prof. Saul Cunningham, Fenner School of Environment & Society	saul.cunningham@anu.edu.au Cc: fsesea@anu.edu.au	02 6125 4588	1. Phone 2. Email	No response
CSIRO	Dr David Yeates, Director, Australian National Insect Collection	David.Yeates@csiro.au	02 6246 4282	1. Phone 2. Email	No response
University of Canberra	Dr Will Osborne, Adjunct Associate Professor Students and associates may also be included	will.osborne@canberra.edu.au	02 6201 5377	1. Phone 2. Email 3. Face-to-face meeting (TBC)	Documents received. No further response.
Friends of Grasslands	Andrew Russell, Public Officer Geoff Robertson, President Alison Rowell	info@fog.org.au arowell@inet.net.au	0403 221 117	1. Phone 2. Email 3. Face-to-face meeting (TBC)	Documents received. Alison Rowell expressed interest in contributing to the archival record. No further response.

2.4 Oral Histories and Expert Engagement

The Scientific Heritage Impact Assessment (Umwelt, 2018a) that accompanied the Preliminary Documentation (Umwelt, 2018b) included stakeholder consultation. The following stakeholders participated either through face-to-face interview or via email.

- Dr David Yeates, Director Australian National Insect Collection, Senior Principal Research Scientist, CSIRO. Dr Yeates participated in a face to face interview on 14 March 2018 and also provided some follow up suggestions, references and contacts.
- Associate Professor Will Osborne, Institute for Applied Ecology, UC. Dr Osborne provided a preliminary email response and more detailed follow up email response to specific questions.
- Dr Philip Gibbons, Fenner School of Environment and Society, ANU. Dr Gibbons provided a brief email response.

Each stakeholder was asked the following questions, which sought to guide discussion:

- **The value of the previous research and monitoring, in relation to the Australian criteria:**
 1. How do you see that previous research on golden sun moth and its habitat at this site has contributed to scientific knowledge and conservation management in the ACT?
 2. How has the research conducted at the Project Area since the 1990s supported or informed more recent work in native grasslands and golden sun moth habitat and populations in the ACT and surrounding areas?
 3. How would you describe the significance of that research, in terms of special insights on the natural heritage of the ACT and surrounding areas? What value has your organisation received from this research output? What are the key themes that it addresses? Examples could include species persistence on small sites, species response to shading, grassland composition, and grassland management/disturbance.
- **The value of the Project Area as a continuing research site:**
 4. What is the current focus of golden sun moth research in the ACT and surrounding areas?
 5. How does York Park Conservation Area fit with current and proposed future research effort on native grasslands and golden sun moth in the ACT and surrounding areas? Which components of future research could this site contribute to?
 6. What do you see as the role of small urban land parcels in natural heritage research and conservation?
- **Mitigation of potential impacts of the proposed action on scientific heritage values:**
 7. Is enhancement of the scientific components of the natural heritage value of the Project Area feasible in-situ? How could that be achieved?
 8. How could the scientific community's interest in native grasslands and golden sun moth be demonstrated, communicated, or interpreted to the broader community?
 9. Should the history of scientific studies at the Project Area be part of that communication or interpretation? Why is the Project Area valuable for that purpose and how could that best be done? Which themes would be the focus of interpretation – for instance, about the role of landscaping and conservation in the 'bush capital'?

- **Offsetting of scientific heritage value:**

10. Could you suggest approaches to offsetting the scientific heritage values of the Project Area, which could be included in an offset strategy?

Section 5.3 summarises the responses from these stakeholders as they relate to the key questions outlined above.

Additional oral histories were sought from community groups and researchers during preparation of this archival record; however, none have yet been obtained.

SECTION 3

Site Description and History



3.0 Site Description and History

The following section provides a summary of the environmental values of the Site as context to its scientific significance. These values have been the basis for the YPCA becoming a locally important site for scientific research.

This summary draws on the information contained within several reports and documents that have been included within the archival record itself, as well as the Preliminary Documentation submitted to DAWE.



Figure 1 Location of the Site

3.1 Site Description

The Site is located on Blocks 3 and 15, Section 22, in the division of Barton, ACT. Its registered address is 23 National Circuit, Barton, ACT, and is located on the corner of Sydney Avenue and National Circuit, in close proximity to Parliament House.

The two blocks are a total of 1.25 hectares in size (1.15 and 0.1 hectares, respectively). The 'York Park Conservation Area' only accounts for a portion of Blocks 3 and 15 (refer to **Figure 1**), covering an area of 0.51 hectares.

3.2 Historical Overview of the Site

The Site is located within Ngunnawal country. The Ngunnawal people are thought to have lived in small, highly mobile, kin-based groups throughout the Canberra region (ERM, 2016). While it is likely that the Ngunnawal people transited the Site, no Aboriginal heritage objects have been found during excavation of the Site (ERM, 2016).

The first documented case of Europeans visiting the Canberra region is in 1820 when Charles Throsby passed through the area in search of the Murrumbidgee River (ERM, 2016). In 1824 the Site was located within land that formed part of Robert Campbell's Estate, which covered up to 32,000 acres. Robert Campbell was a Sydney merchant who was awarded a land grant in the Canberra-Queanbeyan region as compensation for his ship 'Sydney', which was lost whilst in the service of the NSW Government. The estate, including the Site, was used for agricultural purposes (primarily livestock) until in 1908 when Canberra was selected to become the nation's capital. Approximately 2,368km² was set aside as the Australian Capital Territory, including the majority of the Campbell estate. However, it was not until after the First World War that construction of Canberra progressed in earnest.

There is photographic evidence to suggest that the cleared land in and surrounding the Site was used for military parades and aerial displays in the 1920s. These photographs, as well as those from later years, imply that 'York Park' referred to a larger cleared area bound by Kings Avenue, National Circuit, Canberra Avenue and State Circle (refer to **Figure 2**).



Figure 2 1950 Aerial Photograph of the site(red) and 'York Park' (blue)

(Image from Department of the Interior, accessed via National Library Australia, edited by the author)

Construction of the Provisional Parliament House, now referred to as 'Old Parliament House', in the new suburb of Parkes commenced in 1923 and was completed by early 1927. This resulted in the rapid construction of housing and community services in Ainslie, Civic, Forrest, Griffith (including Manuka) and Kingston. Aerial photographs indicate that the Site and surrounding area remained largely undeveloped between the 1940s – 1960s, though with evidence of tree plantings apparent (refer to **Figure 2** and **Figure 3**).

From the 1960s onward, development increased within Barton and its surrounding suburbs. Construction of a new Parliament House on Capital Hill commenced in 1981 and was completed in 1988. As a result, substantial development began to occur throughout Barton during the early 1990s, including the RG Casey Building within 'York Park', which now accommodates the Department of Foreign Affairs and Trade.

From this point onward, 'York Park' has generally referred to a small open public space located on the corner of Kings Avenue and State Circle. However, scientific investigations from this time also refer to the Site as 'York Park'.



Figure 3 Aerial view of Canberra looking North across Lake Burley Griffin, showing limited development around the Site (circled in white)

(courtesy ACT Heritage Library, unknown photographer, 1966, reference #003886, edited by the author)

Scientific investigations of the Site appear to have begun in the mid-1990s, and included detailed surveys, monitoring events, assessments and reviews as a result of its location within a core national capital development area, but also due to its close proximity to key research institutions such as the ANU, CSIRO and University of Canberra (Umwelt, 2018b). It is unclear as to when golden sun moth was first officially observed at the Site, however, it is apparent that the research of Dr Ted Edwards from the CSIRO Division of Entomology was a catalyst for the ongoing monitoring of the species at the Site. The presence of this species in an urbanised context, as well as increasing development pressures and the site's accessibility, meant that it attracted significant local scientific interest.

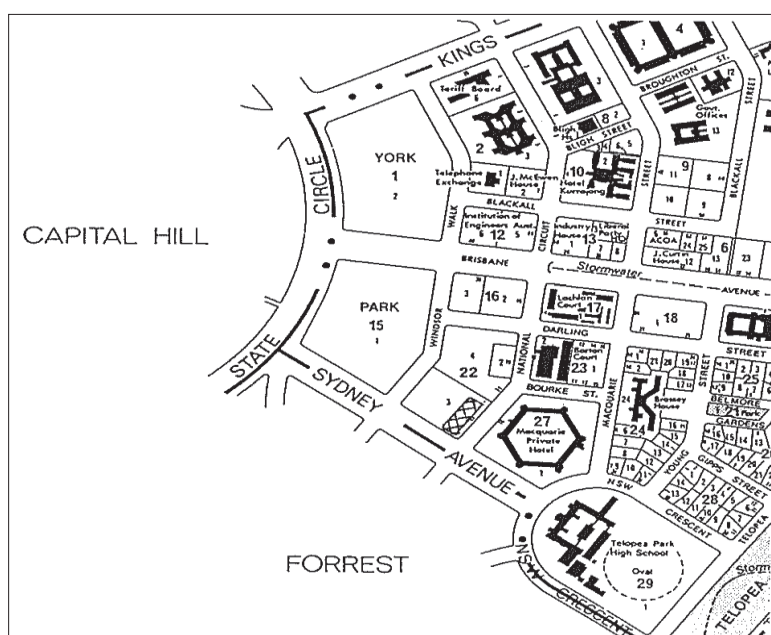


Figure 4 Development around the site in the early 1990s (Cook & Edwards, 1993)

By 2004, the suburb of Barton was substantially developed, though the Site itself still remained undeveloped. It was not until 2015 that the Site was formally identified as the 'York Park Conservation Area'. By this stage, the Site had been referenced as having a known population of golden sun moth for over 20 years.

Table 3.1 below provides an outline of the historical timeline for the York Park Conservation Area and local region.

Table 3.1 Historical Timeline for The YPCA And Local Region

Date	Activity or Event
Pre-European settlement	Ngunnawal people travelling through the region, utilising resources on annual gatherings for hunting and initiation ceremonies.
1820s-30s	Pastoral settlement of the region, large areas of land granted to and/or purchased by Robert Campbell. Introduction of sheep farming.
1910s	Walter Burley Griffin wins design competition for the new Federal Capital. Construction of Canberra begins.
1923-1927	Old Parliament House is constructed, with development commencing in surrounding suburbs. The Site and its immediate surrounds are used for military displays.
1960s	Site still comprises of a cleared lot with some tree plantings. Development of surrounding areas increases.
1981-1988	New Parliament House is constructed. Development in Barton increases.
1990s	Development within larger 'York Park' area, including the RG Casey Building. Site remains undeveloped. Golden sun moth and associated grassland habitat research commences at the site by local scientific community.
2013	Site is identified as the 'York Park Conservation Area' following approval of the proposed development of an access road for the approved Little National Hotel adjacent to the Site.
2015	Construction of Little National Hotel adjacent to the Site is completed.
2019	Approval is received from the Commonwealth Department of the Environment and Energy to clear and divest the site.

3.3 History of Research Undertaken at the Site

As is further discussed in **Section 4.0**, the heritage value of the site is based on the scientific research that has occurred, particularly in relation to golden sun moth. A large number of surveys for the species have been conducted on the Site since the early 1990's.

The following table outlines the known golden sun moth surveys that have been undertaken at the Site, as apparent from the literature collected for this Archival Record. It is acknowledged that this is not an exhaustive list of all surveys undertaken at the Site, noting that a number of records remain unrecovered.

Table 3.2 Known Golden Sun Moth Surveys That Have Been Undertaken at the Site

Year	Survey
1992-93	Cook, L & Edwards, T (1993) – undertook mark-release-recapture techniques for golden sun moth between November 1992 to January 1993.
1995	O'Dwyer C & Attiwill, P (1998) – comparative study of golden sun moth habitat using eight sites in urban areas in Canberra, including York Park Conservation Area.
1997	Clarke, G & O'Dwyer (1998) – collection of adult male golden sun moth at ten sites in the ACT including the Site, between November-December 1997.
1997-98	Clarke, G (2000) – Hand net surveys during the 1997 and 1998 flying season.
1997-2000	Clarke, G & Whyte, L (2003) – surveys for genetic variation assessment over a four-year period.
2006-08	Richter (2010) – undertook surveys at the Site between mid-October to end January over a two-year period.
2008-09	Richter <i>et al</i> (2009) – a pilot golden sun moth monitoring program that surveyed a number of sites across the ACT, including the Site. Surveys were undertaken by community members supervised and trained by ecologists.
2011	Rowell (2012) – a mark-release-recapture survey was carried out in December 2011
2013	Umwelt (2014) – surveys were undertaken in November-December of 2013 to justify recommendations to changes to the Parsons Brinckerhoff (2008) Maintenance Plan. Robert Jessop Pty Ltd (2014) provides the baseline results of flying golden sun moth surveys, pupal case surveys and vegetation surveys for 2013.
2014-15	Umwelt (2015) – this was the 2014 monitoring event targeted at golden sun moth and natural temperate grassland. Robert Jessop Pty Ltd (2015) – this is the second year of baseline results of flying golden sun moth surveys, pupal case surveys and vegetation surveys for 2014-15.
2015	SMEC (2016) – this was the third-year monitoring event for golden sun moth at the Site, undertaken in November-December 2015. Umwelt (2016) – this was to provide an update to the 2013 Maintenance Plan and to complete the 2015 monitoring event for golden sun moth. Similarly, to SMEC (2016), surveys were undertaken in November-December 2015.
2016	SMEC (2017) – this was the fourth-year monitoring event for golden sun moth at the Site, undertaken in November-December 2016.
2017	SMEC (2018) – this was the fifth-year monitoring event for golden sun moth at the Site, undertaken in November-December 2017. Umwelt (2018) – these surveys were undertaken in November-December 2017 for golden sun moth on the Site for the purpose of calculating potential offset requirements for the proposed divestment and clearing of the site.
2018	SMEC (2019) – this is the sixth monitoring event for golden sun moth at the Site. The surveys were undertaken in November-December 2018. Umwelt (2019) – this also provides the 2018 monitoring event for golden sun moth at the Site. The surveys were undertaken in November-December 2018.

According to the Preliminary Documentation (Umwelt, 2018c), the results of the surveys undertaken from 2007 onwards demonstrate a general decline in the extent of golden sun moth habitat within the York Park Conservation Area, particularly from 2013 onwards.

Table 3.3 Golden Sun Moth Habitat at the Site and Surrounds (Umwelt, 2018c; Umwelt, 2019)

Year	York Park Conservation Area	Remaining area of Block 3	Sydney Avenue median strips	Total Area
2006 (Rowell, 2007)	0.56	0	0 Entirety could be rehabilitated to habitat	0.56
2007 (Parsons Brinckerhoff, 2008)	0.39			
2008 (Richter <i>et al</i> , 2009)	-	-	Unknown area, but GSM recorded	Unknown
2011 (Rowell, 2012)	0.56	-	-	0.56
2013 (Umwelt, 2014)	0.56	-	-	0.56
2014 (Umwelt, 2015)	0.34	-	-	0.34
2015 (Umwelt, 2016)	0.32	-	-	0.32
2017 (Umwelt, 2018)	0.32	0	0.4*	0.72
2018 (Umwelt, 2019)	0.36	0	-	0.36

- Indicates that there is no data for these areas during the years indicated.

* The Entirety of Sydney Avenue median strips was assumed to be GSM habitat for the purposes of the original Referral.

The Preliminary Documentation (Umwelt, 2018c) states that the primary reasons for this general decline of golden sun moth habitat at the Site were:

- EPBC Act approved impact associated with EPBC Act Referral 2010/5548. This Referral was for the construction of an access road off National Circuit to support the construction of the Little National Hotel. The driveway directly impacted upon approximately 0.04 hectares of natural temperate grassland in the north of the York Park Conservation Area. The impact occurred between the 2013 and 2014 survey seasons.
- Weed incursion recorded within the York Park Conservation Area, primarily throughout the southern portion of Block 3 (Umwelt, 2015 and Umwelt, 2016). Dominant weed species recorded were *Dactylis glomerata* (cocksfoot) and *Phalaris aquatica* (phalaris). While male golden sun moth had been observed flying over the area of weed incursion, as neither cocksfoot nor phalaris are golden sun moth feed species (i.e. C3 grasses), this area was not considered to be habitat. The weed incursion separated the previously contiguous patch of golden sun moth habitat into two patches.

- Upgrades to the footpath adjacent to National Circuit disturbed the grassland of York Park. This area was re-planted with native *Themeda triandra* (kangaroo grass), which is not a golden sun moth feed species, therefore these works also reduced the area of habitat present within York Park Conservation Area (Umwelt, 2016).

The most recent known extent and quality of golden sun moth habitat on the Site is shown in **Figure 5** below.

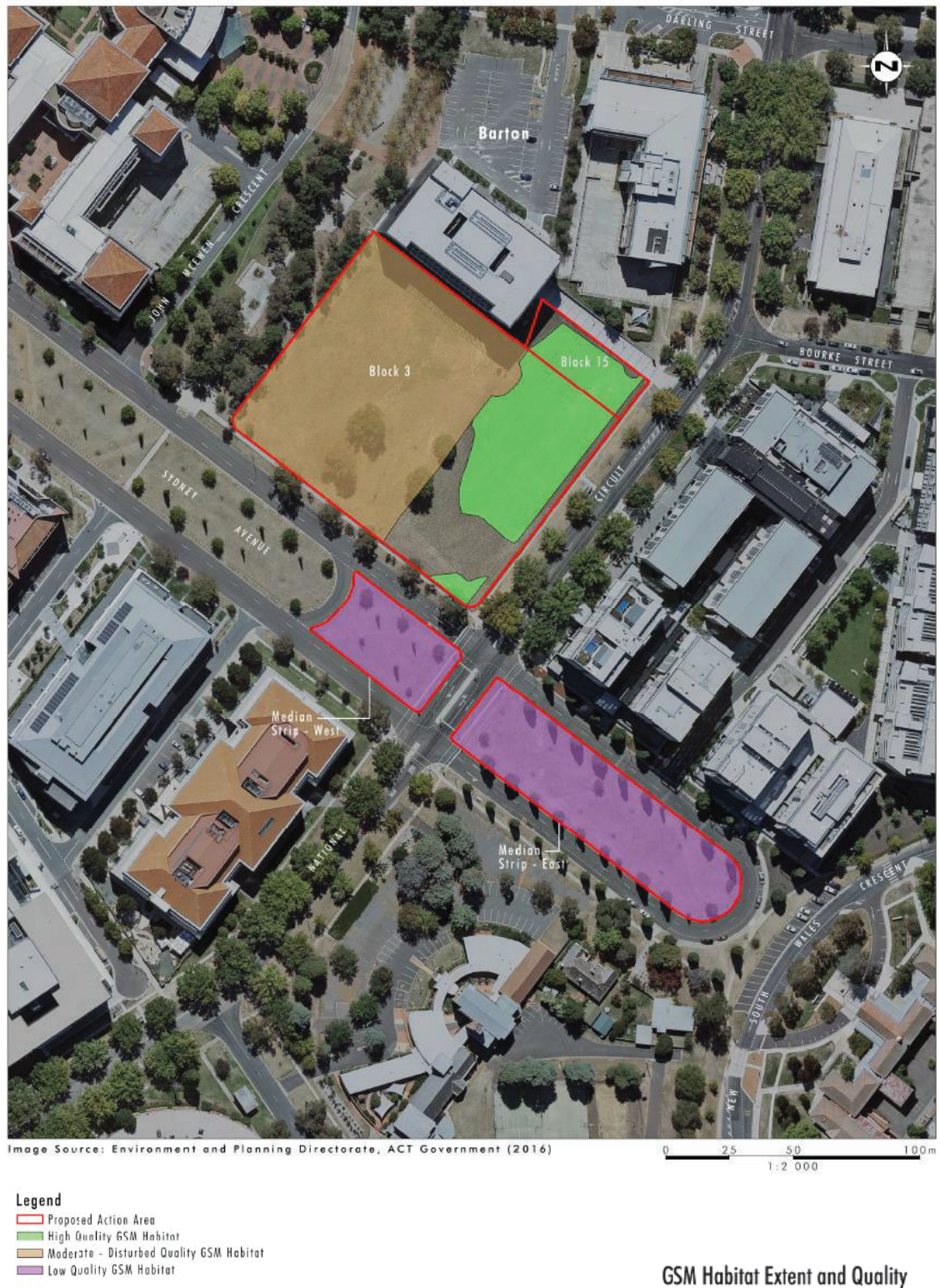


Figure 5 Golden Sun Moth Habitat on Site and Surrounding Area (Umwelt, 2018c)

SECTION 4

Heritage Values



4.0 Heritage Values

4.1 Understanding Scientific Heritage Value

The scientific heritage value of the Site was considered in the EPBC Referral process, as Finance, a Commonwealth Agency, had to consider impacts to the 'whole of the environment' as part of the referral of their proposed action. The whole of environment consideration (as defined in the Significant Impact Guidelines, 1.2 (DSEWPaC, 2013) requires a more wide-ranging appreciation and assessment of the environment, including locally and state significant values, in comparison to the nine matters of national environmental significance generally assessed under the EPBC Act.

According to the Burra Charter (ICOMOS, 2013), scientific value of heritage places is defined as:

Scientific value refers to the information content of a place and its ability to reveal more about an aspect of the past through examination or investigation of the place, including the use of archaeological techniques. The relative scientific value of a place is likely to depend on the importance of the information or data involved, on its rarity, quality or representativeness, and its potential to contribute further important information about the place itself or a type or class of place or to address important research questions. To appreciate scientific value, ask: "Would further investigation of the place have the potential to reveal substantial new information and new understandings about people, places, processes or practices which are not available from other sources?" (p.3, ICOMOS, 2013).

Threshold indicators can be used to help determine the relative significance of a heritage place (ICOMOS 2013b). The Department of the Environment, Water, Heritage and the Arts (2008) provides summary guidelines about thresholds for different levels of heritage listing.

- To reach the threshold for the National Heritage List (NHL), a place must have **outstanding** heritage value to the Nation against one or more of the Commonwealth heritage criteria listed in **Table 4.1**.
- The threshold for inclusion on the Commonwealth Heritage List (CHL) is that a place must have **significant** heritage value against one or more of the Commonwealth heritage criteria listed in **Table 4.1**.

These thresholds are elaborated in 'Identifying Commonwealth Heritage Values and Establishing a Heritage Register – a Guideline for Commonwealth Agencies' (AHC, 2010).

The threshold for inclusion on the CHL is defined further as a place being of local heritage significance (p. 7, AHC, 2010). That is, a place is considered to have Commonwealth heritage value (i.e. meet the 'significant heritage value' identified above) if it is assessed as having local heritage significance.

For the purposes of the Heritage Assessment, the ACT heritage criteria were used to understand the scale of local heritage significance.

Table 4.1 Commonwealth and ACT Heritage Criteria

Commonwealth Heritage Criteria (s. 10.03A EPBC Regulation)	ACT Heritage Criteria (used as an indication of local significance)
<p>(a) the place has significant heritage value because of the place's importance in the course, or pattern, of Australia's natural or cultural history</p> <p>(b) the place has significant heritage value because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history</p> <p>(c) the place has significant heritage value because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history</p> <p>(d) the place has significant heritage value because of the place's importance in demonstrating the principal characteristics of:</p> <p>(i) a class of Australia's natural or cultural places; or</p> <p>(ii) a class of Australia's natural or cultural environments</p> <p>(e) the place has significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group</p> <p>(f) the place has significant heritage value because of the place's importance in demonstrating a high degree of creative or technical achievement at a particular period</p> <p>(g) the place has significant heritage value because of the place's strong or special association with a particular community or cultural group for social, cultural or spiritual reasons</p> <p>(h) the place has significant heritage value because of the place's special association with the life or works of a person, or group of persons, of importance in Australia's natural or cultural history</p> <p>(i) the place has significant heritage value because of the place's importance as part of Indigenous tradition</p>	<p>(a) Important to the course of the ACT's cultural or natural history</p> <p>(b) Has uncommon, rare or endangered aspects of the ACT's cultural or natural history</p> <p>(c) Potential to yield information that will contribute to an understanding of the ACT's natural or cultural history</p> <p>(d) Importance in demonstrating the principal characteristics of a class of cultural or natural places or objects</p> <p>(e) Importance in exhibiting particular aesthetic characteristics valued by the ACT community or a cultural group in the ACT</p> <p>(f) Importance in demonstrating a high degree of creative or technical achievement for a particular period.</p> <p>(g) Has a strong or special association with the ACT community, a cultural group in the ACT for social, cultural or spiritual reasons</p>

Note: the criteria that relate to scientific heritage value (as defined in the Burra Charter) are highlighted in **blue**. All other criteria are not considered relevant for the assessment of scientific heritage value.

The analysis in the Preliminary Documentation (Umwelt, 2018c) determined that the Site has local scientific heritage value relating to the historical scientific investigations of golden sun moth within the YPCA.

Golden sun moth population at the Site has been monitored periodically for over 20 years by the local scientific community and citizen scientists and is an example of an accessible place that illustrates the scientific community culture of Canberra. A combination of accessibility and tenure has facilitated the early recognition species presence, and a long monitoring record of golden sun moth population at the Site. As discussed in **Section 5.0**, this monitoring has been influential for golden sun moth research in the ACT.

4.2 Key Scientific Heritage Values

This section describes the specific heritage values associated with the Site. As it was determined that the Site did not meet the heritage criteria for either the National Heritage List (NHL) or the Commonwealth Heritage List (CHL), the ACT Heritage Criteria (refer to **Table 4.1**) have been used as the basis for the following discussion.

The full analysis is provided in the Scientific Heritage Impact Assessment (Umwelt, 2018b).

4.2.1 Important to the course of the ACT's cultural or natural history

The basic test for this value is outlined as follows within the ACT Heritage Assessment Policy (ACT Heritage Council, 2018):

*The place or object has a clear association with an event, phase, period, process, function, tradition, land use, movement, custom, way of life, **ecological community, species, biodiversity**, geology, climate, or evolution of natural landforms in the ACT's history.*

AND

*The association of the place/object to the event, phase etc. is **evident in the physical fabric of the place/object and/or in documentary resources** or oral history.*

The various types of scientific work conducted at the Site for golden sun moth in the past meets a number of the inclusion criteria outlined above. The long research and monitoring interest in the Site have influenced other work on golden sun moth in the ACT and more broadly in the scientific community. There is local community interest (both citizen science and general) in the Site and interpretation information has been provided around the site boundary for the benefit of visitors.

The research and monitoring that has been conducted at the Site for almost 30 years has meant that it provides a record of local scale environmental change (to the grassland habitat) and the resilience of an important and readily recognised endangered invertebrate species in the ACT. This is recorded in a range of scientific documents, including journal articles, workshop documents, monitoring reports and reports on citizen science. Of note, the early work undertaken by Dr Ted Edwards, Lyn Cook, Cheryl O'Dwyer and Geoffrey M. Clarke during the early 1990s at the Site has had an ongoing influence on the study of golden sun moth, particularly within the ACT. The documentary evidence from the Site about its golden sun moth population and habitat can (at this time) be considered 'rare', and the work there can be considered to have a 'seminal influence, long association and influential association' in the ACT.

Because of the ownership, location and management history of the Site, it cannot be considered representative of the broader grassland (or urban grassland) landscape of the ACT.

Similarly, the occurrence of striped legless lizard at the Site is considered to be isolated and not representative of striped legless lizard habitat in the ACT.

As such, its scientific value primarily relates to golden sun moth. The Site is not the only or the best location in Canberra and surrounding districts for investigation of golden sun moth conservation issues, however, it is currently the most studied site, benefitting from its central, accessible and conspicuous location.

However, as noted within the Heritage Impact Assessment (Umwelt, 2018b), this is likely to change over time, as robust monitoring of important conservation sites throughout the ACT become more common (such as annual monitoring at Offset Sites). Additionally, the Site at this stage is considered to be vulnerable due to its small size and urban context. It is expected that the value of its fabric will decline. The Site has been increasingly affected by weeds (particularly *Dactylis glomerata* (cocksfoot) and *Phalaris aquatica* (phalaris)), and other urban edge effects. While the Site may have some short-term value in demonstrating the resilience or demise of the species within the YPCA, this value is likely to decline due to the disturbed nature of the Site.

As such, while the Site presently demonstrates importance to the course or pattern of the ACT's natural history, this value is unlikely to remain in the medium to long term.

4.2.2 Uncommon, rare or endangered aspects of the ACT's cultural or natural history

The basic test for this value is outlined as follows within the ACT Heritage Assessment Policy (ACT Heritage Council, 2018):

*The place or object must have a **clear association with an aspect of the ACT's cultural or natural history.***

AND

*The association of the place/object to the aspect of history must be evident in the **physical fabric of the place/object and/or in documentary resources** or oral history.*

AND

*The aspect of history must have made a strong, noticeable or **influential contribution to the ACT's society** or environment.*

The ACT Heritage Assessment Policy indicates that, when considering natural heritage, the intent of this criterion is to apply to places which provide significant habitat for rare, threatened, uncommon, and at limits of range species. Rarity and uncommonness are assessed in the context of similar places elsewhere in the ACT.

Overall, it is considered that the Site meets this criterion at a local (ACT) scale. The value of the Site is as an example where long-standing scientific interest has monitored and demonstrated the survival of an endangered species on a small and isolated parcel of land in an urban context.

That is, the Site itself is not rare in terms of the species that are present, or that it has outstanding conservation values for the golden sun moth. Rather, the scientific and community interest in the site, which arose in part from its location and accessibility to major research institutions in Canberra, makes it a place with a locally significant associated history and a place which has made a strong, noticeable or influential contribution to the ACT's society or environment. The length of time over which investigations or monitoring have occurred at the Site and the insights it has provided about the survival of rare or endangered species on urban habitat fragments is its key value.

The Site was determined to have either low or now value against the other criteria relevant to scientific heritage.

4.3 Qualifications to Scientific Heritage Value and the Site

It is important to note that this Archival Record report provides a snapshot in time of the scientific heritage value placed on the YPCA.

As noted within the Scientific Heritage Impact Assessment (Umwelt, 2018b), there are a number of factors which indicate that the scientific heritage values of the Site are presently in decline:

- The accessibility of the YPCA has been an important factor in the early detection of golden sun moth on the Site. This has subsequently led to an extensive monitoring record, in some cases attached to EPBC Act obligations and approval requirements. This is particularly relevant to the later investigations of the Site undertaken by Robert Jessop Pty Ltd, SMEC and Umwelt from 2014 onwards. However, now that there are numerous other golden sun moth sites known in and around the ACT, and monitoring and conservation programs are being implemented at diverse habitat sites, the significance of the scientific record at the Site is likely to decline over time. The scientific record of the Site is ultimately one snapshot of the species' population dynamics at a site that is not representative of the range of sites on which the golden sun moth and its grassland habitat are now known to occur.
- The scientific heritage value of the Site in relation to future research prospects depends on the condition and integrity of the fabric of the place. It is important to note that the integrity of the fabric of the Site is vulnerable to a range of urban and isolation threats. Going forward, this may have provided a short-term research opportunity to study how the population responds to these urban pressures over time. However, over the medium term, the value of the place is expected to decline, even if the Site were not to be sold and developed. This Site is already more intensively managed than many other grassland sites in the ACT, in an effort to maintain its habitat and golden sun moth population. This has not prevented substantial changes to the habitat, particularly weed invasions.

Nonetheless, it is apparent that the documentation of scientific work on golden sun moth at the Site has had a seminal influence on research on golden sun moth populations in the ACT, and that it has received significant local community interest.

As such, it is relevant and appropriate to capture this research within a consolidated record for future reference. This is the purpose of the Archival Record, which is further discussed in **Section 5.0**.

SECTION 5

Scientific Review



5.0 Scientific Review

5.1 Ecological Values

The Site is known to have had the following ecological values, each listed under the EPBC Act:

- natural temperate grassland of the south eastern highlands (natural temperate grassland), a critically endangered ecological community
- striped legless lizard (*Delma impar*), a vulnerable reptile species
- golden sun moth (*Synemon plana*) a critically endangered invertebrate species.

The following sections provide an overview of these values and their presence at the Site.

5.1.1 Natural Temperate Grassland

Natural temperate grassland is an ecological community dominated by native tussock grasses with a diversity of wildflowers and other grassland-specialist plants and animals. The ecological community occurs at altitudes up to around 1200 metres and as low as 250 metres. It is a naturally treeless or sparsely treed community.

The major dominant or co-dominant grass species are kangaroo grass (*Themeda triandra* syn. *T. australis*), snowgrass (*Poa sieberiana*), river tussock grass (*Poa labillardierei* var. *labillardierei*), kneed speargrass (*Austrostipa bigeniculata*), slender speargrass (*Austrostipa scabra* var. *falcata*), red grass (*Bothriochloa macra*), various wallaby grasses (*Rytidosperma species* syn. *Austrodanthonia species*), and blownglass (*Lachnagrostis filiformis*). These dominant or co-dominant grasses occur in association with a range of other native herbaceous species, including many forb and grass-like species.

Natural temperate grassland provides habitat for a range of native animals including striped legless lizard and golden sun moth, which are discussed below.

According to the most recent surveys conducted in 2018, there is 0.36 hectares of natural temperate grassland within Blocks 3 and 15 (Umwelt, 2019). Natural temperate grassland occurs in two patches, both located within the YPCA. Data from 2015 (Umwelt, 2016) indicated that the natural temperate grassland varied between moderate to high quality based on the diversity of native, non-grass flora species. In 2016, the natural temperate grassland ecological community was re-listed under the EPBC Act, with new parameters developed to determine its quality (TSSC, 2016). The data was subsequently reviewed, and the quality of the natural temperate grassland was rated as high to very high (Umwelt, 2018a).



Figure 6 Natural Temperate Grassland at York Park Conservation Area (Umwelt, 2017)

5.1.2 Striped Legless Lizard

Like other members of the legless lizard family, striped legless lizard does not have forelimbs and has very reduced vestigial hind limbs. These hind limbs are only apparent as small flaps. Striped legless lizard reaches a maximum total length of about 300 mm. While it shows considerable variation in colour and pattern, striped legless lizard is usually pale grey-brown above and cream on the ventral surface, with a series of lateral and dorso-lateral stripes along the length of the body, becoming diagonal bands on the tail. Superficially, striped legless lizard resemble snakes but can be distinguished by the presence of external ear openings, a fleshy undivided tongue and a tail which, when unbroken, is longer than the body. Striped legless lizard is found in grasslands of south-eastern NSW, the ACT and north-eastern, central and south-western Victoria.

One striped legless lizard individual was opportunistically identified within the YPCA (SMEC, 2017) while undertaking annual golden sun moth monitoring. The striped legless lizard was recorded towards the eastern boundary of the YPCA, within the natural temperate grassland. Due to the opportunistic nature of the species' record, a targeted survey of the YPCA was undertaken in November and December 2017 by Umwelt so that greater detail regarding the species' extent could be gathered. The presence of the individual striped legless lizard was subsequently confirmed in December 2017 (Umwelt, 2018c).

In addition, a number of reptile skins (approximately eight) were found on the Site in February 2018. These skins could not be identified down to species level; however, were consistent with striped legless lizard in terms of size and shape. A precautionary approach was undertaken, and these skins were assumed to be from striped legless lizard. These observations indicated that the entire YPCA could provide habitat for striped legless lizard.



Figure 7 Striped Legless Lizard in York Park Conservation Area (Umwelt, 2017)

5.1.3 Golden Sun Moth

Golden sun moth is a medium-sized day-flying moth with green eyes, clubbed antennae and no functional mouthparts. It has a wingspan of about 3 – 3.5 cm and a tapered abdomen. Males are slightly larger than females, and the sexes are distinguished by their wing colours, with only the females having characteristic golden hind wings. Males can be seen flying in a zig-zag pattern in the warmest part of the day looking for females, while the females rarely fly.

Breeding occurs between mid-October and January. Females generally lay their eggs in clumps of wallaby grass, laying around 100 to 150 eggs. The eggs hatch after about 21 days and the larvae then tunnel into the ground, where they live for one to three years (refer to **Figure 8** and **Figure 9**). The larvae feed on the wallaby grass but have also demonstrated a willingness to feed on the exotic Chilean needle grass (*Nassella neesiana*). Adult moths only live for one to four days.

A large number of ecological investigations have been conducted at the Site over the past three decades. As of the 2017/2018 flying season, about 0.32 hectares of golden sun moth habitat existed within Blocks 3 and 15 (consistent with the extent of natural temperate grassland). However, golden sun moth was also identified within the adjacent median strips of Sydney Avenue, where Chilean needle grass is present.



Figure 8 A male golden sun moth in York Park Conservation Area (Umwelt, 2017)



Figure 9 Golden sun moth larvae from soil under native grassland, Canberra ACT
(David McCleneghan CSIRO, 2004)

5.2 Research Themes

In fulfilment of Condition 6 of the EPBC Act Approval, this Archival Record report provides a scientific review of the themes identified within the research within the Archival Record catalogue. The objective of this scientific review is to summarise the research that has been completed at the YPCA relevant to golden sun moth. This scientific review does not provide an assessment of the validity or credibility of the research undertaken, rather creates a consolidated synopsis of scientific research for the future education and information of all.

The majority of the scientific work that has been carried out at the YPCA relates to the critically endangered golden sun moth. This includes academic research and citizen science conducted in Melbourne, across western Victoria, in Canberra, the ACT (including at the YPCA) and NSW. In light of the large number of research papers and documents included within the Archival Record catalogue, this scientific review is intended to highlight the key research themes relevant to golden sun moth at the YPCA.

This scientific review has identified that research into golden sun moth at YPCA falls into the following broad research themes:

- genetic diversity
- population change over time
- links between population vulnerability and habitat quality (and what defines quality habitat for this species)
- the resilience of the species to major events and gradual change
- the value of flagship species and accessible urban sites in driving or supporting conservation outcomes and awareness
- the broader issues around decision making for effective conservation management.

Several of the publications cover a number of these themes, building from basic ecological research to broader issues of conservation management processes and effectiveness.

As demonstrated in the Archival Record catalogue (refer to **Appendix 1**), the publications also come in a number of different forms. This has ultimately influenced the objectives of the research undertaken in each publication, the style in which it has been presented, and to an extent the outcomes reported. These types are outlined in **Table 5.1**.

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Table 5.1 Publication Types within the Archival Record

Publication Type	Research themes and discussion	Key documents [#]
<p>Specialist scientific research</p> <p>Includes research conducted by academic staff and students at the major research institutes in Canberra. These generally focus on small sites or specific technical issues (e.g. genetic analysis of populations).</p>	<p>Individually, these studies may not contribute much to national scale golden sun moth research themes. However, when considered together, this specialist scientific research contributes to the following themes:</p> <ul style="list-style-type: none"> • genetic diversity of the species • population change over time • links between population vulnerability and habitat quality (and what defines quality habitat for this species) • the resilience of the species to major events and gradual change • value as a 'flagship species' in an urban site. <p>The studies may provide evidence to support strategic planning and land management decisions.</p>	<ul style="list-style-type: none"> • Braby M & Dunford (2006) (No. 5) • Clarke, G (2000) (No. 7) • Clarke, G & O'Dwyer, C (1998) (No. 9) • Cook, L & Edwards, T (1993) (No. 13) • Richter et al (2013) (No. 44)
<p>Studies required for development assessment purposes</p> <p>As golden sun moth reside within lowland areas of the ACT, they often occur within future development areas. As golden sun moth are protected under Commonwealth and ACT legislation, studies (primarily impact assessments) are required to support development applications and approvals processes.</p> <p>This type may include peer review or strategic studies undertaken for planning purposes; but many are undertaken by consultants or researchers that operate in a consultancy context.</p>	<p>David Hogg Pty Ltd (2010) provides a list of 41 such reports completed prior to 2010, for at least 25 different sites. Parsons Brinkerhoff (2008) and Umwelt (2014, 2016) are examples of documents prepared for the Site as requisites for a planning and/or environmental approval.</p> <p>These studies provide information relevant to themes such as:</p> <ul style="list-style-type: none"> • population change over time • links between population vulnerability and habitat quality (and what defines quality habitat for this species). 	<ul style="list-style-type: none"> • Parsons Brinckerhoff (2008) (No. 39) • Umwelt (2014) (No. 53) • Umwelt (2016) (No. 55)

Publication Type	Research themes and discussion	Key documents [#]
Monitoring <p>This includes studies undertaken on a regular basis, usually by landowners, managers, or their delegates due to the known presence of protected species or species of interest.</p> <p>This work is primarily conducted by consultants on behalf of ACT or Commonwealth Governments; but as above, may also be conducted by academic researchers.</p>	<p>Much of the reporting undertaken by consultancies, such as ERM, SMEC and Umwelt are examples of this type of publication.</p> <p>This type of work has been integral to monitoring the presence of golden sun moth at the Site. This type of work can also provide information that can support analysis of population change over time and factors influencing the vulnerability or resilience of threatened species.</p>	<ul style="list-style-type: none"> • David Hogg Pty Ltd (2012) (No. 16) • ERM (2016) (No. 22) • Robert Jessop Pty Ltd (2014; 2015) (No. 45, 46) • Rowell, A (2012) (No. 47) • SMEC (2016; 2017; 2018; 2019) (No. 49, 50, 51, 52)
Regional scale conservation planning <p>This includes baseline survey, monitoring, or targeted management research conducted as part of regional scale conservation planning and priority setting.</p>	<p>Edwards (1994) is the earliest of these types of surveys identified by the literature review, with other strategic conservation reviews prepared by (as examples) Richter <i>et al</i> (2009) and Hogg (2010).</p>	<ul style="list-style-type: none"> • Clarke, G (1993) (No. 6) • Cooper, M (2009) (No. 14) • Edwards, T (1991) (No. 18)
Policy for conservation management <p>This includes policy documents, action plans, strategic plans and guidelines primarily prepared by government agencies, that seek to prioritise conservation efforts and spending.</p>	<p>ACT Government (1998; 2005) are examples of strategic conservation management plans that integrate scientific studies into management priorities.</p> <p>These documents are generally limited to demonstrating the research theme of broader issues around decision-making for effective conservation management.</p>	<ul style="list-style-type: none"> • ACT Government (1998) (No.1) • Mulvaney, M (2012) (No. 36)
Citizen science research <p>The Site has been subject to a number of collaborative research studies between research institutions and local community groups. Newsletters prepared by community groups demonstrate the organisational efforts of these community groups and their educational role in assisting volunteers undertake golden sun moth surveys at the Site.</p>	<p>The poster (FOG, 2008) and newsletters prepared by Hnatiuk (2008-2009) are examples of the citizen science activities that have been undertaken at the Site. These documents do not relate to a research theme as such (and have therefore been designated as 'other') but are nonetheless valuable in demonstrating the forms of research that have been carried out at the Site.</p>	<ul style="list-style-type: none"> • Friends of Grasslands (2008) (No. 24) • Hnatiuk, S (2008-2009) (No. 28-35)

[#] Includes reference number assigned in Archival Record Catalogue.

For ease of discussion, the follow section discusses the research themes identified above in the following groupings:

- **Section 5.2.1** discusses genetic diversity, population change over time, and links between population vulnerability and habitat quality.
- **Section 5.2.2** discusses conservation management issues relating to flagship species and golden sun moth resilience.
- **Section 5.2.3** discusses broader conservation management decision making.

5.2.1 Golden Sun Moth Species and Population Issues

Research topics that sit within the research themes of genetic diversity and population change generally relate to specialist scientific studies that have been undertaken at the Site. These include the following:

- Determining the life cycle of golden sun moth and how it relates to soil and grassland conditions:
 - Edwards (1994), and later Richter *et al* (2013) found at the Site that based on the size classes of larvae observed in the soil, golden sun moth appears to remain underground for at least two years.
 - O'Dwyer & Attiwill (1998) found that phosphorus concentrations in the soil had an impact to golden sun moth larvae, in that high concentrations can be toxic to the species.
- Genetic variability and diversity of golden sun moth:
 - Clarke and O'Dwyer (1998), who undertook the largest genetic study of a threatened invertebrate species at the time, found that five major population groupings within the ACT and Victoria all had somewhat lower genetic variation compared to other lepidopteran species.
 - This was further discussed by Clarke and O'Dwyer (2000), in that it was hypothesised that this limited level of genetic variation may have resulted from population bottlenecks and founder events following habitat fragmentation.
- Identifying methods for population monitoring, given that golden sun moth spends most of its life cycle underground and only emerges to fly for a short period of time in summer:
 - Richter *et al* (2013) refer to the difficulty of formulating specific conservation actions for golden sun moth because of the lack of a standardised monitoring protocol and limited knowledge of golden sun moth ecology. They report a number of monitoring methods that may be applied that have varying levels of complexity, skill requirements, and time requirements. They conclude that different methods provide reliable estimates of population size and are suitable for different types of research. It was apparent that the time of day for monitoring is also important.
- Research into the value of small, urban habitat for the conservation of the species has also been undertaken:
 - David Hogg Pty Ltd (2010) suggests that locations where golden sun moth occur in central Canberra are on land that was withdrawn from rural land use early in Canberra's development. These land parcels were likely retained (generally unmanaged) as grassland remnants or only limitedly modified by rural uses that would have precluded golden sun moth habitat regeneration. Despite this value, these sites are generally more vulnerable to edge effects or catastrophic events due to their size and isolation and have generally low species diversity.

- Research undertaken by David Hogg Pty Ltd (2010) as part of this broader research theme also notes the conservation value of existing, longer-term monitoring programs. Specifically, any sites that have a long and reliable monitoring history, which would be difficult to replicate elsewhere or are otherwise scientifically significant (e.g. because of their use for major grassland rehabilitation trials). The Site is noted for its 'cultural scientific value and extensive monitoring records' (David Hogg Pty Ltd 2010, p 4), as opposed to the quality of its golden sun moth habitat.

This specialist scientific research has subsequently informed much of the policy development related to the species. For example, the research of Richter *et al* (2013) was used within the ACT Native Grassland Conservation Strategy and Action Plans (ACT Government, 2017) to provide context to its policy actions and strategies (refer to **Figure 10**). Furthermore, the national approved conservation advice for golden sun moth (DoE, 2013) references many of the studies included within this Archival Record. Similarly, the Significant impact guidelines for the species (DEWHA, 2009) also uses much of the research that has been undertaken on the golden sun moth at the Site. It is apparent that this research has had a direct impact on the national conservation efforts for the golden sun moth.

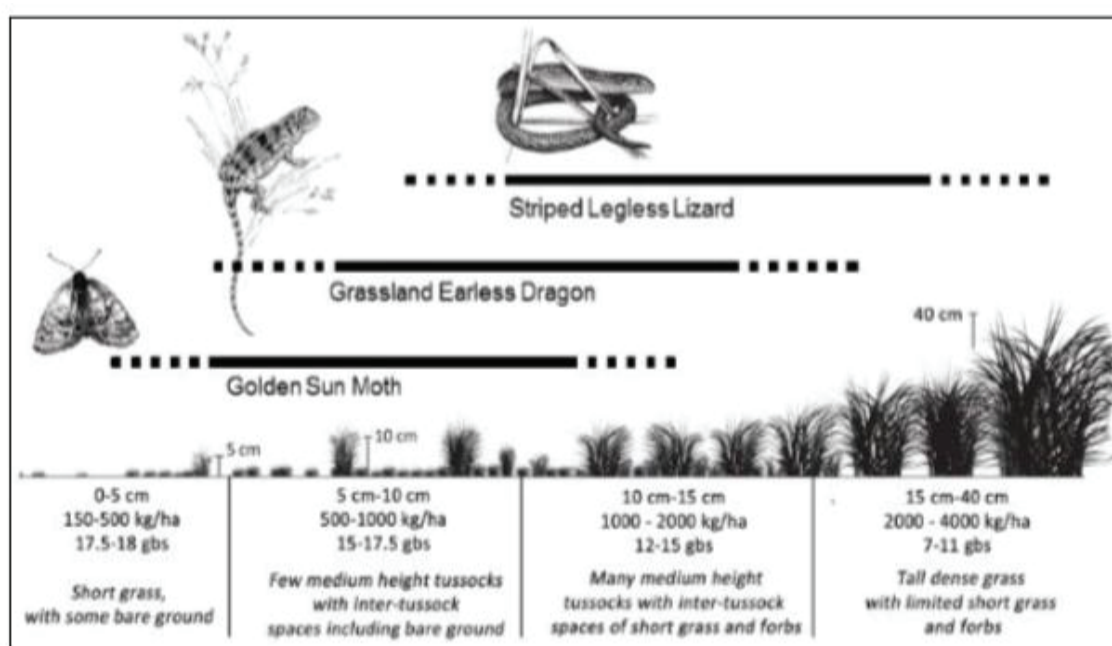


Figure 10 Grassland Structure and Habitat Suitability for Some Threatened Grassland Fauna (ACT Native Grassland Conservation Strategy and Action Plans, ACT Government, 2017)

5.2.2 Broader Conservation Issues

A common theme throughout much of the golden sun moth research at the Site relates to broader conservation issues of the species, and of endangered invertebrate species generally. Examples of this research are as follows:

- The use of golden sun moth as a 'flagship' species for insect conservation:
 - Gibson & New (2007) and Richter *et al* (2013) use this term to describe golden sun moth and justify the need for further research into the species' biology.
 - The species appears to have first been described as a 'flagship' species by Edwards (1993), in which he argues that the species serves as a figurehead for many invertebrates as being unstudied and at risk of extinction.

- A number of studies also discuss and highlight the value of citizen science in urban areas, including the role of 'friends' groups in conservation efforts:
 - The various FOG newsletters are testament to the 'Sun Moth Count' community monitoring events held by University of Canberra and FOG at the Site and across Canberra. In the FOG Newsletter 2 (Hnatiuk, 2008b) it states that there were 41 volunteers counting moths at around 36 sites throughout Canberra. This cross-city survey organised by the University of Canberra and FOG (refer to **Figure 13**) was able to distinguish several urban sites where golden sun moth had previously been observed but were not part of this survey; or where apparent suitable habitat was present, but the species was not observed.
 - Following the 'Sun Moth Count' project, Richter *et al* (2009) prepared a report on the outcomes of the investigation. The report also describes the participant demography and their feedback (refer to **Figure 11**) The use of volunteers also assisted in raising publicity for the project and the species generally (refer to **Figure 12**).
 - David Hogg Pty Ltd (2010) highlights the importance of 'friends' groups in insect conservation campaigns. This includes their capacity to encourage large numbers of participants to join in field monitoring exercises. The ease of access and lack of travel costs for people working in their local area means that people can potentially visit a site on multiple occasions and increase the database of observations.
 - Richter *et al* (2013) report the role of volunteers who participated in surveys in Canberra in 2012 and collected some 650 pupal cases from 11 grassland areas.
- Identifying the habitat and food tolerances/preferences of golden sun moth:
 - In particular, this relates to building an understanding of the role and value of the Weed of National Significance (WoNS) Chilean needle grass (*Nassella neesiana*) for golden sun moth; and how it may affect the distribution and survival of the species in the future. The spread of golden sun moth into areas of previously 'unsuitable' habitat has been very traceable at YPCA through annual monitoring. It can be identified when it started using areas previously not mapped as habitat, as Chilean needle grass invaded the Site. This raises a potential conflict in conservation efforts the need to remove weed invasions and the desire to protect golden sun moth populations. Publications that discuss golden sun moth presence in Chilean needle grass include:

▪ Braby & Dunford (2006)	▪ Richter <i>et al</i> (2013)
▪ Richter (2010)	▪ David Hogg Pty Ltd (2010)
▪ Richter <i>et al</i> (2012 and 2013)	
- The impacts of conflicting land use on small, urban habitat is also reoccurring theme in multiple publications:
 - Edwards (1990) notes the impacts of the construction of Parliament House on nearby known habitat sites, presumably referring to the YPCA itself.
 - Falconer (1991) and later Clarke & O'Dwyer (1998) warn of the impacts of urban and agricultural expansion and that these small golden sun moth habitat sites will be a 'litmus test' to 'our' ability to coexist with the natural environment in the ACT.

Over the past 20 years, golden sun moth has gone from being a species studied by only a handful of scientists primarily in the ACT, to one that has attracted wide community interest and research. This is apparent from the 'Sun Moth Count' Project which was a collaboration between the Institute for Applied Ecology at the University of Canberra and the community group, Friends of Grasslands (FOG) (Richter *et al*, 2009). This collaborative research effort between research institutions and community groups has ultimately culminated into the scientific heritage values discussed within **Section 4.0**.

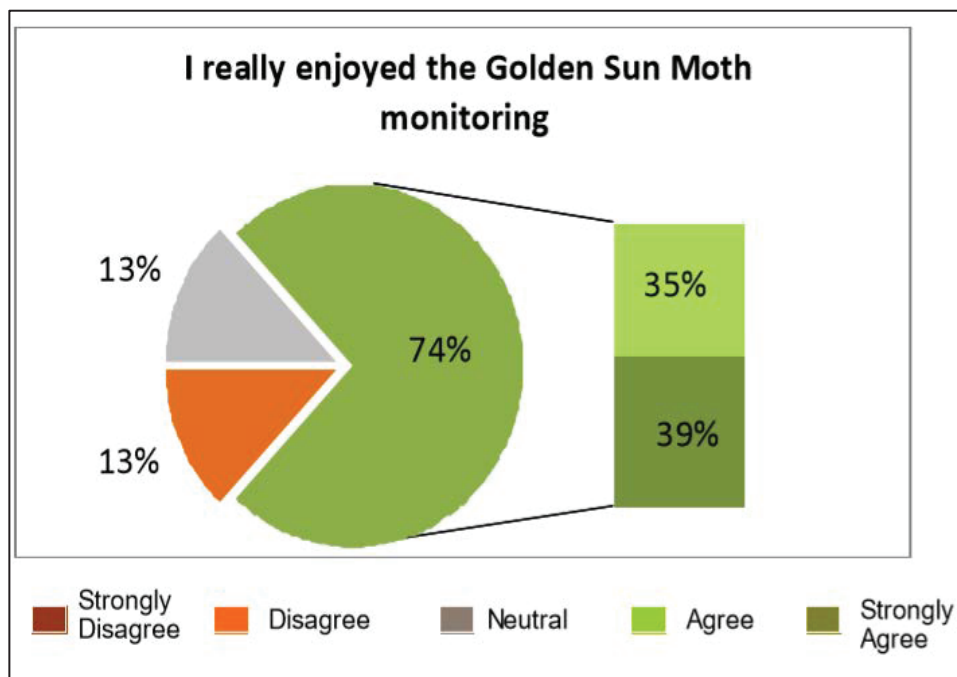


Figure 11 Volunteer ratings of their enjoyment of the 'Sun Moth Count' Project
(Richter *et al*, 2009)



Figure 12 Article from the Sunday (Canberra) Times on the 'Sun Moth Count' Project
(Leigh, Kate; 13 March 2009, taken from Richter *et al*, 2009)

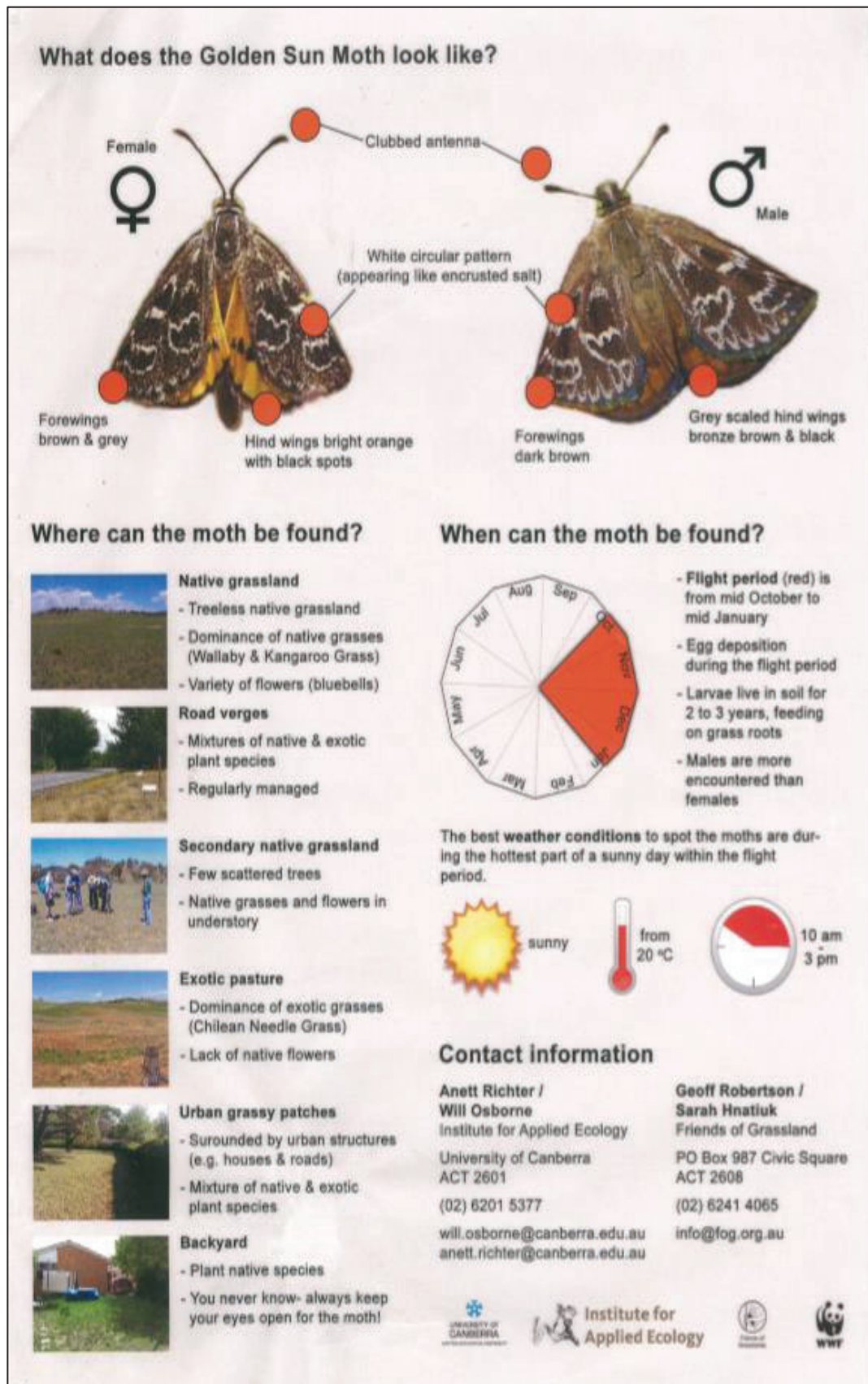


Figure 13 Poster from the 'Sun Moth Count' Project (Friends of Grasslands, 2008)

5.2.3 Conservation Management Decision-Making

The majority of literature on golden sun moth at the Site provides commentary on conservation management decision-making. However, those that are solely dedicated to this research theme are either policy documents or regional scale baseline studies for conservation management. The themes and conservation attitudes identified within this research theme include:

- Determining conservation priorities in contested land use contexts:
 - Action Plan No. 7 (ACT Government, 1998) lists the loss or degradation of habitat as the major threat to golden sun moth, noting that its habitat continues to be in demand for urban, industrial and infrastructure development, as well as being vulnerable to alteration by agricultural practices. Key conservation objectives are subsequently to develop cooperative management arrangements between the Commonwealth and ACT Government, as well as negotiating with rural lessees for cooperative management arrangements. This continues to be a recognised threat and measure for protections, respectively, in Action Plan No. 28 (ACT Government, 2005).
 - David Hogg Pty Ltd (2010) notes that it is inevitable that future developments will adversely affect some golden sun moth habitat; but that conservation of the species does not necessarily mean conserving every site at which it has been recorded. Rather, a strategy should be developed to build on major initiatives that the ACT Government has already undertaken by improving habitat quality or implementing indirect offsets in those areas of highest conservation value and/or greatest long-term security. This is reflected in the Golden Sun Moth ACT Strategic Conservation Management Plan (Mulvaney, 2012), in which he notes that the larger habitat areas are likely to contain greater genetic variation and that smaller sites are unlikely to contribute to the overall ecological health of the species.
- Use of golden sun moth as an 'indicator' species:
 - Richter *et al* (2013) discusses how monitoring is a powerful tool in conservation biology and how species such as butterflies and moths may be used as environmental indicators used in long-term monitoring. The benefit of such indicators is the way it can be used by citizen scientists, allowing larger and cheaper monitoring events (refer to **Figure 13**).
- Research into the impact of climate change on insect populations:
 - Richter *et al* (2013) refer to the potential for climate change to greatly modify the habitat value of temperate grasslands naturally located in frost prone areas at low to moderate elevation. This will influence the survival of endangered ecological communities and their insect fauna. Details of specific ecological impacts are a subject for further research, to support conservation efforts.
 - Mulvaney (2012) also discusses the potential implications of changes in climate to the species. Referencing Richter *et al* (2011), he notes that an increase in atmospheric carbon dioxide may impact the coverage of C3 grasses, which are the preferred food source for golden sun moth. Increases in carbon dioxide may affect C3 grasses photosynthetic processes, and result in a decline in coverage. This reduced food availability may have significant impacts on golden sun moth, which have limited dispersal capability.
- Conserving native grassland habitat as a means of protecting golden sun moth and other species. This prioritisation for protecting native grassland has resulted from much of the research undertaken on the life cycle and biology of golden sun moth, as outlined in **Section 5.1**:
 - Action Plan No. 28 (2005) and the ACT Native Grassland Conservation Strategy and Action Plans (2017) focus on providing guidance on the conservation of native grasslands as a means for protecting component species, such as golden sun moth.

- The Report on ACT Lowland Native Grassland Investigation (Cooper, 2009) provides a series of recommendations for the protection of lowland native grasslands. This includes improving the ecological condition of sites that are in a critical condition, or approaching this state, by reducing threatening processes such as weed invasion, inappropriate mowing and overgrazing. The YPCA is highlighted as one of these sites that requires urgent management.
- This approach is further demonstrated by the Maintenance Plan prepared by Parsons Brinckerhoff (2008) which sought to provide a framework for ongoing best-practice management of natural temperate grassland at the Site. The Plan states that its aim is to “conserve native plant diversity while maintaining structure and species composition thought to be favourable to the survival of the Golden Sun Moth” (p.1). This is an approach that is subsequently adopted in all of the following monitoring reports, in that each monitoring event includes floristic surveys of the natural temperate grassland at the Site, as well as golden sun moth counts.

As noted in **Section 5.2.1**, much of the research on golden sun moth that has been carried out at the Site has subsequently been used in the above policy documents. These policies and plans demonstrate the importance of local scientific research in informing environmental management and policy. Furthermore, the knowledge sharing within the local scientific community on this research has encouraged the ACT Government to provide a public source for consolidated ecological information (e.g. ACTMAPi, ACT Wildlife Atlas). This is apparent in **Figure 14** and **Figure 15** in which the known distribution of golden sun moth within Canberra has become significantly more site-specific and publicly accessible.

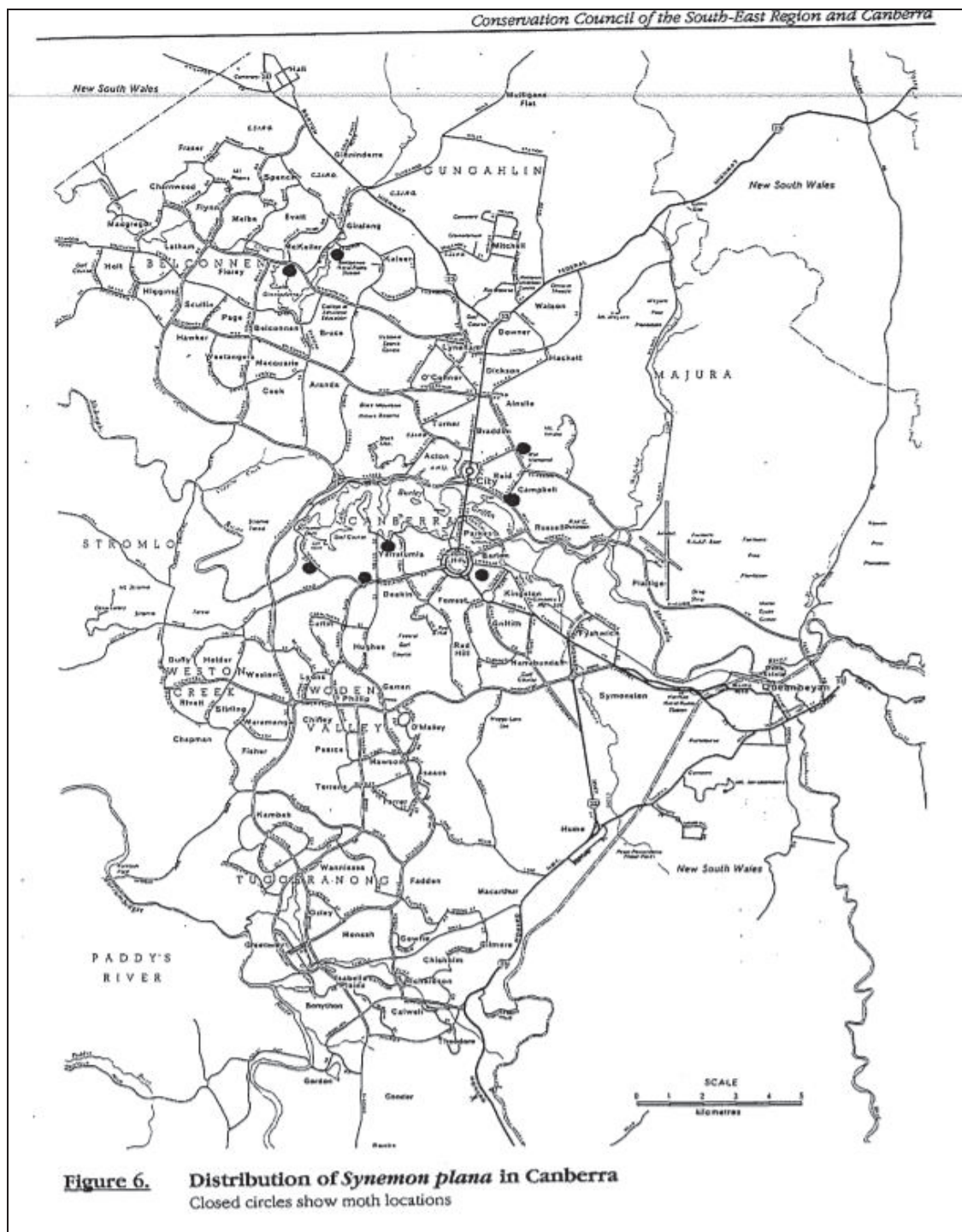


Figure 14 Known distribution of golden sun moth in Canberra in 1991 (Edwards, 1991)

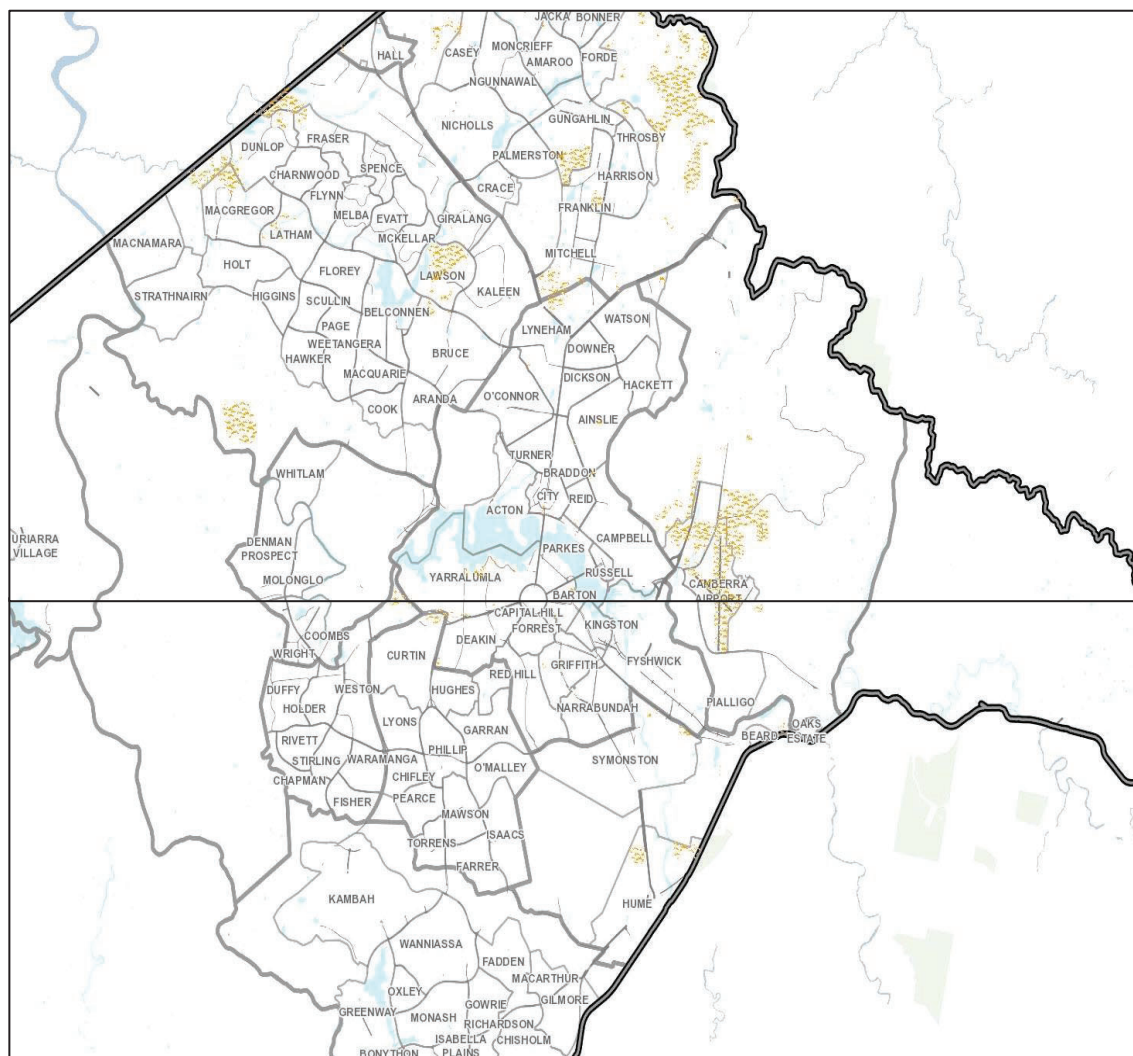


Figure 15 Publicly Available Data on the Distribution of Golden Sun Moth in Canberra in 2019 (ACTMapi, 2019)

5.3 Stakeholder Consultation

As introduced in **Section 2.4**, in addition to published research, researchers and other experts have been consulted as part of the larger project. **Table 5.2** summarises a number of anecdotal records provided by these expert stakeholders to provide another perspective on the research undertaken at YPCA.

Table 5.2 Stakeholder Responses from Scientific Heritage Assessment (Umwelt, 2018b)

Key questions/Responses
<p>How do you see that previous research on the golden sun moth and its habitat at this site has contributed to scientific knowledge and conservation management in the ACT?</p> <p>Scientific knowledge</p> <p>Dr Yeates referred to the work of Clarke and Dwyer (1998) and earlier studies by Edwards (1993 and 1994), which investigated the genetic diversity of the golden sun moth across its distribution, in the ACT, southern NSW and Victoria. The results of this work showed that the five ACT sites sampled for those studies were relatively closely related genetically, i.e. the ACT populations are a genetic cluster. Samples from further away (e.g. western Victoria) were more different and today could perhaps be regarded as a subspecies.</p> <p>There have been several important developments in genetic research since this work was done in York Park, which was able to use few genetic markers. Modern research would provide a lot more information about genetic distinctiveness and connectedness.</p> <p>Opportunities for genetic research include the capacity to sample from dead specimens in collections (including some material currently held at Wollongong University which may be from Clarke's collection); new genetic material could also be collected at York Park, to be analysed with modern techniques.</p> <p>Conservation management</p> <p>The continuing population at York Park demonstrates that the critically endangered golden sun moth does have resilience. It can persist (as far as the 20 to 25 years overall of studies demonstrate) in small patches of habitat. Habitat fragmentation around this site has been ongoing for at least 80 years. The golden sun moth has a generation time of 2 to 3 years. The monitoring information from York Park therefore covers approximately 10 generations. This is a longer monitoring record than at other grassland or golden sun moth sites in the ACT. There are also observations that the golden sun moth can adapt to habitat provided by an invasive species (Chilean needle grass), which has a structure and chemical composition similar to the native grass habitat. Given the Weeds of National Significance (WoNS) listing of Chilean needle grass and its widespread, but recent incursion into temperate grasslands in the ACT, this raises complex conservation policy and management questions.</p> <p>Dr Osborne considers that the previous research on the golden sun moth and its habitat at Block 3 has made a significant contribution to the knowledge of the species and its conservation management. He commented on the reliability of the population (i.e. stable numbers) and suggested this was useful to researchers and environmental consultants.</p> <p>He also referred to the value of the isolation of the site from other golden sun moth habitat as being valuable for comparative study. He commented 'It is an important site that has contributed significantly to our ability to calculate extinction probabilities for the species in sites of different sizes, as documented in Annet Richter's PhD thesis – What makes a species vulnerable to extinction following habitat fragmentation and degradation – a test using insect fauna from native temperate grasslands in South eastern Australia (University of Canberra, 2010).</p> <p>The site has been used to test methods for tracking population stability, including visual and mark/recapture release methods of monitoring moths (Richter et al 2013 provide a good example; see also Rowell, A. 2012). Dr Osborne suggested that findings from the York Park research have contributed considerably to the development of the action plan for the species in the ACT and referred to the ACT Native Grassland Conservation Strategy and Action Plans 2017 pp 184-206).</p>

Key questions/Responses

How has the research conducted at Block 3 since the 1990s supported or informed more recent work in native grasslands and golden sun moth habitat and populations in the ACT and surrounding areas?

See above in relation to Chilean needle grass.

There are further research questions on the connectivity of primary grassland habitat for the golden sun moth and how the presence of Chilean needle grass affects connectivity.

The existing knowledge does not consider the potential impacts of invasive invertebrates or predator species on the mortality rates of the golden sun moth. This in part relates to the encroachment of tree cover around the margins of grassland communities, particularly as climate change linked temperature rise affects habitat distribution. The moths are vulnerable to birds.

The research dating back to the 1990s is part of the scientific culture of Canberra as a small city with major research institutions that are nationally and internationally recognised for their excellence. Canberra has huge universities right in the centre of town, and the CSIRO. The attention to Blocks 3 and 15 is part of this old Canberra scientific culture, where convenient and accessible in town sites are valued for local research and teaching opportunities. Dr Yeates was not sure what level of scientific significance this would mean (and it would apply to multiple sites, not just Blocks 3 and 15), but it is a distinctive Canberra cultural heritage feature.

Dr Osborne suggested that York Park is an example of high quality natural temperate grassland. The presence of moths in disturbed median strips adjacent to the site (both in native grassland and sites dominated by Chilean needle grass) makes it a suitable site for the study of habitat restoration.

He considered that the site has high significance as a site for continuing research, addressing key questions about population persistence within an urban matrix.

How would you describe the significance of that research, in terms of special insights on the natural heritage of the ACT and surrounding areas?

What value has your organisation received from this research output?

What are the key themes that it addresses? Examples could include species persistence on small sites, species response to shading, grassland composition and grassland management/disturbance.

Key themes in the research at this site include threatening processes affecting small populations on isolated sites and what limits their viability.

Golden sun moth is a flagship species for conservation management. ACT organisations that have contributed research – at this site and at other sites across the ACT have benefited from the scientific profile of a flagship species.

Although, in time the length of record can be replicated at other sites, it was suggested that this small site is unique (nationally and potentially internationally) as a case study of an endangered species on a tiny urban site. (Note however, that if another site emerged from research across the ACT with similar resilient population, uniqueness would be reduced).

What is the current focus of golden sun moth research in the ACT and surrounding areas?

Research themes highlighted included the impact of invasive species and predators on these small isolated populations. Examples include other exotic grass species (already present in general rural landscapes across the ACT), the role of ants in the subsoil habitat component of the golden sun moth life cycle, and the potential for other predators species such as European wasps.

The survival and enhancement of endangered species populations in urban contexts is a general interest of conservation scientists, but the research addresses a wide range of species, not just those occurring at this site.

Further research on the impacts of landscaping and access management on small remnant areas – e.g. further habitat dissection by informal walking paths across grassland, mowing practice, and locations and species of trees planted; also watering protocols.

Note: ACT Government mapping and monitoring is only on land owned by the ACT Government. There are opportunities for greater coordination of monitoring on land owned by Defence or other Commonwealth agencies.

Key questions/Responses

What do you see as the role of small urban land parcels in natural heritage research and conservation?

Dr Osborne noted the attention to Block 3 over the years, and that it had been visited and used many times by consultants, entomologists, research students and members of the public who have an interest in 'this unusual day flying moth and its natural grassland habitat'. Dr Osborne also thought that the level of scientific and community science interest in the site would not have been documented. People who have conducted research or visited the site in relation to the conservation values included Dr Ted Edwards (CSIRO), Dr Annet Richter (a site used as part of her PhD project, at the University of Canberra) and a community engagement program (the golden sun moth count) organised by the Friends of Grasslands group.

Dr Osborne commented on the accessible and inner city location of Block 3, as a site 'embedded deep within the urban matrix of Canberra and in one of the earliest parts of the city'.

Dr Gibbons commented that the Fenner School at ANU has not been involved in active research at York Park; their interest at the site is restricted to teaching. The site is used to discuss the issues associated with the conservation of small populations, including undertaking a PVA based on available published data. The use of the site for teaching is linked to its central location, close to the ANU and the existing monitoring data available for the site, commissioned by the Commonwealth government because of the presence of the critically endangered golden sun moth.

Dr Yeates commented on the community education value of small urban sites partly independent of the scientific research value.

He also noted that based on the existing evidence, the site is not critical in a genetic sense, because of its similarity to the genetic composition of other ACT sites.

How could the scientific community's interest in native grasslands and the golden sun moth be demonstrated, communicated or interpreted to the broader community?

It was suggested that native grasslands could be presented to the broader community as a type of 'surprise package' in terms of their potential to yield scientific information. Native grasslands may look simple and familiar, but on closer inspection they can include diverse and important (threatened and endangered) species with interesting ecology/life cycles.

The potential to use social media and local signage, as well as develop an ACT ecological science trail for interpretation, was noted.

It was also suggested that major academic and research institutions could promote the science culture of Canberra as a city with and large remnants of natural landscape that are easily accessible. 'Science/nature on your street'.

Note these suggestions do not relate specifically to the Project Area but are about broad opportunities for interpretation of native grassland communities (which are widespread across the Canberra locality) to the people of the ACT.

Should the history of scientific studies at this site be part of that communication or interpretation?

Why is this site valuable for that purpose and how could that best be done?

Which themes would be the focus of interpretation – for instance, about the role of landscaping and conservation in the 'bush capital'?

Yes, with respect to small and isolated sites still supporting relatively stable populations of critically endangered species – how and why?

Generally about the conservation role of connected sites (noting the limited connectivity of this site beyond its immediate context).

5.5 Scientific Review Summary

While research at the Site has not been central to any major entomology or conservation research programs, it is apparent that it has influenced ongoing research about golden sun moth within the ACT. In the past, this research was most likely considered to be influential to the monitoring, management and conservation of the species.

Notably, the collaboration between scientific institutions and community groups into the research of golden sun moth at the Site has undoubtedly contributed to the high profile that golden sun moth now enjoys within the ACT. It is a species that is well known throughout Canberra, with targeted government policies dedicated to its conservation.

SECTION 6

Conclusion



6.0 Conclusion

This archival record of the historic scientific research of the critically endangered species, golden sun moth (*Synemon plana*) at Blocks 3 and 15, Section 22 in Barton, ACT (also partly known as the York Park Conservation Area), has been prepared to fulfil Condition 6 of the EPBC Act approval 2017/8028. This report has been prepared in accordance with the NSW Heritage Office's *How to Prepare Archival Records of Heritage Items* (1998) and will be submitted to the Commonwealth Department of the Environment and Energy, the National Archives of Australia and the National Library of Australia.

The York Park Conservation Area has been found to meet the ACT local heritage criteria due to the early recognition of the Site as golden sun moth habitat and its accessible location in the centre of a city with major research organisations and long-standing citizen science interest. The research and monitoring that has been conducted at the Site for over 20 years has been influential on golden sun moth research and management.

This Report has provided a summary of the values of the Site, and a scientific review of the research undertaken over the past 20+ years.

A catalogue of the documents contained within the archival record is provided in **Appendix 1**, including a complete bibliography of all of the publications. These documents have been attributed reference numbers, research themes and abstracts to assist when reviewing these documents.

Appendix 2 consists of the archival record itself, with copies of all available publications included. It is noted that some publications could not be retrieved, however, citations have been included to encourage further research.

We encourage members of the Canberra scientific community and associated community groups to contribute further to this archival record where additional information on golden sun moth research at the York Park Conservation Area comes to light.

SECTION 7

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APPENDIX 1

Archival Record Catalogue

Bibliography

The following table provides a complete bibliography of all the documents referenced within the archival record catalogue. Each citation is attributed a reference number, which is also included in the catalogue to aid in identifying specific documents.

Archival Record Bibliography

Reference No.	Citation
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No.	Copy in Archive?	Report Title	Report Author	Publication Date	Prepared For / Publisher	Abstract	Direct Reference to YPCA?	Survey Date	Research Theme	Research Category	Key Words	Raw Data	Spatial Data	Image Data	Report Source
1	Y	Golden Sun Moth (Synemon plana): An endangered species. Action Plan No. 7	ACT Government	1998	ACT Government	Action Plan No.7 was prepared in response to the declaration of golden sun moth as an endangered species under the Nature Conservation Act 1980. The Action Plan provides a description of the species and its ecology, including physical attributes, habitat, behaviour and biology and distribution within Australia. Conservation objectives, issues and intended management actions are outlined, including possible management conflicts with other species. The Action Plan also ranks the conservation value of specific populations within the ACT, ranking them either of High, Moderate, Low or Minimal Conservation Value. York Park is ranked Moderate Conservation Value (Rating 2). Responsibilities for implementation and review are also noted.	Yes	N/A	decision making	Policy for conservation management	golden sun moth; action plan; ACT Government; conservation management; policy	N/A	N/A	In Archival Record	ACT Government (online)
2	Y	ACT Lowland Native Grassland Conservation Strategy: Action Plan No. 28	ACT Government	2005	ACT Government	This Strategy aims to provide an integrated, territory-wide approach to the protection of remaining lowland native grasslands. This is noted as involving the maintenance and improvement of the viability of the grassy ecosystem within the remnant patches themselves, as well as improving connectivity to other native vegetation and minimising impacts from adjacent land uses. The Strategy identifies these remaining grassland areas, outlines the values of these grasslands, outlines conservation objectives and actions and incorporates Action Plans for listed species, including golden sun moth.	No, however, the policy makes direct reference to research that has been carried out at York Park, including Cook & Edwards (1993) and Clarke & O'Dwyer (2000)	N/A	decision making	Policy for conservation management	grasslands; conservation; strategy; action plans; management; policy	N/A	N/A	Not available	ACT Government (online)
3	Y	ACT Native Grassland Conservation Strategy and Action Plans	ACT Government	2017	Environment, Planning and Sustainable Development	The Conservation Strategy and Actions Plans aims to provide guidance on the conservation of native grasslands and component species, including golden sun moth, in the ACT. The Strategy outlines the ACT Government's conservation goals, while the action plans provide specific conservation management actions for specific species. One of the action plans is specifically for golden sun moth. This action plan is informed by citizen science projects and monitoring studies undertaken at York Park , among other studies and sites.	Yes	N/A	decision making	Regional scale baseline studies for conservation management	native grasslands; golden sun moth; ACT; habitat; conservation; policy	N/A	N/A	Not available	ACT Government (online)
4	N	Principles and practical management guidelines for protected areas of Golden Sun Moth Synemon plana habitat in urban areas	Biosis Research	2010	Department of Sustainability and Environment	<i>Report not able to be sourced, however understood to be relevant to York Park.</i>				Policy for conservation management					
5	Y	Field Observations on the ecology of the golden sun moth, <i>Synemon plana</i> Walker (Lepidoptera: Castniidae)	Braby, M & Dunford, M	2006	Australian Entomologist, vol 33 (2), pp. 102-110.	This paper outlines the results of surveys undertaken at Macgregor West in western Belconnen, ACT for golden sun moth. The paper refers extensively to research undertaken at York Park Conservation Area. The surveys of this study revealed that golden sun moth concentrated mainly along the Ginninderra Creek corridor and its drainage lines. The highest density of golden sun moths occurred in an open grassland flood plain comprising of improved pasture where Chilean needle grass was dominant. The paper indicated a need to further study the dietary requirements of the species.	No, however, the paper references much of the research undertaken at York Park, including O'Dwyer & Atzwill (1998) and Edwards (1994)	December 2003; December 2004.	population vulnerability and habitat quality	Specialist scientific research	golden sun moth; Chilean needle grass; dietary requirements	N/A	N/A	N/A	Will Osborne
6	Y	The Golden Sun Moth, <i>Synemon plana</i> - an endangered species	Clarke, G	1993	ANIC News, No.2	This article provides a description of the research studies being undertaken within Canberra on the golden sun moth. It provides a description of its biology and ecology. The article also claims that due to the small and fragmented known habitat sites and limited grasslands, the species must be endangered (prior to its formal listing). The article notes that the National Capital Planning Authority is providing funding to monitor the population on the site at York Park .	Yes	N/A	flagship species	Regional scale baseline studies for conservation management	golden sun moth; research; conservation	N/A	N/A	N/A	Will Osborne
7	Y	Inferring demography from genetics – a case study of the endangered golden sun moth, <i>Synemon plana</i>	Clarke, G	2000	Genetics, Demography and Viability of Fragmented Populations (eds. Young, A, Clarke, G) Cambridge University Press, pp. 213-225.	This paper aims to demonstrate how genetic-marker technologies have been applied to golden sun moth to infer fundamental life-history and demographic parameters. The method used for this investigation involved collection of 1200 adult males from 36 sites, including York Park , during the 1997 and 1998 flying seasons using a hand net. Analysis was then undertaken by cellulose acetate electrophoresis. The results indicate the investigation found a number of new findings on the species, including a one-year generation time (as opposed to the previously thought two-year period) and significant levels of inbreeding. The article also outlines findings on effective population size, adult and larval mortality, population structure, fragmentation and colonisation. Clarke concludes that the study has provided much-needed empirical data on the impacts of fragmentation on invertebrate species, but notes that genetic data should not be viewed as being either comprehensive or exclusive.	Yes	1997; 1998 flying seasons	genetic diversity	Specialist scientific research	genetics; golden sun moth; demography	N/A	N/A	N/A	Cambridge University Press
8	N	A Survey of Native Grassland Sites in South-eastern New South Wales for the Endangered Golden Sun Moth, <i>Synemon plana</i>	Clarke, G & Dear, C	1998	CSIRO Entomology	<i>Report not able to be sourced, however understood to be relevant to York Park.</i>				Specialist scientific research					
9	Y	Genetic analysis of populations of the endangered golden sun moth, <i>Synemon plana</i>	Clarke, G & O'Dwyer, C	1998	Threatened Species Unit, NSW National Parks and Wildlife Service, Southern Zone and Wildlife Research and Monitoring Unit, Environment ACT	This investigation is stated to have been the largest genetic study of a threatened invertebrate in the world at the time of its undertaking. The investigation aimed to carry out an assessment of genetic diversity of golden sun moth. It involved the collection of adult male golden sun moth at ten sites in the ACT, eight sites in NSW and two sites in Victoria between 7 November – 11 December 1997. A total of 556 individuals were collected with almost 11,000 genotypes analysed. It was found the populations cluster into 5 major groupings, which corresponded to geographic location. York Park is identified as being within Group 5. The article notes that populations within Groups 3-5 have been fragmented primarily through urban and agricultural expansion in the ACT. This in turn limits the chances for recovery of genetic diversity within these populations. The paper also notes that the population size at York Park is relative stable at approximately 1000-15000 individuals. The York Park population is considered to deserve special attention due to its high profile and considerable research focus. The article concludes that levels of genetic variation within all populations are somewhat lower than that observed in other lepidopteran species.	Yes	November – December 1997	genetic diversity	Specialist scientific research	genetics; golden sun moth; habitat fragmentation; conservation priorities	Not available	Not available	Not available	Will Osborne
10	Y	Genetic variability and population structure of the endangered golden sun moth, <i>Synemon plana</i>	Clarke, G & O'Dwyer, C	2000	Biological Conservation 92, 371-381	Clarke and O'Dwyer assess levels of genetic variation and diversity to investigate patterns of population structure in golden sun moth. Twenty populations were sampled from throughout the geographic range of the species, including specimens collected from York Park . The article states that the results suggest that levels of genetic variation within most populations were lower than that observed in other moth species. It is suggested that this level of variation may have resulted from population bottlenecks and founder events following habitat fragmentation.	Yes	N/A	genetic diversity	Specialist scientific research	golden sun moth; genetics; habitat fragmentation; conservation	N/A	Not available	Not available	Biological Conservation Journal (online)
11	Y	A Review of the Conservation Status of Selected Australian Non-Marine Invertebrates	Clarke, G & Spier-Ashcroft, F	2003	National Heritage Trust	The review aims to objectively assess the conservation status of a selected suite of Australian non-marine invertebrates, including the golden sun moth. The Review states that it has selected 25 species that are representative of the diversity of Australian invertebrate fauna, their geographic distribution, different habitat requirements and associations and potential threats. Each of the species is then assessed against the 1994 IUCN Threatened Species Criteria using the software package RAMAS RedList. The majority of the taxa were categorised as critically endangered with the remaining as data deficient. The report aims to draw attention to the conservation needs of non-marine invertebrates.	No, but the paper specifically refers to the surveys that have been undertaken at York Park, including by Harwood et al (1995)	N/A	population vulnerability and habitat quality	Regional scale baseline studies for conservation management	non-marine invertebrates; assessment; conservation;	N/A	Not available	Not available	Will Osborne
12	Y	Phylogeography and population history of the endangered golden sun moth (<i>Synemon plana</i>) revealed by allozymes and mitochondrial DNA analysis	Clarke, G & Whyte, L	2003	Conservation Genetics 4, 719-734.	This paper outlines the findings of a study that used a combination of combination of allozyme and mitochondrial DNA markers to determine the contribution of recent and ancient causes of patterns of genetic variation within and among 46 populations of golden sun moth, including that occurring at York Park . Allozyme analysis grouped the 46 populations into 5 major genetic clusters that corresponded closely with geographic location following an isolation-by-distance model. Clarke and Whyte state that the evidence of this study suggests that the populations within these groups derived from a small founding population that underwent rapid demographic expansion in ancient times. This was followed by more recent population bottlenecks resulting from habitat fragmentation associated with the widespread introduction of agriculture into the region.	Yes	1997; 1998; 1999; 2000 flying seasons	population change over time	Specialist scientific research	golden sun moth; genetics; population change; habitat fragmentation	Not available	N/A	N/A	Conservation Genetics Journal
13	Y	Population monitoring of endangered moth <i>Synemon plana</i> 1992-93, York Park, Barton	Cook, L & Edwards, T	1993	National Capital Planning Authority	This report provides the results of golden sun moth monitoring at York Park between 24 November 1992 - 31 January 1993. The survey method consisted of mark-release-recapture techniques. The adult population was sampled daily over the study period. The results of the study state that the observed ratio of males to females among captures was 9:1. However, it was noted that active males are more readily observed than females. It was determined that the site consisted of approximately 1000 individuals. It was considered that a moth population of this size should remain viable subject to no further invasion of predators and introduced plants, and favourable climatic conditions. The report concludes by providing directions for further monitoring.	Yes	November 1992 - January 1993	genetic diversity	Specialist scientific research	golden sun moth; sex ratio; monitoring; population	Not available	Not available	Not available	Will Osborne
14	Y	Report on ACT Lowland Native Grassland Investigation	Cooper, M	2009	ACT Government	The report was prepared by the Commissioner for Sustainability and the Environment, under the directive of the ACT Minister for the Environment, Water and Climate Change. The report investigates 49 lowland native grassland sites in the ACT. The report notes that within lowland native grassland sites, a number of endangered species are present, including golden sun moth. The report makes a number of recommendations, with two highlighted as requiring urgent attention. These urgent recommendations include the need for land management action to be undertaken to protect the 60% of the Territory's lowland native grassland sites that are currently in a critical condition or approaching this state. This includes kangaroo population management. The other urgent recommendation is to improve the ecological condition of sites that are in a critical condition or approaching this state, by reducing current threatening processes such as weed invasion, inappropriate mowing and overgrazing. York Park , Barton is highlighted as one of these sites.	Yes	N/A	decision making	Regional scale baseline studies for conservation management	lowland native grasslands; ACT; natural temperate grassland; golden sun moth; land management	N/A	Not available	Not available	ACT Government (online)
15	Y	A Strategic Approach to the Conservation and Environmental Assessment of Golden Sun Moth Sites in the Canberra Area.	David Hogg Pty Ltd	December 2010	Land Development Agency	Hogg aims to provide a strategic analysis of all known golden sun moth sites within the ACT in order to inform conservation decision making. The report summarises the population size, habitat type and quality, and mappings of all of the known sites that support golden sun moth within the ACT. Hogg outlines some of the conservation actions that have been undertaken by both the ACT and Commonwealth Governments.	No, however, York Park is referred as the most important Central Canberra site due to its cultural scientific value.	N/A	decision making	Regional scale baseline studies for conservation management	golden sun moth; strategy; conservation; strategic analysis; ACT	N/A	Not available	Not available	David Hogg
16	Y	Barton Section 22 Block 14 Stage 1 Development Ecological Assessment including Potential Shading Impacts on the York Park Conservation Site	David Hogg Pty Ltd	October 2012	Doma Group	Hogg aims to provide an assessment of the potential impacts of shading caused by a new development to golden sun moth habitat at York Park Conservation Area. The proposed building development by Doma Group, was to be located adjacent to York Park . The assessment noted the potential impacts to golden sun moth habitat quality and behaviour, including flying movement and breeding. In particular, it notes the impacts relating to sunlight, soil and air moisture, wind patterns and vegetation growth and diversity that may affect the habitat at the site. Shading analysis was undertaken for 5 days of the year, reflecting the solstices and equinox, as well as the peak golden sun moth flying period. This was done through computer animations and shading diagrams. The assessment compared the percentage of shading over the site for three different designs. It was found that shading impacts would primarily occur during winter. The report concluded there would be minor environmental changes affecting golden sun moth habitat in winter, meaning there was unlikely to be distinguishable changes to environmental conditions. Of the three building designs, Design 8 was considered to be the preferred option relating to shading impacts on York Park .	Yes	N/A	decision making	Monitoring or management required of the land owner	golden sun moth; York park conservation area; shading impacts; habitat quality; behaviour impacts	N/A	Not available	Not available	Doma Group

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17	Y	Belconnen naval station harbour endangered moth	Edwards, T	1990	NPA Bulletin, Vol. 21, No. 2	This article appear to seek to raise awareness of the golden sun moth and its threats to its survival. The article first describes the species' biology and ecology, noting its uniqueness compared with other similar species. Edwards then discusses the impacts of agriculture and urban development on known habitat sites in Canberra, including mentioning those near Parliament House (assumed to include as York Park). He concludes the article stating the need to conserve known habitat sites, particularly the Belconnen naval station. The article emphasises that conservation efforts should be focused on preserving wallaby grassland, being the primary habitat for the species.	Yes	N/A	population vulnerability and habitat quality	Regional scale baseline studies for conservation management	golden sun moth; Belconnen Naval Station; urban threats; conflicting land uses; conservation	N/A	N/A	N/A	Will Osborne
18	Y	Synemon plana – a grassland case history, in The ACT's Native Grasslands	Edwards, T	1991	Conservation Council of the southeast region and Canberra	This paper provides a summary of the proceedings of a workshop held at the national Museum of Australia, Canberra on 17 February 1991. The aim of the workshop was to raise awareness of the need for further grassland conservation. A series of transcripts from experts on the importance and possible future management methods of native grasslands is provided within the paper. One transcript is from Dr Edwards from the CSIRO Division of Entomology. The transcript indicates the Edwards discussed golden sun moth and its reliance on remnant patches of <i>Danthonia carphoides</i> (wallaby grass) grasslands. He notes that the principal threats to the survival of the species are urban and suburban development and weed invasion. He argues that these threats can be managed through management of the grassland. He notes that the golden sun moth is being used as a figurehead for other invertebrates that are present in native grasslands. A map accompanies the transcript, with York Park in Barton marked as a known moth location.	Yes	N/A	decision making	Regional scale baseline studies for conservation management	native grasslands; golden sun moth; ACT; habitat; conservation	N/A	Not available	Not available	Will Osborne
19	Y	Golden sun moth	Edwards, T	1993	Australian Natural History 24(6): 16- 17.	This article provides a description of golden sun moth and argues that the species may be threatened with extinction. It implies that the species was found over a much greater area of Australia at the time of European settlement. The article argues that through chemical fertilisers and introduced grass species, the golden sun moth is under threat. The article refers to the Belconnen Naval Station in Canberra. It also notes the potential threat of housing and office development in Canberra. The article concludes by stating that the golden sun moth serves as a figurehead for many invertebrates as being unstudied and at the risk of extinction.	No, however, Edwards was a significant contributor to the research undertaken at York Park. This article seeks to raise awareness of the species within the local scientific community. Additionally, in the article, he notes the impacts of housing and office development in Canberra and the threat of weeds, both of which are impacts that have affected York Park.	N/A	flagship species	Specialist scientific research	golden sun moth; conservation; impacts; figurehead species	N/A	N/A	N/A	Will Osborne
20	Y	Survey of lowland grassland sites in A.C.T for the Golden Sun Moth, Synemon plana	Edwards, T	1994	CSIRO Report to the Wildlife Research Unit	This report provides the survey results of golden sun moth at nine sites throughout the ACT. The surveys were conducted in a single season. Previous data from York Park is referred to demonstrate the limitations of survey counts. In particular it refers to the impacts of local weather conditions. The results of the surveys indicated that there was a distinct tendency for most sites to be on low ridges, hillocks or low hills. It was noted that the absence of golden sun moth at the National Museum was most likely due introduced weeds. The report ranks each site according to the importance, based on size and extent of population, overall condition and location in relation to development.	Yes	November - December 1993	population vulnerability and habitat quality	Regional scale baseline studies for conservation management	golden sun moth; population distribution;	Not available	Not available	Not available	Will Osborne
21	Y	Provisional Management Recommendations for York Park Moth Site	Edwards, T	1995	National Capital Planning Authority	This report provides management recommendations specifically for the maintaining the population of golden sun moth at York Park , Barton. The recommendations include management of weed invasions, mowing practices, avoidance of shading, and excluding vehicles and pedestrians from the Site. The report also encourages involvement of community organisations in the maintenance of York Park.	Yes	N/A	decision making	Monitoring or management required of the land owner	golden sun moth; York Park; management; conservation	N/A	N/A	N/A	Will Osborne
22	Y	Block 3, Section 22, Barton ACT: Heritage Assessment	ERM	April 2016	Department of Finance	ERM was commissioned by the Department of Finance in November 2015 to prepare a Heritage Assessment for the York Park Conservation Area, referred to as Block 3 Section 22. The assessment included background research of the site, database searches, site inspection, assessment against Commonwealth and ACT heritage criteria, ranking of heritage significance, conclusion and recommendations. ACT Representative Aboriginal Organisations were also consulted in March 2016. Site inspections were carried out on 26 November 2015. The assessment considered the heritage criteria for Indigenous, Historic and Natural Heritage. The assessment found that the site did not meet the criteria for any classification of heritage listing. The site was noted to have the presence of a Commonwealth and Territory-listed endangered species, being golden sun moth, but this was not considered sufficient to have significant natural heritage values.	Yes	November 2015	other	Monitoring or management required of the land owner	heritage assessment; historic heritage; indigenous heritage; natural heritage; York park conservation area	Not available	Not available	Not available	Will Osborne
23	Y	Synemon's last stand or the moths that ate Belconnen Naval Base	Falconer, R	1991	Bogong 12, 1: pp. 4-6	This article aims to draw attention to the threats encountered by the golden sun moth, particularly in the ACT. Falconer provides a description of the known ecology of the species, including its known habitat within native grasses. He claims that the species has greatly declined due to the introduction of exotic grasses and fertilisers as a result of pasture improvement activities. he notes that up until early 1991, only nine records of habitat sites existed. He noted that eight of the sites were located in urban Canberra, with the majority being no larger than about 100 metres by 35 metres. However, Falconer identifies the Belconnen Naval Base as the best prospect for the long-term survival of the species. He notes that new suburbs threaten to sprawl into other larger sites. He concludes that the golden sun moth will be a litmus test of 'our' ability to coexist with the natural environment in the ACT.	No, however, Falconer clearly makes references to York Park, noting that much of the known golden sun moth habitat in Canberra is within small, urban sites.	N/A	flagship species	Regional scale baseline studies for conservation management	golden sun moth; Belconnen Naval Station; urban threats; conflicting land uses; conservation	N/A	N/A	N/A	Will Osborne
24	Y	What does a Golden Sun Moth look like?	Friends of Grasslands	2008	University of Canberra	This is a poster presented to the Friends of Grasslands volunteers during the 'Sun Moth Count' project in 2008-2009. York Park was a key survey site for the project. The poster provides information as to where the species lives, what it looks like and the conditions it is most likely to be visible in.	Yes	N/A	other	Citizen science research	golden sun moth; poster; citizen science	N/A	N/A	N/A	Will Osborne
25	Y	Managing pasture for the critically endangered Golden Sun Moth (Synemon plana)	Gibbon, P & Reid, T	2013	Lachlan Catchment Management Authority	This report does not specifically refer to the York Park Conservation Area, but is an indicator of subsequent research that has resulted from the investigations of golden sun moth at York Park. The report forms part of the Lachlan Management Authority's Native Grasslands Recovery for Greater Landscape Resilience Project. The report aims to provide survey results of golden sun moth presence in the Lachlan Catchment area and provide guidance for its ongoing management.	No	2012	decision making	Regional scale baseline studies for conservation management	golden sun moth; Lachlan catchment; management; grazing	Not available	N/A	N/A	ANU Edge
26	Y	Problems in studying populations of the golden sun-moth Synemon plana (Lepidoptera: Castniidae), in south eastern Australia	Gibson, L & New, T	2007	Journal of Insect Conservation	This article aims to draw attention to the difficulties of evaluating populations of golden sun moth. The article outlines and discusses the results of surveying of the species at a large grassland remnant near Melbourne, Craigieburn Grassland Reserve. The site was visited between 1 November 2005 and 15 January 2006. The results showed records of golden sun moth varied across the reserve. It is noted that data from York Park was used to compare golden sun moth incidence, however, noting that York Park is considerably smaller than the reserve. The article concludes that the biology of golden sun moth provides both constraints and opportunities for quantitative population assessments and comparison of populations between different sites.	Yes	November 2005 - January 2006	other	Specialist scientific research	grassland; flagship species; transects; surveys; phenology	Not available	Not available	Not available	Journal of Insect Conservation
27	N	Population monitoring of endangered moth Synemon plana 1994–95, York Park, Barton	Harwood, T, Narain, S & Edwards, T	1995	National Capital Planning Authority	<i>Report not able to be sourced, however understood to be relevant to York Park.</i>				Monitoring or management required of the land owner					
28	Y	GSM Newsletter no. 1	Hnatiuk, S	2008a	Friends of Grasslands	This newsletter is the first issued by the Friends of Grasslands in relation to the golden sun moth counters project. The newsletter provides information about the chosen golden sun moth sites and counters, maps, contact details and process for counting and recording moths and pupal cases. The newsletter also notes that practice sessions were scheduled for volunteers at York Park .	Yes	N/A	other	Citizen science research	citizen science; golden sun moth; GSM counters project	N/A	Not available	Not available	Geoff Robertson
29	Y	GSM Newsletter no. 2	Hnatiuk, S	2008b	Friends of Grasslands	This newsletter is the second issued by the Friends of Grasslands regarding the Sun Moth Count Project, for which York Park was one of the sites investigated. The newsletter provides an update of the number of volunteers and sites being monitored. The newsletter also contains a modified vegetation record sheet to clarify the recording process. A Golden Sun Moth Photo Contest is also notified in the newsletter.	Yes	N/A	other	Citizen science research	citizen science; golden sun moth; GSM counters project	N/A	Not available	Not available	Geoff Robertson
30	Y	GSM Newsletter no. 3	Hnatiuk, S	2008c	Friends of Grasslands	This newsletter is the third issued by the Friends of Grasslands regarding the Sun Moth Count Project, for which York Park was one of the sites investigated. The newsletter provides guidance to volunteer counters regarding suitable conditions for moth counting. It also informs readers of the deadline for submitting record sheets. The newsletter also notes an Aboriginal Land Claim has been submitted for the Belconnen Naval Station.	Yes	N/A	other	Citizen science research	citizen science; golden sun moth; GSM counters project	N/A	Not available	Not available	Geoff Robertson
31	Y	GSM Newsletter no. 4	Hnatiuk, S	2008d	Friends of Grasslands	This newsletter is the fourth issued by the Friends of Grasslands regarding the Sun Moth Count Project, for which York Park was one of the sites investigated.. The newsletter informs readers that the deadline for submitting record sheets to Anett Richter will be the first week of January 2009. The newsletter also requests feedback and provides some comments on the number of moths flying. A feedback form is attached to the newsletter.	Yes	N/A	other	Citizen science research	citizen science; golden sun moth; GSM counters project	N/A	Not available	Not available	Geoff Robertson
32	Y	GSM Newsletter no. 5	Hnatiuk, S	2009a	Friends of Grasslands	This newsletter is the fifth issued by the Friends of Grassland regarding the Sun Moth Count Project, for which York Park was one of the sites investigated. It notes that the project for the season has concluded and that a meeting will be held to discuss some of the preliminary findings.	Yes	N/A	other	Citizen science research	citizen science; golden sun moth; GSM counters project	N/A	Not available	Not available	Geoff Robertson
33	Y	GSM Newsletter no. 6	Hnatiuk, S	2009b	Friends of Grasslands	This is the sixth newsletter by the Friends of Grasslands for the Sun Moth Count Project, for which York Park was one of the sites investigated. It notes that the group received a grant from the Federal Government's Volunteer Grants Program and that some volunteers may be able to receive payment to cover the costs of travel to and from golden sun moth counting events. The newsletter also notes that they have registered with the Clean Up Australia Day campaign to remove rubbish from grassland containing golden sun moth. It also notes that about 30 people attended the wrap up workshop for the project.	Yes	N/A	other	Citizen science research	citizen science; golden sun moth; GSM counters project	N/A	Not available	Not available	Geoff Robertson
34	Y	GSM Newsletter no. 7	Hnatiuk, S	2009c	Friends of Grasslands	This newsletter is the seventh by the Friends of Grassland relating to the Sun Moth Count Project, for which York Park was one of the sites investigated. This newsletter provides an update on golden sun moth monitoring and the progress of the previous year's reporting. It also indicates that continued golden sun moth monitoring would be welcomed and provides details as to where and how sittings recordings can be submitted.	Yes	N/A	other	Citizen science research	citizen science; golden sun moth; GSM counters project	N/A	Not available	Not available	Geoff Robertson
35	Y	GSM Newsletter no. 8	Hnatiuk, S	2009d	Friends of Grasslands	This is the eighth newsletter by the Friends of Grassland relating to the Sun Moth Count Project, for which York Park was one of the sites investigated. The newsletter requests that observations of golden sun moths are sent in, with specific reports by particular volunteers being noted.	Yes	N/A	other	Citizen science research	citizen science; golden sun moth; GSM counters project	N/A	Not available	Not available	Geoff Robertson
36	Y	Golden Sun Moth (GSM) ACT Strategic Conservation Management Plan	Mulvaney, M	2012	Flora and Fauna Committee	This plan aims to provide strategic guidance as to how golden sun moth within the ACT may remain viable over the long term. It first seeks to identify its known and potential distribution, population sizes, habitat connections and threats. The threats identified include loss and degradation of habitat, climate change, weed invasion, and inappropriate habitat. The plan then goes on to provide prioritisation of habitat sites and strategic actions aimed to conserve the species. Mulvaney ranks each known habitat site in the ACT based on habitat size, population size, habitat connectivity, vegetation type, understorey quality and the presence of other threatened species. York Park and the Sydney Avenue median strip is ranked equal 16 with two other sites. The report concludes by outlining 18 recommendations for the conservation management of the species within the ACT.	Yes	N/A	decision making	Policy for conservation management	strategic plan; conservation; management; golden sun moth	N/A	Not available	Not available	Will Osborne

No.	Copy in Archive?	Report Title	Report Author	Publication Date	Prepared For / Publisher	Abstract	Direct Reference to YPCA?	Survey Date	Research Theme	Research Category	Key Words	Raw Data	Spatial Data	Image Data	Report Source
37	Y	The habitat of the Golden Sun Moth.	O'Dwyer, C	1999	The Zoological Society of New South Wales	The paper provides a summary of the findings of a study that aimed to describe golden sun moth habitat and determine the components necessary for its survival. The paper first describes in relative detail the known biology and historical distribution of the species. It then briefly explains the method of the study, in that 12 current sites (eight in the ACT and four in Victoria) and two historical sites in Victoria were investigated and compared. York Park was one of the sites investigated. O'Dwyer then briefly describes the results of the floristic and soil surveys, and concludes by stating that the study clearly demonstrated a relationship between soil fertility, the percentage cover of weeds and the percentage cover of <i>Danthonia</i> . This is considered useful in enabling some predictions about golden sun moth habitat to be made to assist conservation strategies or recovery plans.	Yes	Unknown	population vulnerability and habitat quality	Regional scale baseline studies for conservation management	golden sun moth; habitat features; soil fertility; weeds	Not available	Not available	Not available	Will Osborne
38	Y	A comparative study of habitats of the Golden Sun Moth <i>Synemon plana</i> Walker (Lepidoptera: Castniidae): implications for restoration	O'Dwyer, C & Attiwill, P	November 1998	Biological Conservation	The article outlines the comparative study of habitats of golden sun moth. Eight sites were visited in urban areas of Canberra including York Park , while six sites were investigated in Victoria. The study used a number of methods, including recording floristics, bioclimatic modelling, soil profiling, a pot experiment that varied the amount of phosphorus applied, and vegetation data analysis. It was determined that the density of <i>Austrodanthonia</i> spp. and the concentration of available phosphorus are limiting the distribution of golden sun moth. The species are known to occur in soils that are low in phosphorus, with higher concentrations having a toxic effect on soil-borne larva. This may have implications for the use of fertilisers.	Yes	September 1995	population vulnerability and habitat quality	Specialist scientific research	golden sun moth; habitat; soil; fertilisers; vegetation	Not available	Not available	Not available	Will Osborne
39	Y	Natural Temperate Grassland Maintenance Plan Block 3 Section 22 Barton, ACT	Parsons Brinckerhoff Australia Pty Limited	June 2008	Department of Finance and Deregulation	This report presents a maintenance plan for the management of ecological values at Blocks 3 and 7 Section 22 Barton, ACT (York Park Conservation Area). The plan notes that the site has received a moderate conservation value rating from the ACT Government, due to its high profile and considerable research focus. The plan outlines maintenance requirements, including weed management objectives and procedures; biomass management and monitoring requirements. The plan highlights the site an opportunity to provide ongoing golden sun moth annual monitoring, for ongoing comparisons of observational data collection methods. The maintenance plan noted that it should be reviewed at the end of five years.	Yes	N/A	flagship species	Studies for development assessment purposes	golden sun moth; Block 3 Section 22; natural temperate grassland; maintenance plan; monitoring; conservation	N/A	Not available	Not available	Department of Finance
40	Y	What makes species vulnerable to extinction following habitat fragmentation and degradation? A test using the insect fauna in native temperate grassland in South-eastern Australia	Richter, A	2010	University of Canberra	This thesis reports on a three year study of the conservation ecology of terrestrial insects in highly fragmented native temperate grassland in the ACT. The thesis examines the vulnerability of carabid beetles (<i>Carabidae, Coleoptera</i>) and scarab beetles (<i>Scarabaeidae, Coleoptera</i>) to modifications in landscape structure and habitat quality following native grassland fragmentation. To accompany this study, Richter also conducted an autecological study of the golden sun moth. York Park was a key site surveyed, as well as 14 other sites within Canberra. Richter states that the results of her investigations provide clear evidence that golden sun moth at all life stages occupies habitat dominated by native grasses, particularly mixed wallaby grass and spear grass, but can also occur at sites comprised almost entirely of the exotic Chilean needle grass. She argues that the size of grassland fragments are of less importance. She concludes by noting that the findings about the species adult and larval biology and ecology fill important gaps in the understanding of the golden sun moth. Note - only the Abstract, Chapters 1, 2, 6, Synopsis and References are considered most relevant and therefore included in this archival record.	Yes	October 2006 - January 2008	population vulnerability and habitat quality	Specialist scientific research	carabid beetles; scarab beetles; golden sun moth; Chilean needle grass; habitat	Not available	Not available	Not available	Will Osborne
41	Y	Community Monitoring of Golden Sun Moths in the Australian Capital Territory Region, 2008-2009	Richter, A, Osborne, W, Robertson, G, & Hnatiuk, S.	November 2009	Threatened Species Network	This report outlines the method and findings of a pilot study to monitor golden sun moth in natural temperate and exotic grasslands in the ACT. The report states that the aim of the study was to develop and evaluate standardised monitoring protocols for use by community groups, and to trial the approach with volunteers. The study also sought to establish a basic information guide for future golden sun moth monitoring that could assist in site management. Monitoring was undertaken at 12 survey plots within the ACT and NSW, including at York Park . The report provides management and monitoring recommendations, including modifications to the monitoring program of golden sun moth.	Yes	Dates unclear	decision making	Regional scale baseline studies for conservation management	citizen science; golden sun moth; monitoring; management	In Archival Record	Not available	Not available	Department of Finance
42	Y	Dietary specialisation in the Golden Sun Moth <i>Synemon plana</i> – the key to understanding habitat requirements and site rehabilitation for this critically endangered species	Richter, A, Osborne, W & Traugott, M	2011	Biodiversity Policy and Programs Branch Victorian Department of Sustainability and Environment	This research paper aims to describe the diet of the golden sun moth. The investigation involved field work in the ACT and Victoria, and makes extensive references to research undertaken at the York Park Conservation Area . The paper seeks to address the issue of whether golden sun moth also feeds on Chilean needle grass, being an exotic noxious weed. The results of the study indicate that golden sun moth have a dietary preference for C3 grass species which include both native grass species and Chilean needle grass. It is noted that climate change is likely to have an impact on this class of grass species, which may have consequences for the golden sun moth.	No, however, the paper references much of the research that has been undertaken at York Park, including Clarke & O'Dwyer (2000) and Edwards (1994).	Late autumn and spring between 2007 - 2009	resilience of the species	Regional scale baseline studies for conservation management	golden sun moth; dietary requirements; Chilean needle grass; climate change	Not available	Not available	Not available	Will Osborne
43	Y	More than an empty case: a non invasive technique for monitoring the Australian critically endangered golden sun moth, <i>Synemon plana</i> (Lepidoptera: Castniidae)	Richter, A, Weinhold, D, Robertson, G; Young, M, Edwards, T, Hnatiuk, S & Osborne, W.	November 2012	Journal of Insect Conservation	This article argues that detection of empty pupal cases for golden sun moth is a potential additional tool to monitor the species. It is argued that the technique is not dependent on the restrictions of prevailing weather conditions and time of day, and can be undertaken by citizen scientists. It also noted that the presence of pupal cases in native grasslands and in grasslands comprised entirely of the exotic Chilean needle grass means that the species has expanded its range to include these exotic grasslands. The article concludes by stating that the authors hope sampling pupal cases will make an important contribution to future research and monitoring of the species.	No, however, the article discusses the 'Sun Moth Count' Project in which York Park was a key survey site.	November 2008	resilience of the species	Specialist scientific research	golden sun moth; <i>Synemon plana</i> ; monitoring; pupal cases; sex ratio; citizen scientists	Not available	Not available	Not available	Journal of Insect Conservation
44	Y	Moths in fragments: insights into the biology and ecology of the Australian endangered golden sun moth <i>Synemon plana</i> (Lepidoptera: Castniidae) in natural temperate and exotic grassland remnants	Richter, A, Osborne, W, Hnatiuk, S & Rowell, A	September 2013	Journal of Insect Conservation	The study examined the abundance, population structure and reproductive biology of golden sun moth in a both natural temperate and exotic grassland remnants in and near Canberra, ACT. The study sought to fill knowledge gaps to better inform conservation management. Survey was undertaken between 2006 and 2009 over 47 grassland sites, from mid-October until the end of January. Mark-release-recapture technics were used at York Park to assist in determining population size and survival rates. The study found that golden sun moth are not limited to natural temperate grassland and were found to occur in areas of Chilean needle grass. The study also determined that local weather conditions and seasonal trends in climate are likely to have an effect on larval development, adult activity, population demography and feeding behaviour of the species.	Yes	October 2006 - January 2009	population vulnerability and habitat quality	Specialist scientific research	golden sun moth; flagship species; Chilean needle grass; abundance; conservation; monitoring	Not available	Not available	Not available	Journal of Insect Conservation
45	Y	York Park Golden Sun Moth Monitoring 2013	Robert Jessop Pty Ltd	June 2014	Section 22 Barton Pty Ltd	This report provides baseline results of flying golden sun moth surveys, pupal case surveys and vegetation surveys for 2013. The surveys were conducted according to ACT Government survey guidelines. The surveys found the presence of golden sun moth at low to moderate activity levels within the York Park Conservation Area, low detection rates of pupal cases and confirmed the presence of natural temperate grassland.	Yes	November - December 2013	population change over time	Monitoring or management required of the land owner	golden sun moth; baseline monitoring; York park; surveys; natural temperate grassland	Not available	Not available	Not available	Department of Finance
46	Y	York Park Golden Sun Moth Monitoring 2014	Robert Jessop Pty Ltd	February 2015	Section 22 Barton Pty Ltd	The report provides the second year of baseline results of flying golden sun moth surveys, pupal case surveys and vegetation surveys for 2014. Similarly to the 2013 reporting, the surveys found low to moderate activity levels at York Park , low pupal case detection rates and identified natural temperate grassland. Flying moth numbers during this surveying period was considered to be consistently higher than during the 2013 flying season. Three times as many pupal cases were also detected during this survey compared with 2013.	Yes	November 2014 - January 2015	population change over time	Monitoring or management required of the land owner	golden sun moth; baseline monitoring; York park; surveys; natural temperate grassland	Not available	Not available	Not available	Department of Finance
47	Y	Block 3 Section 22 Barton ACT: Five-year monitoring event for Golden Sun Moth and condition assessment of Natural Temperate Grassland	Rowell, A	May 2012	Department of Finance and Deregulation	This report outlines the results of a mark-release-recapture survey that was carried out at York Park in December 2011. The investigation was limited by adverse weather and the golden sun moth season starting prior to the survey dates. The results of the survey indicate golden sun moth numbers were lower at the site in 2011 than in previous years. The report makes a number of conservation recommendations relating to weed management, mowing practices and general vegetation management.	Yes	December 2011 - January 2012	population change over time	Monitoring or management required of the land owner	golden sun moth; monitoring; natural temperate grassland; Block 3 Section 22	In Archival Record	In Archival Record	In Archival Record	Alison Rowell
48	N	Draft ACT Golden Sun Moth Monitoring Plan	Rowell, A & Evans, M	2014	Conservation Planning and Research, Environment and Sustainable Development, ACT Government	<i>Report not able to be sourced, however understood to be relevant to York Park.</i>				Studies for development assessment purposes					
49	Y	Golden Sun Moth Monitoring 2015: York Park	SMEC Australia Pty Ltd	27 April 2016	22 Barton Pty Ltd	This report provides the results of the Year 3 monitoring event for golden sun moth at York Park , including flying moth survey, pupa case search and vegetation condition assessment for 2015. The results of the monitoring event included recording moderate numbers of flying golden sun moth that quickly decreased by early December. Overall abundance was noted to be consistent with previous surveys. Pupa case detection was considered to be very low and consistent with previous surveys. Vegetation condition was considered to be generally lower in comparison to previous surveys, however, it was noted this may be attributed to survey timing and seasonal conditions. The report recommended that pupae case surveys be removed from the monitoring plan and that soil temperatures be monitored for one full season.	Yes	November - December 2015	population change over time	Monitoring or management required of the land owner	golden sun moth; monitoring; natural temperate grassland; surveys	Not available	Not available	Not available	Doma Group
50	Y	Golden Sun Moth Monitoring 2016: York Park Conservation Area.	SMEC Australia Pty Ltd	June 2017	22 Barton Pty Ltd	The report provides the results of the Year 4 monitoring event for golden sun moth at York Park , providing results on flying moth survey, pupae case search and vegetation condition assessment conducted in 2016. The results detailed in the report note that flying golden sun moth were recorded in low-moderate numbers during the 2016 season, being consistent with previous monitoring events. Detection of pupae cases remain low. The vegetation composition was found to be comparable with 2015. Noxious weeds such as St John's Wort were prevalent at the site in 2016. Data loggers for soil temperatures were deployed, indicating soil temperature variation in accordance with the seasons. No inferences on golden sun moth abundance or vegetation condition were made regarding shading impacts.	Yes	November - December 2016	population change over time	Monitoring or management required of the land owner	golden sun moth; monitoring; natural temperate grassland; surveys	Not available	Not available	Not available	Doma Group
51	Y	Golden Sun Moth Monitoring 2017: York Park Conservation Area	SMEC Australia Pty Ltd	February 2018	Section 22 Barton Pty Ltd	The report provides the results of the Year 5 monitoring event for golden sun moth at York Park , providing results on flying moth survey, pupae case search and vegetation condition assessment conducted in 2017. The results indicate that while flying golden sun moth were still recorded in low-moderate numbers, their abundance was higher than the annual averages of 2013-2016. Pupa case detection remained low. Vegetation composition and condition was similar to previous annual averages, however a lower diversity of both native and exotic species were recorded in comparison to the previous monitoring event. Soil temperatures were found to be more extreme and variable in both summer and winter. The report did not identify any biologically and statistically significant decline in vegetation condition at York Park that correlated with the onset of shading. Ongoing weed management was recommended and the continuation of monitoring.	Yes	November - December 2017	population change over time	Monitoring or management required of the land owner	golden sun moth; monitoring; natural temperate grassland; surveys	Not available	Not available	Not available	Doma Group
52	Y	Golden Sun Moth Monitoring 2018: York Park Conservation Area	SMEC Australia Pty Ltd	February 2019	Section 22 Barton Pty Ltd	This report presents the findings of the Year 6 monitoring event undertaken at York Park for golden sun moth. Surveys were undertaken, including flying moth surveys, pupae case search and vegetation condition assessment conducted in 2018. The report also analyses all data from the previous six years of monitoring. The report found that there was no biologically or statistically significance declines in pupae case numbers, floristic value or flying moth numbers at York Park that correlated to the onset of shading.	Yes	November - December 2018	population change over time	Monitoring or management required of the land owner	golden sun moth; monitoring; natural temperate grassland; surveys	Not available	Not available	Not available	Doma Group

No.	Copy in Archive?	Report Title	Report Author	Publication Date	Prepared For / Publisher	Abstract	Direct Reference to YPCA?	Survey Date	Research Theme	Research Category	Key Words	Raw Data	Spatial Data	Image Data	Report Source
53	Y	Natural Temperate Grassland Maintenance Plan	Umwelt (Australia) Pty Ltd	March 2014	Department of Finance and Deregulation	This report aims to be an update to the maintenance plan prepared for the York Park Conservation Area by Persons Brinkerhoff in 2008. The report also includes an updated assessment of the status and condition trends of natural temperate grassland and weed distribution within York Park . Additionally, it reports on golden sun moth population numbers, however, it notes that population trends were not assessed due to the highly ephemeral nature of larval hatchings across seasons. The report concludes that the natural temperate grassland has changed since 2007, with a decrease in bare ground and increase in vegetation density. Updated management strategies are also included in the report.	Yes	November - December 2013	population change over time	Studies for development assessment purposes	golden sun moth; Block 3 Section 22; natural temperate grassland; maintenance plan; monitoring; conservation	In Archival Record	In Archival Record	In Archival Record	Umwelt
54	Y	Natural Temperate Grassland Condition Assessment and Golden Sun Moth Monitoring Event: Block 3 Section 22 Barton ACT	Umwelt (Australia) Pty Ltd	March 2015	Department of Finance	This report presents the results from a survey monitoring event for Natural Temperate Grassland and golden sun moth at the York Park Conservation Area, as recommended by the updated maintenance plan prepared by Umwelt in 2014. The report includes a contemporary assessment of the status and condition trends associated with a range of vegetation and habitat values. It also reports on golden sun moth population numbers, noting that larger numbers were observed. The report recommends revising contracted weed spraying arrangements, undertaking immediate control of African lovegrass within the site, and continuing the implementation of the maintenance plan.	Yes	November - December 2014	population change over time	Monitoring or management required of the land owner	golden sun moth; monitoring; natural temperate grassland; surveys	In Archival Record	In Archival Record	In Archival Record	Umwelt
55	Y	Golden Sun Moth and Natural Temperate Grassland Vegetation Management Plan: Block 3, Section 22, Barton ACT	Umwelt (Australia) Pty Ltd	January 2016	Department of Finance	Umwelt aims to provide an update to the 2013 Maintenance Plan for the York Park Conservation Area (Umwelt, 2014) as well as complete a 2015 monitoring event for golden sun moth and natural temperate grassland. The surveying results indicated a general maintenance of vegetation cover, however, there was an increase in exotic grasses and exotic vegetation generally. Native grasses and overall native vegetation decreased. The report indicates that it would be more appropriate to analyse population trends for golden sun moth in the maintenance plan review in 2020, following ongoing monitoring of the site.	Yes	November - December 2015	population change over time	Studies for development assessment purposes	golden sun moth; monitoring; surveys; maintenance plan	In Archival Record	In Archival Record	In Archival Record	Umwelt
56	Y	Golden Sun Moth Ecological Surveys	Umwelt (Australia) Pty Ltd	April 2018	Department of Finance	This report presents the findings of surveys undertaken by Umwelt for golden sun moth at the York Park Conservation Area. The report also provides an impact assessment for the proposed divestment of the site, which included clearing of all environmental values within the property. The report presents the results of a desktop assessment and surveys targeting golden sun moth undertaken in November and December 2017. These surveys were also undertaken at two other sites in Hall, ACT and Wallaroo Road, NSW, to determine whether they were appropriate offset sites. The results of the surveys indicated that golden sun moth was present at all three sites. Golden sun moth were found to occupy a larger area than previously recorded at York Park , and were confirmed to occur on nearby median strips. The impact assessment determined that impacts to 0.72 hectares of golden sun moth would be significant under the EPBC Act, and would require offsetting.	Yes	November - December 2017	population vulnerability and habitat quality	Monitoring or management required of the land owner	golden sun moth; EPBC Act Referral; surveys; offset; York Park Conservation Area	In Archival Record	In Archival Record	In Archival Record	Umwelt
57	Y	Scientific Heritage Impact Assessment: EPBC Referral 2017/8028	Umwelt (Australia) Pty Ltd	June 2018	Department of Finance	This report provides advice to the Department of Finance on the heritage significance of the Site and was submitted to the Department of the Environment and Energy to support the Preliminary Documentation for the Referral 2017/8028. The assessment concludes that while the York Park Conservation Area does not have national or regional heritage significance, its extensive record of scientific research on golden sun moth indicates that it is of local scientific heritage value.	Yes	N/A	other	Studies for development assessment purposes	scientific heritage assessment; golden sun moth; York Park Conservation Area; scientific heritage	N/A	N/A	N/A	Umwelt
58	Y	Preliminary Documentation Report: EPBC Referral 2017/8028	Umwelt (Australia) Pty Ltd	September 2018	Department of Finance	This report is the complete Preliminary Documentation report submitted to the Department of the Environment and Energy for the divestment of Blocks 3 and 15, Section 22, Barton, otherwise known as the York Park Conservation Area. The report provides a full impact assessment under the impacts of the proposed action to the Site. The report also includes in its appendices the following documentation: - Initial Referral Documentation for 2017/8029 - Initial Referral Documentation and Request for Additional Information - National Capital Plan Amendment 88 - 2018 golden sun moth and impact assessment report - 2018 striped legless lizard ecological and impact assessment report - 2018 Scientific Heritage Assessment and Impact Assessment Report - Social and Economic Impact Assessment - Offset Strategy Report - Response to Public Submissions report	Yes	N/A	other	Studies for development assessment purposes	preliminary documentation; heritage assessment; golden sun moth; York Park Conservation Area	N/A	In Archival Record	In Archival Record	Umwelt
59	Y	2018 Monitoring Report: York Park Conservation Area Blocks 3 and 15, Section 22 Barton ACT 2600	Umwelt Environmental & Social Consultants	June 2019	Department of Finance	This report provides the results of the 2018 monitoring event, undertaken under the management plan for the York Park Conservation Area. The monitoring undertaken was in relation to the extent and quality of vegetation at the site, as well as estimated population of golden sun moth. The report also analyses and compares the 2018 results with previous monitoring events, from 2010-2016. The report concludes that while there was an increase in the extent of native vegetation, there was a possible decline in diversity and underlying grassland condition. Weed invasion is noted as an ongoing pressure to the management of the site. The number of golden sun moth identified within the site was stated to be within the normal fluctuations previously observed. The report recommends that established monitoring timeframes are adhered to, with additional and consistent monitoring events potentially providing more robust results.	Yes	November - December 2018	population change over time	Monitoring or management required of the land owner	golden sun moth; monitoring; natural temperate grassland; surveys	In Archival Record	In Archival Record	In Archival Record	Umwelt

APPENDIX 2

Full Archival Record