Attachment K

Golden Sun Moth Survey and Ecological Assessment of the Dudley Street Road Reserve

Briefing Note

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Subject: Canberra Brickworks and Environs Project: Golden Sun Moth Survey and Ecological Assessment of the Dudley Street Road Reserve

Purpose

To communicate the outcomes of the golden sun moth (*Synemon plana*) survey and brief vegetation assessment completed for the Canberra Brickworks and Environs Project in December 2015 and January 2016.

Outcomes/Key messages

Golden sun moth, listed as critically endangered under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was confirmed to occur throughout the Dudley Street Road Reserve, in areas of both native and exotic grassland.

In this document

1.0 Introduction

Umwelt was engaged in late December 2015 to undertake a targeted survey for golden sun moth within the Dudley Street road reserve in Yarralumla (from Cotter Road to Kent Street, as shown in **Figure 1**) as part of the ongoing Canberra Brickworks and Environs Project.

Despite the relatively late commencement of the work into the golden sun moth flying season, surveys were undertaken generally in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) survey guidelines for this species. However, the short time available to complete the scope of work resulted in some limitations to the application of the methodology and these are discussed further in subsequent sections.

To support the golden sun moth surveys, a brief vegetation survey was also undertaken. This survey focused on the delineation of native and exotic areas in order to confirm the extent of potential golden sun moth habitat. The vegetation component was conducted using a meandering survey methodology, and did not include any quantitative assessment.

Figure 1 – Project Area

2.0 Methodology

2.1 Vegetation Assessment

A Senior Ecologist from Umwelt undertook a meandering survey of the Project Area on 4 January 2016. To address the project objectives, the survey focussed on delineating vegetation types present at a high level, and identifying any potential threatened species' habitat.

Descriptions of each vegetation type were made, and a map (**Figure 2**) was developed based on observations. No quantitative surveys (such as quadrats) were undertaken as a component of the assessment.

2.1.1 Limitations

As no quantitative surveys were completed, and the objective of the vegetation assessment was to identify native and exotic areas, the delineation shown in **Figure 2** is high level, and should only be considered at the scale presented in the provided maps.

2.2 Golden Sun Moth Survey

The EPBC Act Golden Sun Moth survey guidelines (DEWHA 2009a[1]) specify conditions for surveys. They are to be undertaken over a period of four (4) non-consecutive days, with survey days targeted based on suitable climatic conditions (as follows):

- A warm to hot day (above 20°C by 10:00 am);
- The warmest part the day (i.e. between 10:00 am and 2:00 pm);
- Clear or mostly cloudless sky;
- Still or relatively still wind conditions during the survey period;
- ≥ 2 days since rain; and
- Staggered to increase the likelihood of detection given the short adult life span (1-4 days between surveys).

The methodology used involved a meandering survey and point observations. During the meander, whenever a moth was identified, the observer would record the GPS location, and count the number of moths visible in the immediate vicinity.

The entire Project Area was surveyed on each occasion.

All golden sun moth surveys were undertaken by appropriately qualified and experienced Environmental Scientists.

2.2.1 Survey Limitations

Due to Umwelt's engagement after the flying season had already commenced, not all survey efforts were able to be compliant with the survey guidelines. Two survey efforts were completed on consecutive days (18/12 and 19/12) to take advantage of suitable weather conditions. Also, due to cool weather leading up to Christmas, the last survey effort (24/12) was undertaken towards the end of the flying season, which is apparent in the lower number of observations made, and correlation from other reference sites (pers. comm.) across Canberra which noted a decline in observations from Mid-December.

[1] DEWHA (2009a) *Significant impact guidelines for the critically endangered golden sun moth (Synemon plana)*, Department of Environment, Water, Heritage and the Arts (Canberra).

3.0 Results

3.1 Vegetation Assessment

The vegetation assessment identified a range of vegetation types, including areas of natural grassland in various condition classes and areas of highly disturbed exotic grassland. Most of the trees and shrubs present were exotic species.

Native grassland covered 0.8 hectares (17%) of the Project Area. Some areas of grassland were identified as the endangered ecological community *Natural Temperate Grassland of the Southern Tablelands (NSW and ACT)* (natural temperate grassland). These areas were dominated by kangaroo grass (*Themeda triandra)* or mixtures of *T. triandra,* corkscrew grass (*Austrostipa scabra*) and red grass (*Bothriochloa macra*). Other native grasses and a variety of forbs were also present. Forb diversity varied between areas that were highly diverse and intact, to those low in diversity and highly disturbed.

The areas containing exotic landscape tree plantings were mostly typified by ground layer vegetation dominated by exotic grasses, with a minor component of native grasses and some disturbance-tolerant native forbs.

Exotic grassland covered 2.9 hectares (64%) of the Project Area. The areas of exotic grassland covering much of the Project Area were dominated by Chilean needlegrass (*Nassella neesiana*), a noxious weed. Other exotic grasses occur, with African lovegrass (*Eragrostis curvula*), paspalum (*Paspalum dilatatum*) and tall fescue (*Festuca arundinacea*) being the most common. Another noxious weed species, St John's wort (*Hypericum perforatum*) occurred throughout the site in varying densities. Occasional native grasses and disturbance-tolerant native forbs were scattered within the exotic grasslands and under the exotic trees.

Table 1 provides a description of each vegetation type observed within Project Area. This table should be read in conjunction with **Figure 2**, which illustrates the distribution of vegetation, identified by the 'Unit' field below.

Table 1 – Results of Vegetation Survey

Unit	Definition	Description	Approximate Area (ha)	Potential GSM Habitat?
1	Tree plantation, exotic ground layer (not slashed)	Dominated by oaks (*Quercus* spp.) and pines (*Pinus* spp.), with a ground layer dominated by Chilean needlegrass (*Nassella neesiana*). Some minor occurrences of native grasses and forbs, including River Tussock (*Poa labillardierei*), Common Snowgrass (*Poa sieberiana*), Tall Speargrass (*Austrostipa bigeniculata*) and Common Everlastings (*Chrysocephalum apiculatum*), and with scattered St John's Wort (*Hypericum perforatum*), Serrated Tussock (*Nassella trichotoma*), Blackberry (*Rubus fruticosus*) and other exotic grasses and forbs. Trees may provide shelter and feeding habitat for birds, including the NSW Listed Gang-Gang Cockatoo (*Calocephalon fimbriatum*).	0.9	No
2	Exotic grassland (slashed)	Dominated by *N. neesiana*, with other exotic grasses and forbs, including paspalum (*Paspalum dilatatum*), African lovegrass (*Eragrostis curvula*), with scattered *A. bigeniculata* and Monterey pine (*Pinus radiata*).	0.9	Yes
3	Exotic grassland (slashed)	Co-dominated by *N. neesiana, P. dilatatum* and *E. curvula*, with other exotic grasses and forbs, including St John's wort (*Hypericum perforatum*). A cluster of *P. radiata* in the west and a dense planting of Mexican pine (*P. patula*) in the east, and a lone elm (*Ulmus* sp.). Minor occurrences of native grasses and forbs, including *A. bigeniculata, C. apiculatum,* kangaroo grass (*Themeda triandra*), native bindweed (*Convolvulus angustissimus*), red	0.5	Yes

Unit	Definition	Description	Approximate Area (ha)	Potential GSM Habitat?
		grass (*Bothriochloa macra*) and scrambled eggs (*Goodenia pinnatifida*).		
4	Natural Temperate Grassland EEC (slashed)	An area of natural temperate grassland endangered ecological community (NTG EEC), with a co-dominance of native grasses including *T. triandra*, *B. macra,* corkscrew grass (*Austrostipa scabra*) and minor occurrences of *C. apiculatum* and a wallaby grass (*Rytidosperma* sp.). A high cover of *N. neesiana, P. dilatatum*, *E. curvula*, tall fescue (*Festuca arundinacea*) and other exotic grasses and forbs, including *H. perforatum*. The NTG in this unit extends south beyond the Project Area, however the total area is less than 0.1ha, below the minimum patch size for consideration as the EPBC listed ecological community[2].	0.02	Yes
5	Natural Temperate Grassland EEC (slashed)	An area of NTG EEC, with a co-dominance of native grasses including *T. triandra*, *B. macra* and *A. scabra,* and with a moderate diversity of other grasses and forbs, including occurrences of *C. apiculatum, G. pinnatifida,* a wiregrass (*Aristida* sp.), Nodding Saltbush (*Einadia nutans*), Many-flowered Mat-rush (*Lomandra multiflora*), Grassland Wood-sorrel (*Oxalis perennans*) and a native bluebell (*Wahlenbergia* sp.). A moderate cover of *N. neesiana* and *E. curvula*, and some *P. dilatatum,* a lone *R. fruticosus* and several other exotic grasses. Areas of bare ground (c. 5 %) and patches of cryptogams.	0.2	Yes
6	Exotic grassland (slashed)	A large part of this unit is bare ground (an unformed track surface). Grassland co-dominated by *N. neesiana, E. curvula*, and with other exotic grasses and forbs. Scattered native grasses include couch (*Cynodon dactylon*), windmill grass (*Chloris truncata*) and *B. macra*.	0.03	Yes
7	Exotic grassland (slashed)	Co-dominated by *N. neesiana, P. dilatatum*, *E. curvula* and *F. arundinacea*, and with other exotic grasses and forbs. A cluster of densely planted *P. radiata*. Occurrences of disturbance-tolerant native grasses and forbs, including *A. bigeniculata, B. macra, C. dactylon,* weeping grass (*Microlaena stipoides*) *O. perennans* and swamp dock (*Rumex brownii*).	0.2	Unlikely
8	Natural Temperate Grassland EEC (slashed)	An small area of NTG EEC, with a co-dominance of native grasses including *B. macra* and *A. scabra,* with *C. apiculatum* and a moderate cover of *N. neesiana, P. dilatatum*, and other exotic grasses and forbs. The NTG in this unit is less than 0.1 hectares, below the minimum patch size for consideration as the EPBC listed ecological community.	0.02	Yes
9	Exotic grassland (slashed)	Co-dominated by *N. neesiana, P. dilatatum* and *E. curvula*, and with other exotic grasses and forbs. Bordered by ash trees (*Fraxinus* sp.) and Cootamundra wattle (*Acacia baileyana*). Minor occurrences of *T. triandra* and *R. brownii.*	0.05	Yes
10	Natural Temperate Grassland EEC (slashed)	An area of NTG EEC, with a co-dominance of native grasses and forbs, including *T. triandra*, *A. scabra* and with *C. apiculatum, B. macra,* wallaby grasses (*Rytidosperma* spp.), *A. bigeniculata,* New Holland daisy (*Vittadinia muelleri*) and with minor occurrences of *Wahlenbergia* sp., caustic-weed (*Chamaesyce drummondii*), sheep's burr (*Acaena ovina*) and	0.1	Yes

[2] https://www.environment.gov.au/system/files/pages/6a948bae-0207-43a2-a5fe-1b2c8af4861b/files/draft-conservation-advice-temp-grasslands-se-highlands-ne-tablelands.pdf

Unit	Definition	Description	Approximate Area (ha)	Potential GSM Habitat?
		Convolvulus angustissimus. A moderate cover of *N. neesiana, E. curvula*, *P. dilatatum* and with other exotic grasses and forbs. Bare ground between 5 and 30%, apparently caused by slashing too close to the ground. Area partially bounded to the north by *P. radiata*, *A. baileyana* and cotoneaster (*Cotoneaster* sp.). The NTG in this unit extends to the north, beyond the Project Area. It was noted that the current management of NTG to the north of this unit should be reviewed for effectiveness, given the high incidence of *H. perforatum*, some *R. fruticosus* and seedlings of *A. baileyana*.		
11	Exotic grassland (slashed)	Co-dominated by *N. neesiana, P. dilatatum*, *E. curvula* and *F. arundinacea*, and with other exotic grasses and forbs, including *H. perforatum*. Occurrences of disturbance-tolerant native grasses, including *A. scabra, Rytidsoperma* spp.*, B. macra,* and minor occurrences of Native Woodruff (*Asperula conferta*) and *T. triandra,* especially adjacent to the area of NTG.	0.4	Yes
12	Natural Temperate Grassland EEC (not slashed)	A large area of high-quality NTG EEC, with a dominance of *T. triandra* and a diversity of other native grasses and forbs, including, *A. scabra, A. bigeniculata, P. labillardierei*, *P. sieberiana*, wallaby-grasses (*Rytidosperma* spp.), Blue Devil (*Eryngium ovinum*) Variable Plantain (*Plantago varia*), *G. pinnatifida,* and with minor occurrences of *C. apiculatum, R. brownii,* a plume-grass (*Dichelachne* sp.), yellow rush-lily (*Tricoryne elatior*), *Aceana ovina, Asperula conferta,* wattle mat-rush (*Lomandra filiformis*) and *C. angustissimus*. Patchy cover of exotic grasses and forbs, including Wild Oats (*Avena* sp.) and occasional scattered *H. Perforatum*, and a lone Blakely's red gum (*Eucalyptus blakelyi*). The area of NTG extends to the north of the Project Area. This area of NTG is in need of biomass control and weed management.	0.3	Unlikely, due to dominance of *T. triandra*.
13	Natural Temperate Grassland EEC (not slashed)	An area of NTG, dominated by *P. labillardierei* and some *T. triandra,* and with a high cover of exotic annual grasses (mostly *Avena* sp.) and perennial grasses and forbs, including *N. neesiana, P. dilatatum* and *H. perforatum.* This area of NTG is in need of biomass control and weed management.	0.05	Potential
14	Mixed grassland (slashed)	An area of marginal native grassland, co-dominated by *T. triandra, B. macra* and *A. scabra* and with *A. bigeniculata, C. apiculatum* and minor occurrences of small St John's wort (*Hypericum gramineum*), swamp raspwort (*Haloragis heterophylla*), a *Wahlenbergia* sp.*,* and a cudweed (*Euchiton* sp.) and with a high cover of exotic perennial grasses and forbs, including *N. neesiana, P. dilatatum* and *E. curvula.* Includes a cluster of *P. radiata.*	0.2	Potential, however substantial shading by pines limits likelihood of observing flying moths.

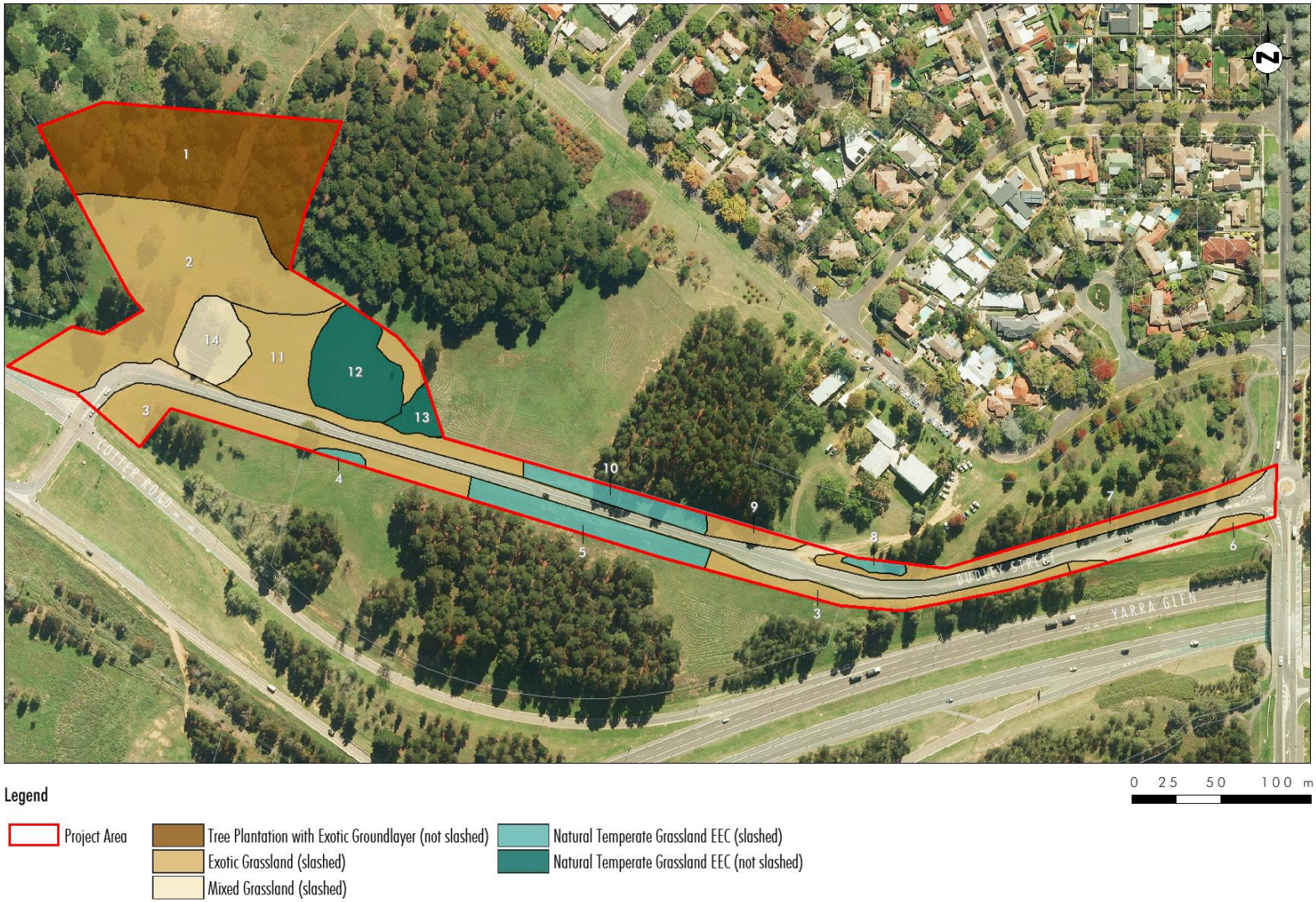

Figure 2 – Vegetation Assessment Results

3.2 Golden Sun Moth Survey

Survey results are shown in **Table 2** and **Figures 3**. The entire Project Area was surveyed on each survey effort.

Table 2 – Survey Details and Results

Date and Time	Weather	Sightings	Notes (Units refer to Figure 2)
16/12/2015 10:30 – 11:10	Slightly cloudy and breezy. Temp: 24°C Wind: 20km/hr ESE Rain: 0mm	37	- 2 moths in Vegetation Unit 6 - 8 moths in Vegetation Unit 6, south of Dudley Street - 8 moths in Vegetation Unit 2, north of Dudley Street - 19 moths in Vegetation Unit 11
18/12/2015 10:30 – 11:05	Clear and sunny. Temp: 28°C Wind: 11km/hr N Rain: 0mm	33	- 6 moths in Vegetation Unit 6, south of Dudley Street - 6 moths in Vegetation Unit 2, north of Dudley Street - 12 moths in Vegetation Unit 11 - 9 moths in Vegetation Unit 9
19/12/2015 11:00 – 11:25	Clear and sunny, breezy. Temp: 31°C Wind: 15km/hr WNW Rain: 0mm	19	- 3 moths in Vegetation Unit 3, south of the Uniting Church - 8 moths in Vegetation Unit 2, north of Dudley Street - 7 moths in Vegetation Unit 11 - 1 moth in Vegetation Unit 9
24/12/2015 10:17 – 10:47	Mostly sunny. Temp: 20.5°C Wind: 15km/hr ESE Rain: 0mm	5	Note: This survey was undertaken towards the end of the flying season, and lower numbers of flying moths was apparent. - 2 moths in Vegetation Unit 6 - 1 moth in Vegetation Unit 6, south of Dudley Street - 2 moths in Vegetation Unit 2, north of Unit 14.

Figure 4 presents the relative quality of golden sun moth habitat, based on the vegetation assessment and moth observations, as summarised in **Table 3**.

Table 3 – Summary of Relative Habitat Quality

Vegetation Type	Comprises Vegetation Units	Relative Number of Moths	Area (ha)
Exotic Grassland	2 and 6	Low	0.9
Exotic Grassland (Chilean Needlegrass Dominated)	3, 9 and 11	Moderate	0.9
Mixed Grassland	14	Absent. Potential Habitat.	0.2
Native Grassland	4, 5, 8 and 10	Moderate	0.3
Natural Temperate Grassland	13	Absent. Potential Habitat.	0.05

Figure 3 – Golden Sun Moth Survey Results

Figure 4 – Relative Quality of Golden Sun Moth Habitat

4.0 Discussion

Based on the wide distribution of golden sun moths throughout the Project Area, the majority of the site has been determined to constitute habitat, albeit of varying quality. Quality has been determined based on vegetation composition and moth observations, as shown in **Table 3** and **Figure 4**.

Sections of the Project Area previously surveyed for golden sun moth (Umwelt, 2014) had been assigned an overall 'moderate' quality based on vegetation quality and historical moth observations. This has been retained as the highest relative quality for the site.

The extent of habitat identified in this survey differs slightly from surveys completed in 2013. This is potentially due to a number of factors, including:

- The high biomass in Vegetation Unit 12 (Natural Temperate Grassland) makes the patch less suitable for golden sun moth. The current dominance of *T. triandra* also makes the patch less suitable for golden sun moth;

- The prevalence of Chilean needlegrass is likely to have increased without appropriate management, increasing the area of suitable habitat[3] for the species; and

- Annual distribution and observations may differ depending on emergence locations, moth flying patterns, weather conditions (e.g. wind blown moths), and other factors as discussed below.

There are inherent limitations associated with this survey method (observing flying male moths) that may also explain some annual variations in habitat mapping. Given females do not fly or fly very short distances, the presence of a male in any given location is not necessarily an indication of the presence of breeding habitat, but that the location is within the flying male dispersal distance from breeding habitat. As males are understood to be able to disperse to within 200 metres of their point of emergence, a margin of error needs to be allowed for in the interpretation of what constitutes golden sun moth habitat. This should also recognise that some locations that are not apparently occupied but otherwise support suitable features for golden sun moth could be regarded as potential habitat if they are functionally connected (adjoining) to areas where females are known to be present. Therefore areas of observed male golden sun moth flight are only considered habitat where suitable foraging habitat is also present.

Based on the surveys conducted in December 2015, there is approximately 2.1 hectares of golden sun moth habitat in the Project Area, and up to 0.25 hectares of potential habitat.

The area is considered to represent moderate quality habitat for the species, in addition to containing other ecological values, including areas of the natural temperate grassland endangered ecological community.

References

DEWHA (2009) *Significant impact guidelines for the critically endangered golden sun moth (Synemon plana)*, Department of Environment, Water, Heritage and the Arts (Canberra).

Richter A, Osbourne W & Tragoutt M (2010) *Dietary specialisation in the Golden Sun Moth Synemon plana – the key to understanding habitat requirements and site rehabilitation for this critically endangered species,* final report to Biodiversity and Programs Branch, Department of Sustainability and Environment (Victoria).

Umwelt (2014) *Canberra Brickworks and Environs Ecological Assessment*, report to the Land Development Agency, Canberra.

[3] Recent studies have shown that golden sun moth, which was previously understood to be a native grassland specialist, also occurs within stands of *N. neesiana*, due to a lifecycle dependence on C3 grasses (cool season or year-long-growing grasses) (Richter *et al*., 2010).