

Appendix 1. EPBC Approval Decision

The approval decision is available at the [Department of Environment](#) website.

Appendix 2. Striped Legless Lizard Advice (Osborne, 2013)



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Institute for Applied Ecology
Ecological Solutions for a Healthy Environment



Suitability of proposed offset areas at Gungahlin for Striped Legless Lizards – extent of habitat, management prescriptions and monitoring

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Introduction

The Striped Legless Lizard (*Delma impar*) is recognised as a globally threatened species (IUCN, 2011) and is listed as Vulnerable at a national level in Australia (Environment Protection and Biodiversity Conservation Act 1999). It is also listed as Vulnerable in the ACT. There are large populations of this vulnerable species in the central and eastern Gungahlin area and much smaller populations in the Majura and Jerrabomberra valleys (ACT Government 1997; Biosis 2012; Eco Logical 2013; M. Evans and M. Mulvaney ACT Government pers. comm.). Very substantial populations in the ACT are protected within three large grassland reserves at Gungahlin (Crace, Mulanggari and Gungaderra reserves) (Rauhala *et al.* 1995). The species also occurs in Jerrabomberra East Nature Reserve but at a much lower density (BIOSIS 2012). Populations are present in areas of non-reserved land at Kenny in Gungahlin, and in the Majura Valley, parts of Symonston and on the eastern side of Fyshwick (M. Mulvaney pers. comm.; Biosis 2012).

The proposed development of block 799, Section 0, in Gungahlin (immediately south-west of Kenny) was assessed by the Commonwealth Government to be a controlled action under the Environment Protection and Biodiversity Conservation Act 1999. It was determined that the proposed development required an offset to compensate for impact on striped legless lizards. As part of the broader strategy for conservation of the striped legless lizard at Gungahlin, and in the context of particular offset requirements, I was contracted by UWELT (Canberra) to consider and evaluate the suitability of the two offset areas: (1) broad acre land on the northern boundary of Gungaderra Nature Reserve (referred to as former Crace asbestos dump) and Block 1 section 221 which is a parcel of land adjoining the western side of Mulanggari Nature Reserve (Figures 1 and 2). Specifically I was requested to:

1. Determine what portion of these areas would respectively be considered habitat for striped legless lizard.
2. Determine what action should be incorporated into a management plan for striped legless lizards in both areas such that the long-term suitability of the habitat this species can be maintained
3. Describe an appropriate monitoring regime for both areas.
4. Determine whether any other considerations should be taken into account.

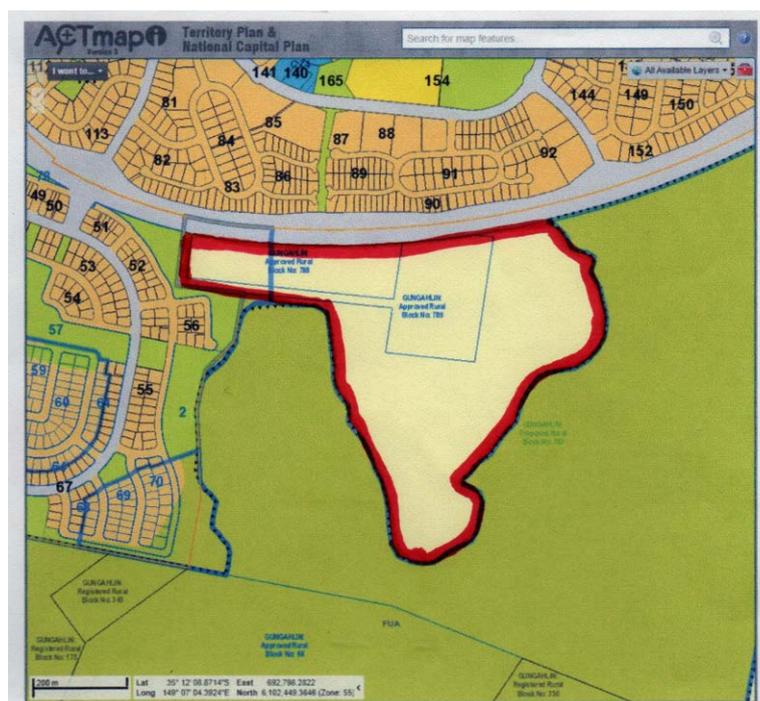


Figure 1. Proposed offset area (enclosed by red line) adjacent to Nudurr Drive and Gungaharra Nature Reserve.

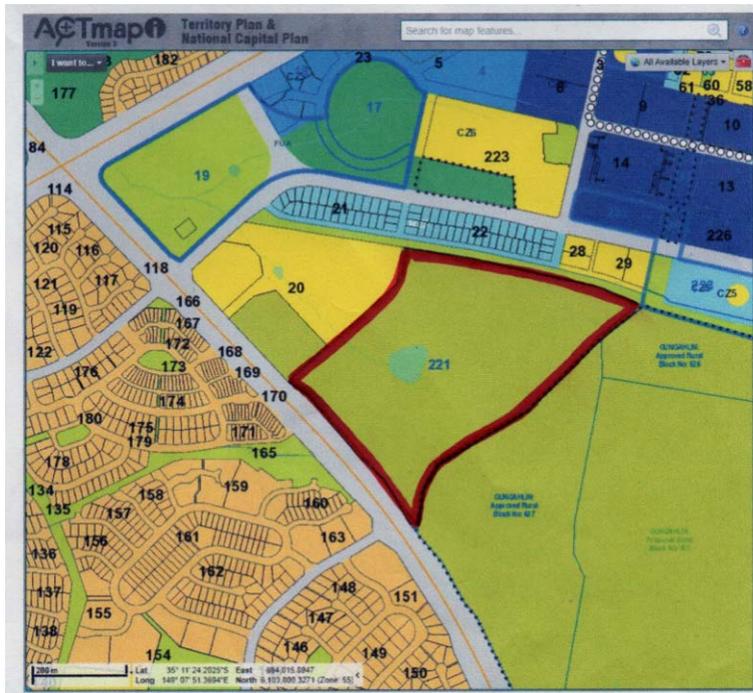


Figure 2. Proposed offset area (enclosed by red line) adjacent to Gungahlin Drive and Mulangari Nature reserve.

What constitutes suitable habitat?

In order to consider the appropriateness of habitat in the areas proposed as offsets for Striped Legless Lizards at Gungahlin it is important that there is a clear understanding as to what designates potential habitat, particularly in terms of vegetation structure, floristics, landform and soil properties. Most of these features are now reasonably well known for sites with the species in the ACT (e.g. Rauhala *et al.* 1995; Dorrrough and Ash 1999; Dunford *et al.* 2001; Biosis 2012) and a more inclusive general description of its habitat is available (M. Evans unpublished ms). Unfortunately, detailed botanical descriptions of sites with the lizards are not yet available in published form despite several extensive surveys being conducted that included quadrat-based information (listings of species of plants and their abundance) (Rauhala *et al.* 1995; Dorrrough 1995; Biosis 2012). Fortunately much of this data has been analysed and modelled (Dorrrough and Ash 1999) and provides important ecological information on the factors that appear to be limiting the distribution of the species in the ACT.

In the past, the species was thought to be a native grassland specialist occurring only in native tussock grasslands dominated by plant species such as *Austrostipa bigeniculata* (tall spear grass) and *Themeda triandra* (kangaroo grass) (e.g. Osborne *et al.* 1983; Coulson 1990). These grassland types are still considered to be the primary habitat for the species (Dorrrough and Ash 1999; O'Shea 2005, 2013; Evans unpublished ms.), and this is therefore of importance in the mapping and conservation of regional populations of striped legless lizards (Candy 2008). Grasses that comprise the main tussock over storey (the major ground cover) in native grasslands (and native pasture) where Striped Legless Lizards have been recorded in the ACT include Tall Spear Grass (*Austrostipa bigeniculata*), Kangaroo Grass (*Themeda australis*), Wallaby Grasses (*Rytidosperma* spp.) and Red-leg Grass (*Bothriochloa macra*). Recent surveys also indicate that breeding populations of Striped Legless Lizard can survive in some exotic tussock grasslands that are contiguous with, or near, occupied sites in

native pasture or native grassland (see review by Evans unpublished ms for details). In the ACT large breeding populations have been found in grasslands dominated by *Phalaris aquatica*. These sites also often include other introduced grasses such as Cocksfoot (*Dactylus glomerata*), Brome Grass (*Bromus* spp.), Wild Oats (*Avena* sp) and Yorkshire Fog Grass (*Holcus lanatus*) (e.g. Rauhala *et al.* 1995, Nunan 1995; Dunford *et al.* 2001; Biosis 2012). It is now considered that the presence of a relatively dense and continuous structure of moderate to tall tussock grasses, rather than the floristic composition of the grasslands, may be a more important factor in determining the occurrence of the species (Dorrrough and Ash 1999; O'Shea 2013).

It has been assumed that Striped Legless Lizards shelter mainly in grass tussocks and other thick ground cover. However, individuals have been found in soil cracks and arthropod burrows. Recent observations after ploughing of salvage sites near Yea in Victoria indicate that the species very commonly occurs below the surface of the soil (R. Retallick, Senior Zoologist, GHD pers. comm.).

Dorrrough (1995) and Dorrrough and Ash (1999) considered that disturbances such as ploughing and denudation of ground cover through heavy grazing have had a major influence on the occurrence of the species, regardless of vegetation composition. Therefore the survival of populations in areas that are still subject to such disturbances may be influenced by the availability of suitable shelter and refuge sites (undisturbed locations, rock outcrops, cracks in the soil etc). As suggested by Kukolic (1994) and Rauhala *et al.* (1995) this shelter may also be provided by plant species that are relatively unpalatable to stock. However, during very hot weather in mid summer, air temperatures within the shelter of tussocks are likely at times to be above the lethal limits for reptiles (Nelson 2004). During hot, dry weather, the presence of cracks in the soil and arthropod burrows may be the essential structural features of the habitat that allow for the survival of individuals. Such refuges are also likely to be important for protection during fires (O'Shea 2013).

Occurrence of breeding populations of Striped Legless Lizards in the proposed offset areas

Striped Legless Lizards were first recorded in the Mulanggari proposed offset (Block 1 Section 221) during surveys conducted twenty years ago by the ACT Government (Kukolic *et al.* 1994; Rauhala *et al.* 1995 ; see also Williams *et al.* 1995 for a planning perspective). Three survey locations were trapped within the offset area and Striped Legless Lizards were caught at one location in a drainage line. The species was also recorded at this time near the (modern) boundary of the Gungaharra proposed offset (Crace asbestos dump and associated broadacre) and at several nearby locations in what is now Gungaharra Nature Reserve (Kukolic *et al.* 1994). These locations can be seen in the maps included in the report by Williams *et al.* 1995).

Recent surveys have confirmed the presence of the lizards in each of the proposed offset areas (Biosis 2012; Eco Logical 2013).

Block 1 section 221 (Mulanggari). Eco Logical (2013) captured the species at two locations within this proposed offset on the west side of Mulanggari Nature Reserve. Many individuals were detected on two (paired) grids established in native pasture at the northwestern corner of the area. By contrast they recorded no individuals and very low numbers of individuals respectively on two grids established in a low-lying area dominated by *Phalaris* in the centre of the block. It is possible that these areas are prone to water-logging during wetter periods. Eco Logical (2013) recorded a high abundance of the species in Mulanggari Nature Reserve and Biosis (2012) recorded a very high abundance of the species on grids placed immediately to the North East of the proposed offset near the Town Centre. It is therefore

very likely that Striped Legless Lizards occur throughout the better-drained parts of Block 1 Section 221.

Crace asbestos dump and associated broadacre. Biosis (2012) were responsible for the survey of this area. Striped Legless Lizards were detected at all seven tile grids established in the proposed offset area, and high densities were recorded at five of these sites. Based on vegetation structure and cover, Biosis (2012) concluded that the species could potentially occur throughout the entire proposed offset area. A recent survey by Eco Logical (2013) confirms that Striped Legless Lizards are still abundant in Gungaherra Nature Reserve and this adds strength to the Biosis conclusion.

A brief evaluation of the extent of potential habitat in the two proposed offset areas is presented in next section.

The extent of potential habitat in the offset areas.

Habitat condition was examined qualitatively by visual inspection in order to prepare generalised maps showing habitat quality. Five broad classifications were used based on grassland structure, dominant species and position in the landscape: (a) native pasture, (b) exotic pasture, (c) tall exotic pasture (typically *Phalaris*), (d) very low-open native grassland (cleared or disturbed woodland sites now dominated by low-growing plants such as *Rytidosperma*, *Chrysocephalum* and *Lomandra*) and (e) seepage lines dominated by a combination of rushes, sedges and *Phalaris* (in some areas Tall Fescue (*Festuca arundinaceum*) also dominates seepage lines). Woodland was not included in the mapping.

Block 1 Section 221 (Mulanggari)

Block 1 Section 221 was originally included by Williams *et al* (1995) in the maximum feasible grassland conservation area for the Gungahlin Central Area (Mulanggari NR) (Figure 3). However the western extent of the area including the proposed offset area was not included in the reserve because of the poor quality of grassland in this area (Rauhala *et al.* 1995). Since this time a reduction in the intensity of livestock grazing has led to an improvement in grassland condition in the proposed offset area and 6.9 ha of native pasture (mainly the northern portion of the area) would be considered to be suitable for maintaining high densities of Striped Legless Lizard (Figure 4). Well-drained areas with a moderate cover of disturbed native pasture (more open grassland that includes a higher proportion of introduced pasture grasses) totalling 8 ha occurs on the southern and eastern side of the offset area north of Gungahlin Drive. This area is likely to be suitable for striped legless lizards, but at a lower likely density (there is still a need to confirm the presence of striped legless lizards in this area). The presence of Striped Legless Lizards has been confirmed for the low-lying seepage areas (Eco Logical 2013) (Area 4 in Figure 3), but at a very low density as would be expected considering that these areas are seasonally waterlogged. The low-lying areas total 8.7 ha.

Extremely dense patches of *Phalaris* and Tall Fescue at the western end of the seepage line and surrounding a farm dam are unlikely to be used by the species on a regular basis – this is because of the extent of water-logging in this area in winter and spring and during prolonged wet weather. Individuals may still move through these areas at times, particularly if herbivore grazing leads to a more open grass structure. It is possible that individuals will shelter in these areas during drought (Kukolic *et al.* 1994). Biosis (2012) attained high capture rates in dense *Phalaris* near the Gungahlin Town Centre so these areas can be considered to provide suitable habitat if they are not subject to water-logging (R. Spiers, Biosis, pers. comm.).

In conclusion the proposed offset area (Block 1 Section 221) provides 14.9 ha of suitable habitat (both exotic grassland and native pasture) that is occupied by Striped Legless Lizards

and potentially can be used on a year-round basis. Importantly it features some elements landscape diversity that includes moister low-lying seepage lines (a further 8.7 ha) and both northerly and southerly aspects. The total area of potential habitat that could be occupied year-round is at least 14.9 ha. A further 8.7 ha of low lying grassland would provide potential habitat of a more seasonal nature (e.g. shelter during droughts). The proposed offset has a broad (700m) edge that connects directly with Mulanggari Nature Reserve allowing for a direct expansion and buffering of the population in this area.

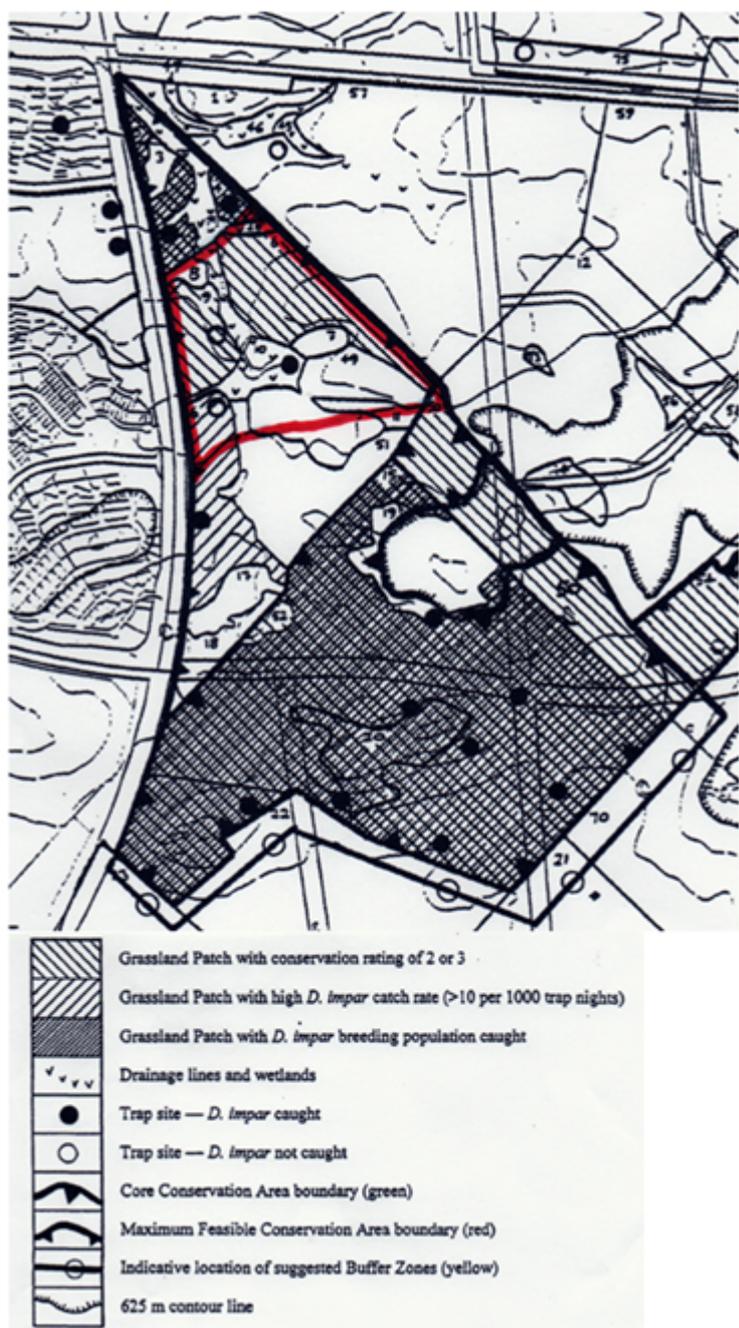


Figure 3. Conservation assessment by Williams *et al.* (1995) for Striped Legless Lizards at Gungahlin Central (Mulanggari) – analysis based on data provided by the ACT Government. Despite being heavily grazed by livestock at the time, the proposed offset area (outlined in red) contained some grassland with a high conservation ranking (patches 6 and 9) and some areas with a high catch rate for Striped Legless Lizards. The area was excluded by the ACT Government from the final reserve designation because of the extensive areas of poor quality grassland in patches 7, 49, 11, 51, 17 and 18 which were thought to provide a

substantial barrier and because of the very small extent of high quality grassland to the west of the proposed offset area. Despite recent surveys it is still not known if the patches of poor quality grassland support Striped Legless Lizards.



Figure 4. Generalised map showing extent and condition of potential habitat for Striped Legless Lizards in the Block 1 Section 221 (Mulanggari) proposed offset area. Mapping based on a visual inspection by W. Osborne in April 2013. 1. Native pasture (*Austrostipa* – *Bothriochloa* – *Microleana*) – high density of SLL recorded by Eco Logical (2013);

2. Disturbed native pasture and exotic pasture – density of SLL unknown; 3. Low-lying seepage area with dense tall exotic grassland (mainly *Phalaris*) – low density of SLL recorded; 4. Low-lying area with disturbed native pasture and exotic pasture – low density of SLL recorded. Striped Legless Lizards could potentially occur throughout the proposed offset area, but abundance is likely to be highest in Area 1 and very low in Area 3. The species is known to occur in areas 1, 3 and 4 (Eco Logical 2013) but further surveys are required to confirm the occurrence of the lizards in areas marked as 2.

Crace broadacre and asbestos dump site (Gungahlerra)

The Crace Broadacre and asbestos dump-site was not included by Williams *et al* (1995) in the maximum feasible grassland conservation area for the Gungahlin Central Area (Gungahlerra NR) (Figure 5). The data available to the ACT Government at that time indicated (mistakenly) that the area was above the maximum elevation that Striped Legless Lizards were thought to occupy in the ACT. Recent surveys by Biosis (2012) have indicated that a very substantial population of Striped Legless Lizards in fact occurs throughout the proposed offset area, including in areas that were originally used as an asbestos dump-site and re-vegetated with *Phalaris*. An estimated 15.6 ha of the proposed offset area has a moderate to high density cover of *Phalaris* (Figure 6), and this area provides suitable habitat for a high density, breeding population of Striped Legless Lizards (Biosis 2012). Moderate to high densities of the species also occur in areas of native pasture on the southeast and southwest sides of the low hill in the middle of the proposed offset area (Biosis 2012) – the

combined area of native pasture is 8.3 ha. An additional 2.6 ha of regenerating Yellow Box woodland is not included as potential habitat.

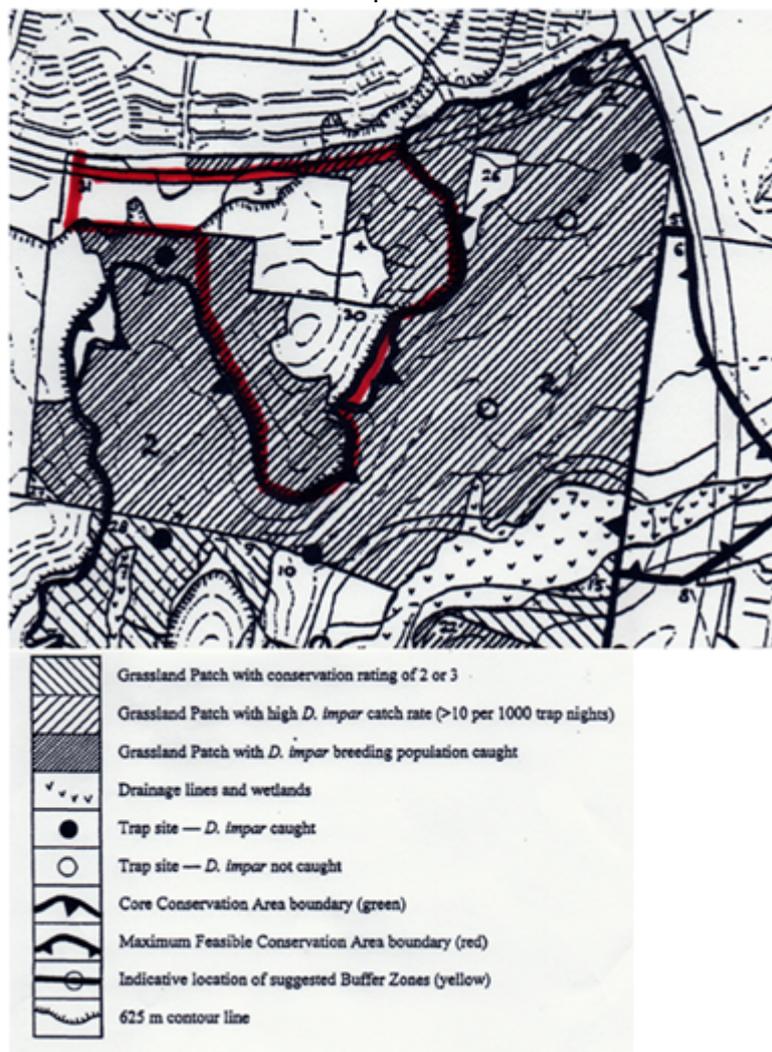


Figure 5. Conservation zones recommended by Williams *et al.* (1995) for Striped Legless Lizards at the northern portion of Gungaharra Nature Reserve – analysis based on data provided by the ACT Government. These authors recommended the exclusion of the proposed offset area because it was (erroneously) thought to be above the predicted altitudinal limit for the Striped Legless Lizard and included extensive areas of exotic grassland also thought to be unsuitable for conservation of Striped Legless Lizards.

Based on their assessment of vegetation cover, Biosis (2012) suggested that Striped Legless Lizards could occur throughout the offset area. I agree with this, but suggest that areas of sparse low ground cover associated with the southern and western slopes of the central hill and ridge (totalling 6.2 ha) do not provide enough groundcover to support resident populations. These areas are unlikely to be suitable for breeding populations of the species. Even so, it is very likely that individuals will regularly move through this part of the landscape during favourable periods, particularly at times when vegetation cover is taller and the grass sward more intact. This southern ridge area also has very skeletal gravelly soils, and prior to land clearing would have been mainly Red Stringybark woodland (Biosis 2012). It is unlikely that it could be rehabilitated to a more suitable habitat for the Striped Legless Lizard.



Figure 6. Generalised map showing extent and condition of potential habitat for Striped Legless Lizards in the Crace Broadacre and asbestos dump site (Gungaharra) proposed offset area. Based on a visual inspection by W. Osborne in April 2013. 1. Regenerating Yellow Box – Blakely’s Red Gum woodland; 2. Tall exotic grassland dominated by *Phalaris* – high density of SLL present (Biosis 2012); 3. Highly disturbed native pasture; SLL likely to be in high numbers due to captures nearby by Biosis (2012); 4. native pasture (*Austrostipa* – *Bothriochloa* – *Microleana*) – SLL recorded in high densities (Biosis 2012); 5. Low grassland (*Rytidosperma*, Wallaby Grasses) lithosolic soil surface (rocky) and bare ground. Not known if SLL occur in this area. It is unlikely to provide enough cover to support populations although individuals could potentially disperse through this area.

In summary 23.9 ha of the proposed offset at Crace Broadacre and asbestos dump-site provides suitable year-round habitat for Striped Legless Lizards. The proposed offset area is highly suited to the conservation of breeding populations of the Striped Legless Lizard. It provides extensive areas of suitable habitat (mainly tall exotic grassland) that is occupied by breeding populations of Striped Legless Lizards. Importantly it includes landscape diversity that includes a broad north-south lying ridgeline. The proposed offset has an extensive and convoluted (approx 2.4 km) edge that connects directly with Gungaharra Nature Reserve. Inclusion of the proposed offset area within the nature reserve would facilitate better management of the area and would substantially reduce edge effects.

Additional survey action

1. Confirm full extent of occurrence of Striped Legless Lizards in Block 1 section 221. It is not known if Striped Legless Lizards occupy the more disturbed native pasture areas on the southern and eastern parts of this proposed offset area (marked as area 2 in Figure 4). Because these areas are extensive a follow up survey should be given a high priority. It is expected, given the results in Area 1 that the species will occur in these areas as well, but perhaps at lower density.

Selected management actions recommended for maintaining suitable habitat

For a comprehensive account of general management requirements for the conservation of Striped Legless Lizards see Smith and Robertson (1999) and more generally for natural temperate grassland (ACT Government 2005 – particularly Section 3 Lowland Native Grassland: Planning and Management for Conservation). I do not propose to re list these broad management guidelines, as they are readily available in these reports. Instead I present an account of the most important issues for the two proposed offset areas.

The availability of suitable grassland habitat is critical to the conservation of Striped Legless Lizards (Coulson 1995; Smith and Robertson 1999). Of greatest importance in managing grasslands as habitat for this species is the need to provide adequate structure, and the need to minimise mowing, and to put in place appropriate grazing and burning regimes. Tree planting should be prevented.

Undertake appropriate biomass management

Biomass reduction is an important feature of the ecology of natural temperate grasslands (Morgan and Lunt 1999). This is because unmanaged grasslands that lack herbivores can result in the widespread senescence of the grass tussocks. A similar situation is likely to occur also in native pasture. To prevent grasslands from becoming overgrown and senescent regular biomass reduction is required with a frequency of no less than every six years for native grassland (Morgan and Lunt 1999). In native pasture, and sites with higher nutrient status, biomass reduction may have to occur more regularly at intervals of 3 to 5 years (O'Shea 2013).

Biomass reduction can be achieved in three main ways:

1. Mowing and slashing
2. herbivore grazing (including kangaroos and livestock); and
3. burning.

There are inherent risks to Striped Legless Lizards from each of the forms of biomass reduction (O'Shea 2013). Spring fires and heavy grazing that are too frequent or intense may have a negative effective on the species survival at individual sites. Despite these concerns it is clear that some form of biomass management is important for managing the habitat of the lizards (Candy 2008; O'Shea 2013). Where grazing has been part of ongoing management for many decades, past grazing regimes should be continued, with monitoring of stocking rates, ground cover and weed species to ensure suitable habitat is maintained (O'Shea 2013)

Biomass should be managed to avoid the complete loss of grass tussock structure (heavy grazing or overgrazing), and conversely to avoid the formation of dense, senescent grasslands (a prolonged absence of grazing or fire for greater than about five years).

Mowing is likely to be a less suitable method for biomass reduction because it leads to an even sward height in the grassland (reducing habitat structural diversity) and there is a very high risk of the accidental introduction of weeds such as the highly invasive African Love Grass. If mowing or slashing is to be used, mowing height should be set at approximately 10-20 cm to maintain suitable structure, and slash raked and removed.

Patch burning is an acceptable method for biomass reduction in grasslands, but requires more research to determine its impact on Striped Legless Lizards. Burning has been used

successfully at many sites in western Victoria where it is used for fuel reduction purposes. Observations at the burnt sites indicate that Striped Legless Lizards continue to survive at those sites (Candy 2008; O’Shea 2013). The availability of nearby unburnt patches or sites is likely to be essential to the survival of populations during the period that grass cover is recovering.

Establish appropriate burning practices and regimes

There is evidence from Victoria that the use of fire correlates with a subsequent increased abundance of Striped Legless Lizards; however this may simply be a result of the easier detection of the species in the low burnt groundcover following burning. Nevertheless the current view from Victoria is that fire is a very important component of the appropriate management of native grasslands that support Striped Legless Lizards (O’Shea 2013).

Where burning has been used previously as a management technique Smith and Robertson (1999) recommend that burning be continued in a mosaic pattern at intervals of between three and five years. Burning should not be conducted during the known above ground activity period of the species in the ACT (September – February).

Prevent and control weed invasion

Weeds present a very serious threat to the habitat. As weeds spread and become entrenched they have the potential to dominate grasslands leading to major changes in vegetation structure and the composition of the arthropod fauna (Richter 2011). Although the Striped Legless Lizards appear to survive quite well in some structurally tall exotic grasslands such as Phalaris (where they feed on alternative invertebrate prey such as grasshoppers; Nunan 1995) it is very unlikely that the lizards would survive in grasslands dominated by highly unpalatable species such as African Love Grass and Serrated Tussock which form dense monocultures that are devoid of invertebrate prey. There are outbreaks of African Love Grass, Serrated Tussock, Chilean Needle Grass and Tall Fescue in parts of the two proposed offset areas. Extreme vigilance involving a carefully planned and implemented monitoring and control programme is required for the early detection and control of weeds before they become an expensive or unmanageable problem. Such a program should be assigned the highest possible priority and budgets for ongoing management of Park resources.

Prevent the further spread of tall large tussock-forming exotic grasses

Although Striped Legless lizards can survive and breed in patches of Phalaris (Biosis 2012), the extensive and ongoing spread of this invasive pasture grass (and Paspalum and Tall Fescue) in the Gungahlin grassland reserves network occurs at the expense of other important elements of biodiversity. In particular the spread of these grasses threatens natural temperate grassland areas and the habitat of Golden Sun Moths, grassland birds and reptiles. This is most evident in the Crace Nature Reserve where the area invaded by Phalaris has expanded very extensively in the past 20 years.

Prevent tree planting within Striped Legless Lizard habitat

Trees should not be planted in grasslands occupied by Striped Legless Lizards. Tree regeneration should also be suppressed if the sites are to be maintained as grassland.

Control feral animals such as cats, dogs and foxes

Introduced predators like cats and foxes regularly include native reptiles in their diet. In the ACT, owners with newly established houses near grassland in Gungahlin have reported that

their pet cats have captured large numbers of legless lizards (W. Osborne unpublished records). Cats and foxes should be controlled in these grassland areas.

Confirming whether the offset areas have been successful for the conservation of striped legless lizards

Surveys conducted by Biosis in 2012 and Eco Logical in 2013 provide samples that can be used to describe the relative abundance of striped legless lizard populations before the change of land tenure. They provide recent benchmark samples for each of the proposed offset areas before the land was incorporated into Canberra Nature Park or similar reserve. The strength of these samples as a baseline is increased when considered in the context of the extensive former surveys conducted by the ACT Government. In order to determine whether, in the longer term, the populations continue to flourish within the proposed offset areas, a program of additional surveys is required. The specific aim of these follow up surveys will be to determine whether the populations in the proposed offset areas continue to survive into the future, and to determine the extent of any changes in relative abundance with respect to the benchmark surveys and surveys conducted at sites in the adjacent grassland nature reserves.

To facilitate this program, repeat surveys should be conducted three years after the change of land tenure and then once every five years for at least 20 years. At that time the conservation status of the species in the ACT region, and the need for a continuation of surveys, should be re-assessed. To obtain a more reliable inter-annual measure of pre-change of tenure relative abundance, two additional sites should be selected for survey within the Mulanggari proposed offset (Block 1, section 221 (giving a total of four sites), and the seven sites at Gungaharra proposed offset area (Crace Asbestos Dump area) should be re-surveyed providing a second sample as soon as possible (preferably in early summer 2013).

The techniques for surveying striped legless lizards in the ACT, and elsewhere, are well known now, having been based on the work of O'Shea (2005). Procedures are clearly prescribed by the ACT Government (2011) and by the Commonwealth Government (DSEWPC 2011). They essentially involve the use of arrays of roofing tiles set out in 10 x 5 grids that occupy an area 50 x 25 m. There are specific conditions involved in the checking of these arrays that involve consideration of season, time-of-day, air temperature and temperature under the tiles. It is essential that these procedures be undertaken by experts and that the procedures be rigorously followed.

To reduce the impact of hand capture on the lizards (for example a high incidence of tail loss can occur during capture and subsequent handling if staff are inexperienced; M. Mulvaney pers. comm.) I recommend that individuals only be captured if identification cannot be made readily by direct visual observation (i.e. prior to capture). This will result in the mean number of detections per grid per day being the measurement that is used for comparison. This will save considerable time that would no longer be spent handling, measuring and photographing individuals. However before this is adopted, a check should be made to see that there is a reliable relationship between the number of detections of striped legless lizards per check day/site (as an index of relative abundance) and the actual number of individuals captured.

Acknowledgements

Peter Cowper of Umwelt requested that I undertake this consultancy and provided GIS data and useful information. Michael Mulvaney (Conservation Planning and Research, ACT

Government) provided helpful information on the sites and provided copies of consultancy reports that I had not seen previously. Murray Evans (Conservation Planning and Research, ACT Government) kindly allowed me to refer to his unpublished manuscript on the conservation of Striped Legless Lizards in the ACT. Robert Speirs from Biosis provided additional quantitative data on grassland floristic composition.

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Plate 1. High quality native pasture / native grassland in Area 1 Block 1 Section 2221 west of Mulanggari Nature reserve. Grassland known to support a high density of Striped Legless Lizards (Eco Logical 2013).



Plate 2. Introduced pasture dominated by a tall dense cover of Phalaris grassland on the north-western side of the proposed offset area north of Gungaharra Nature Reserve. Grassland known to support a high density of Striped Legless Lizards (Biosis 2012).



Plate 3. A small patch of native pasture (dominated by *Austrostipa*) in Area 3 (see Figure 6) north of Gungaharra Nature Reserve. This patch would be a suitable location for directed effort to control the further spread of *Phalaris*. Surrounding grassland known to support a high density of Striped Legless Lizards (Biosis 2012).



Plate 4. Short open native grassland (Area 5 on Figure 6) to the immediate north of Gungaharra Nature Reserve that due to a lack of cover may not support breeding populations of Striped Legless Lizards. It is very likely that the species would still move through this area.



Plate 5. Survey grid site (using roof tiles) used by Biosis to determine relative abundance of Striped Legless Lizards. This site would be suitable as a long term monitoring site.