

**ACT**  
Government

# Striped Legless Lizard Habitat Improvement Plan

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A plan for the management, monitoring and improvement of Striped Legless Lizard, *Delma impar*, habitat in the Gungahlin Strategic Assessment area

Plan Implementation Team for the Gungahlin Strategic Assessment Biodiversity Plan  
March 2015

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## Version control

<b>Revision</b>	<b>Revision date</b>	<b>Details</b>	<b>Authorisation Name/position</b>
0.1	5 June 2014	Initial Draft	Michael Mulvaney, Conservation Planning and Research, Environment and Planning Directorate
1.0	21 October 2014	Submission to Commonwealth Department of the Environment	Dan Stewart/Deputy Director-General, Economic Development Directorate
2.0	March 2015	Submission to Commonwealth Department of the Environment	Dan Stewart/Deputy Director-General, Economic Development Directorate

## Acknowledgments

The Plan Implementation Team would like to acknowledge the significant contribution to the development and production of this document by Michael Mulvaney, Conservation, Planning and Research, Environment and Planning Directorate, ACT Government.

## List of Abbreviations

ACT	Australian Capital Territory
CEMP	Construction Environment Management Plan (interchangeable with EMP)
CPR	Conservation Planning and Research unit (under EPD)
CMTEDD	Chief Minister, Treasury and Economic Development Directorate
DoE	Department of the Environment (Commonwealth) previously SEWPaC
ED	Economic Development (Part of CMTEDD)
EDP	Estate Development Plan
EIS	Environmental Impact Statement
EP Act	<i>Environment Protection Act 1997 (ACT)</i>
EPA	Environment Protection Agency
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Cwth)</i>
EPIP Act	<i>Environment Protection (Impact of Proposals) Act 1974 (Cwth, repealed)</i>
EMP	Environment Management Plan (interchangeable with CEMP)
ESA	Emergency Services Authority
EPD	Environment and Planning Directorate (Previously Environment and Sustainable Development Directorate)
LDA	Land Development Agency (under CMTEDD)
MNES	Matters of National Environmental Significance
NC Act	<i>Nature Conservation Act 1980 (ACT)</i>
NCA	National Capital Authority
NCP	National Capital Plan
NSW	New South Wales
PA	Preliminary Assessment
PALM Act	<i>Australian Capital Territory (Planning and Land Management) Act 1988 (Cwth)</i>
PD Act	<i>Planning and Development Act 2007 (ACT)</i>
PIT	Plan Implementation Team
SEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities (currently Commonwealth Department of the Environment)
TaMS	Territory and Municipal Services Directorate

## General Introduction

The Gungahlin Strategic Assessment Biodiversity Plan (the Plan) commits the ACT Government to maintain and improve, Matters of National Environmental Significance (MNES) within set aside conservation areas. The relevant matters are:

- White Box - Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Woodland),
- Golden Sun Moth, *Synemon plana* (GSM),
- Superb Parrot *Polytelis swainsonii* and
- Striped Legless Lizard, *Delma impar* (SLL).

The basic measures within the Plan to maintain and improve habitat include:

- Reservation of lands that support habitat for MNES that have previously been identified for urban purposes;
- increased investment in habitat enhancement beyond the minimum level required under the Territory's statutory obligation' and
- increased investment in research targeted at the affected MNES and guided by action planning objectives.

Habitat improvement plans have been prepared for each of the MNES. These plans:

- describe the current extent, condition and or population size of a particular value;
- outline what actions will be taken to seek improvement in condition, extent or population size;
- detail how improvements will be measured, monitored and reported;
- detail the research focus areas;
- contain commitments to adapt management depending on research results; and
- outline potential remedial actions should monitoring indicate a decline in a MNES matter

Over much of the offset areas, there is an overlap in the distribution of MNES values. Management favouring one particular value may not always be compatible with actions that enhance another value. For example, the condition of Box Gum woodland can be improved by encouraging regeneration of sapling and tree growth, but the shading that would result from this regrowth may reduce habitat suitable for the GSM or SLL, which are essentially grassland species.

Therefore the plans define where a matter of interest will be the primary focus of improvement actions and where they will be a secondary consideration.

While the plans outline and list the management actions that will be undertaken for particular MNES values, details on how management actions will be implemented will be included within Offset Management Plans that are required as part of the Strategic Assessment approval.

## Outcome commitments within the Plan relevant to Striped Legless Lizard

The Plan includes a committed outcome to the persistence of a viable population at Kenny and no net reduction over the life of the Plan in areas occupied by Striped Legless Lizard in reserved populations. Mechanisms to contribute to this outcome include:

- Establishment of a nature reserve in west Kenny (160ha) to protect a fourth important population of striped legless lizard in Gungahlin;
- Prior to the construction of Kenny, commence management of a nature reserve in Kenny;
- Habitat improvement of 111ha of habitat through conservation grazing, weed control and other measures; and
- Declaration of cat containment areas.

Under the Plan up to 20 ha of habitat can be removed at the Gungahlin Town Centre and for stormwater control and infrastructure at Kenny. 118 ha of known habitat will be reserved at Kenny and Kenny Broadacre. The Plan offsets >500% of the impact for striped legless lizard, well exceeding the 90% target described by the EPBC Offsets policy.

## Extent of habitat

Prior to European settlement the striped legless lizard was most likely distributed broadly in south-eastern Australia wherever suitable habitat (native grassland) was present. Historic and current records of the species come from South Australia, Victoria, New South Wales and the Australian Capital Territory. Victoria encompasses the largest part of the known distribution; most records are from the central and western plains, with a few isolated records from the north east of the state. The species is known to still occur at about 70 sites in Victoria, though many of these are small in area (such as road reserves) and only ten sites are protected in conservation reserves (Robertson and Smith 2010). Two populations are known to occur in South Australia, one of which is protected (Robertson and Smith 2010). In New South Wales striped legless lizards are known to still occur at seven locations, all of which are within 100 km of the ACT. Only one of these locations is protected (Kuma Nature Reserve, near Cooma, NSW).

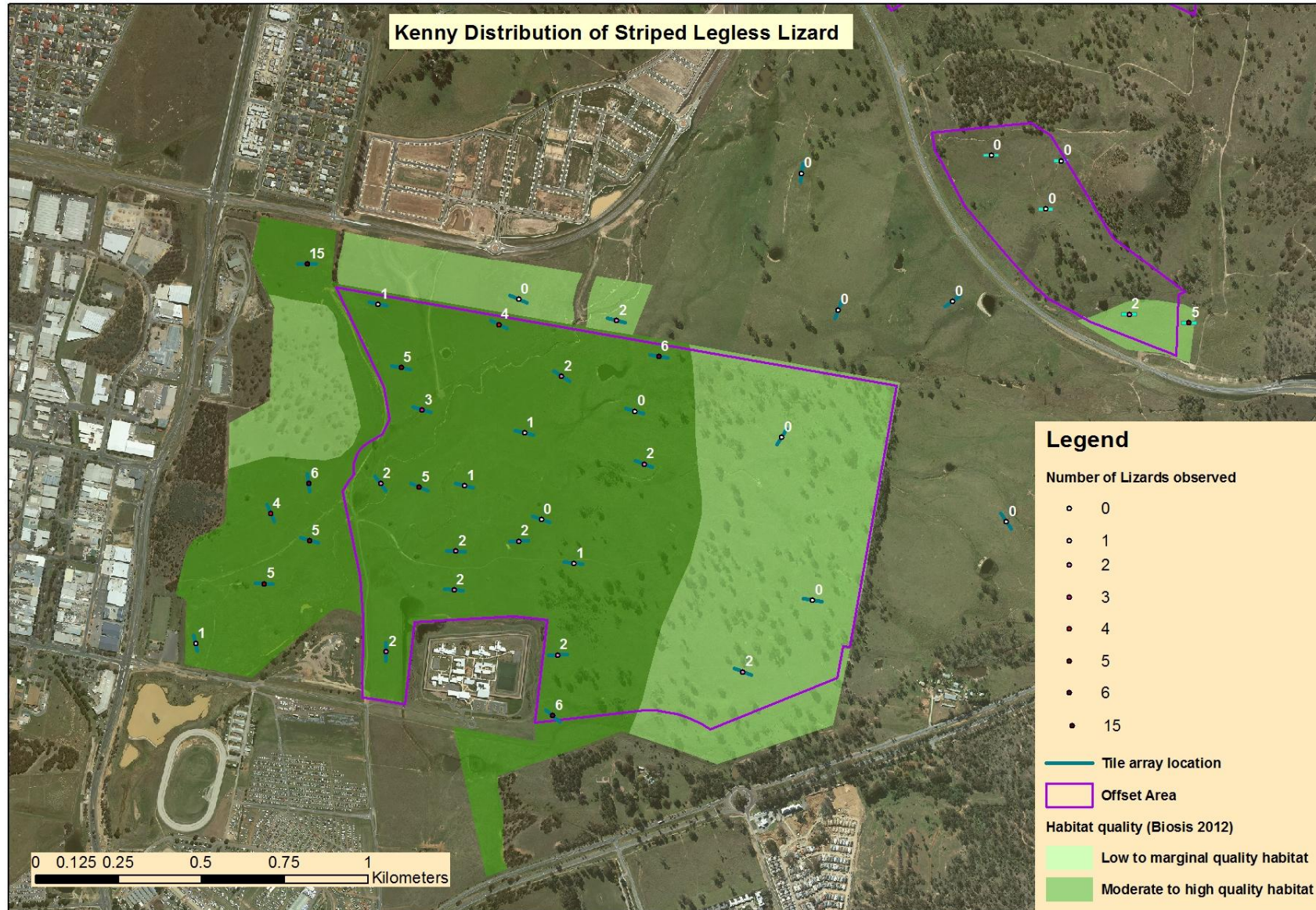
In the ACT striped legless lizard are known to occur in four discrete areas: the Gungahlin area, the Majura Valley in the vicinity of the Airport, land adjacent to Yarramundi Reach on Lake Burley Griffin and the Jerrabomberra Valley. These four populations are effectively isolated by geographic and anthropogenic barriers. The species occurs on a range of land tenures, including Nature Reserve, land owned and managed by the Commonwealth Government, and leasehold land. The species is currently protected in three reserves in Gungahlin (Crace, Gungaderra and Mulanggari grassland reserves) and within two reserves in the Jerrabomberra Valley, but appears to have become locally extinct at Yarramundi Reach. A recent survey (Ecological 2012) has demonstrated that each of the Gungahlin reserves contains populations of at least several thousand lizards, and that the populations in these reserves are amongst the largest of any known habitat.

Within the Gungahlin Strategic Assessment Area, the Striped Legless Lizard has been recorded at the Gungahlin Town Centre, Kenny and Kenny Broadacre areas. During spring 2011 extensive surveys utilising twenty-nine arrays of artificial shelters (696 roofing tiles) were undertaken across Kenny. The array configuration used was 12 x 2 artificial shelters at 5 m spacing, equalling a total of 24 artificial shelters per array, with each array traversing a distance of 55m. Tiles were checked weekly for 12 weeks between the 5<sup>th</sup> of September 2011 and the 20<sup>th</sup> of December 2011. Lizards recaptured during the course of the survey were identified by comparison of head photographs taken of each captured animal. Each lizard has a unique pattern of head scales (Biosis 2012). In the Kenny Broadacre area two tile grids of 5 x 10 tiles (100 tiles) spaced 5m apart were used.

Overall in the Kenny area, 150 captures were made of a maximum of 127 individual lizards. Lizards were caught over approximately 95 hectares of the Kenny development area and about 130 ha over the wider total Kenny area (Figure 1). An estimate of the total population of SLL within Kenny was made based on average home ranges for the lizards and capture rates within the tile arrays, as around 1,000 lizards within the Kenny development area, and up to 1,250 across the wider Kenny area. This is one of the highest densities and largest populations of this lizard ever recorded.

Figure 2 shows the extent of habitat, the location of survey tile arrays and the number of individual lizards caught in each array. Twenty-three arrays (552 tiles) were located in the 160 ha proposed Kenny reserve area. Fifty-one individual lizards were observed under these tiles. Two tile grids (100 tiles) were laid in that part of Kenny that will become a part of Goorooyarroo Nature Reserve with 7 individual lizards observed.

Figure 3 Kenny Distribution of Striped Legless Lizard



## Biology and Ecology of Striped Legless Lizard

Much of the biology and ecology of this cryptic lizard is little understood. Known information pertinent to the planning of habitat improvement is listed and discussed below.

### Longevity

Longevity of individuals is not known, though adults in the wild have been recaptured almost seven years after first capture (Rauhala 1997) and adults have been held in captivity for 12 years (Robertson and Smith 2010). Based on data from other lizard species, it is likely that longevity of the striped legless lizard is between 10 and 20 years (ARAZPA 1996).

*Breeding: rocks and soil cavities may be important egg laying sites.*

Striped legless lizards are thought to reach breeding age at 2-3 years for males and 3-4 years for females (ARAZPA 1996). This is based on evidence for other lizard species and a single ACT record of a female captured at about one year old (based on snout-vent length) that was recaptured three years later in a gravid condition and subsequently laid eggs in captivity (ARAZPA 1996). From observations of striped legless lizards laying in captivity (Banks et al. 1999) and data from other Pygopodids (Cogger 2000) only two eggs are produced, most probably each year (Coulson 1995; ARAZPA 1996). Cohabitation of wild gravid striped legless lizards (Rauhala 1996) and communal clutches of up to 36 eggs (Robertson and Smith 2010) have been observed. There is some evidence that rocks are used as ovipositing sites (Rauhala 1996), as well as soil cavities (including artificial arthropod burrows used to capture grassland earless dragons, Osborne and Dimond (2008); M. Evans pers. obs.). Eggs are laid in December and January and, following a variable incubation period (38 - 47 days in Banks et al. 1999 and 35 to 60 days in Coulson 1995), hatch in January and February. Eggs are off-white and range from 18 - 23 mm long and 8 - 9 mm wide, and weigh between 0.65 - 0.95 g (Banks et al. 1999). Hatchlings in captivity have been recorded at around 30 - 40 mm SVL and weigh around 0.25 - 0.71 g, and reached about twice this length by 12 months of age and adult size (70 mm SVL) at 3 - 5 years of age (Banks et al. 1999).

### Diet

Nunan (1995) determined the diet of striped legless lizards from over 100 faecal pellets obtained from individuals captured at eight sites in the ACT (six sites from Gungahlin, one site from Kaleen and one site from the Majura Valley). Striped legless lizards ate mostly spiders (wolf spiders and jumping spiders), with crickets, cockroaches, springtails and caterpillars (Lepidopteron larvae) also common prey types. Prey types eaten to a lesser extent were grasshoppers, butterflies, moths, beetles, flies and ants. This study found significant differences in the diet between sites but only slight (non-significant) differences in the diet between seasons. Whilst the diet comprised a broad spectrum of invertebrates found in grasslands, striped legless lizards appear to show preference (selectivity) for spiders, crickets, caterpillars and cockroaches. These prey types comprised a greater proportion of the diet than expected based on their abundance in the field relative to other prey types. Other common prey types in the field, such as slaters, ants and bugs, were only rarely eaten.

### Habitat Preference

Defined tussock structure (either exotic or natural) and moderate to high grass biomass are of paramount importance. The Lizard also occurs in areas that are or were once Natural Temperate Grassland or which are nearby secondary (cleared) grassland, and which have a moderate level of grazing.

Dorough (1995) analysed 115 trapping sites in the ACT and found that the species was more likely to occur (and at higher abundance) at sites with longer times since ploughing, had a history of less fertiliser applied, had a lower percentage of bare ground and were located closer to the original primary grasslands. Dorough (1995) also concluded that areas with poor drainage (either permanently or ephemeral) were not favourable habitat.

Rauhala et al. (1995) noted striped legless lizards present in patches of *Juncus subsecundus*, and concluded that wetland and drainage lines may be temporary refuges for the species during dry periods.

Osborne et al. (1993) and Kukolic et al. (1994) concluded the preferred habitat structure to be tall (30 cm – 60 cm high), dense sward with well developed ground cover (70-100 percent total ground cover). In the ACT the species has been recorded in natural temperate grassland on the Majura Training Area (MTA) (owned by the Department of Defence), but has not been found in the adjacent (and contiguous) area of natural temperate grassland on the Canberra airport (Rauhala 1996). The MTA grassland is managed for conservation (generally only light grazing by kangaroos) whereas the grassland on the airport is subject to a mowing regime to maintain a short sward. On the MTA, higher capture rates have been found in a patch of grassland (airport beacon paddock) that had not been grazed by stock for at least 25 years, compared with the adjacent grassland on the MTA which had been lightly grazed on a mostly continuous basis (Rauhala et al. 1995). Recent surveys in the ACT using tiles (Moore et al 2011; Biosis 2012; Howland pers. com.) found high densities of striped legless lizards in areas with tall, dense grass. Howland et al (In press) concluded from surveys across differing grazing levels across ACT habitat that Striped Legless Lizards preferred intermediate grazing intensities.

The presence of striped legless lizards in areas dominated by native tussock species and also in areas dominated by exotic tussock species suggests that it may be the structure of the grass sward, rather than the grass species, that is the key determinant of habitat quality (Dorough 1995). Kukolic et al. (1994) trapped striped legless lizard in patches of *Juncus* spp. and serrated tussock during periods when native species in the same paddock had been heavily grazed. These authors concluded that striped legless lizards used patches of unpalatable species such as *Juncus* and serrated tussock as temporary refuge during periods of heavy grazing, and were able to recolonise areas of native grasses when stock were removed. Rauhala (1996) found capture rates (in pitfalls) declined at sites where there was loss of cover from drought and heavy grazing, but capture rates remained high at the same time at sites where there was adequate cover. Capture rates increased again when grass cover re-established, suggesting the species is able quickly recolonise sites that are temporarily unsuitable as habitat (Rauhala 1996).

The floristic composition of habitat appears to be of little consequence to utilisation by Striped Legless Lizard. Within Kenny and across Gungahlin, areas dominated by exotic pasture species, such as *Phalaris*, were found to support similar densities of lizards to those dominated by native tussock grasses (notably Tall Spear-grass) (Biosis 2012, Ecological Australia 2012). In fact, five of the transects/grids with three or more individuals recorded at Kenny were located within areas supporting an almost monoculture of *Phalaris*. As observed elsewhere, defined tussock structure and moderate to high biomass are of paramount importance to the persistence of Striped Legless Lizard within an area of habitat (Biosis 2012).

In the ACT, Striped Legless Lizard are found in both primary (i.e. Natural Temperate Grassland) and secondary grassland (i.e. native grassland that exists post clearing of woodland) but are generally considered to be restricted to secondary grassland within two kilometres of primary grassland (Rauhala *et al* 1995; Dorough 1995). They also occur within the transitional zone between grassland and woodland, but are only known from open, lightly shaded areas of woodland.

## Movement

During spring and early summer the lizard appears to move little and probably has a home range of 10m<sup>2</sup>, however it is capable of longer movement and may move between local areas that become favourable under different conditions.

Ecological Australia (2012) utilised 1460 tiles in 38 arrays to survey Striped Legless Lizards within the Gungahlin grassland reserves of Gungahlin, Mulanggari and Crace. A total of 323 lizard observations occurred over a ten week period, of which 71 were recaptures. Of these recaptures 54 (76%) were under the same tile, a further 6 (8.5%) of recaptures were under an adjacent tile 5m away. Only 6 (8.5%) of recaptures were further than 10m apart. There was only one record of movement greater than 20m and that was of lizard which travelled 80m in two weeks in November. Kukolic et al. (1994) recaptured thirteen individuals which had moved between 2.5 m and 62.5 m (mean 14 m) straight line distance between captures that spanned an interval of up to nine days. One individual travelled 60 m in two days. Rauhala et al. (1995) found no relationship between distance moved and number of days since recapture. Of the ten individuals recaptured by Rauhala et al. (1995) the two longest straight-line distances were 52 m and 58 m, which occurred over a short period (two days), whereas the shortest movement (5 m) occurred over a relatively long period of 20 days. Dunford (1998) recaptured an individual that was 160 m away from where it had been captured three years previously. Tracking individuals marked with fluorescent powder has revealed movements vertically and horizontally through grass tussocks and along the surface of the soil for distances up to 20 m in a day (Kutt 1993). Home ranges have been conservatively estimated at 10 m<sup>2</sup> based on recaptures using tiles in Victoria (Robertson and Smith 2010). It is suspected that animals generally only move short distances, but that they are capable of moving into new adjacent habitat, and as they may live for ten years or more, probably move between habitats that become suitable or unsuitable under certain weather conditions.

During winter the lizard is thought to hibernate and shelter in soil cracks or the base of tussocks.

## Response to fire

Fuel reduction burning has resulted in deaths of striped legless lizard at Derrimut Native Grassland Reserve in Victoria. Kukolic (1994) does not recommend burning extensive areas of Striped Legless Lizard habitat, any proposed burns should be only done in small patches. Dunford (1998) and Ecological (2012) captured striped legless lizard in unburnt grassland and adjacent grassland that had been burnt by wildfire the previous year, suggesting the species is capable of using grassland at least one year following fire, if animals are able to disperse into the area from adjacent unburnt areas. In August 2012 an area of about 12 ha within Mulanggari Grassland Reserve, was subject to a patchy low-intensity burn. Eighty tiles in two grid arrays of fifty and thirty tiles were placed within this area in October 2012 and surveyed ten times up until late December 2012. Thirty captures of twenty-one individual lizards were made (Ecological 2012). This suggests that lizards are capable of surviving low-intensity patchy burns.

ACT Government guidelines (Kitchin and Matthews 2012) define the following prescriptions for burning within Striped Legless Lizard habitat:

- Burns should be restricted to early spring (Sep-Oct), before the summer breeding, or early autumn (Mar-Apr) to ensure sufficient regrowth of vegetation before winter;
- Burns must be patchy and low-intensity; and
- Burns should be conducted during the middle of the day or evening, rather than early morning when the lizards may be cold and slow moving.

## Condition of Kenny habitat

The future Kenny Reserve (160ha) is a flat and low lying component of the Sullivan's Creek floodplain. There is a gradual south-westerly slope across the land from 610 to 590 metres. The creek runs through the western section of the reserve. The western half of the reserve is a mixture of exotic and native pasture, while the eastern section is open woodland, characterised by very large and old eucalypts. The Bimberi Youth Justice Centre is located on the south-west boundary, while the new suburb of Kenny will be built to the north and east.

A sub surface layer of gravel and sandy clays of between 0.5 to 3 metres thick occurs over much of the reserve. This layer results in widespread water logging and creates surface discharge in some areas.

Natural Temperate Grassland would have occurred in the lower areas near Sullivans Creek, and Yellow Box – Blakely's Red Gum Grassy Woodland would have occurred as elevation increased (likely to be in the vicinity of the 595metres AHD contour) and dominated the surrounding gently undulating land (Biosis 2012).

Pasture improvement and a long grazing history have meant that there is no longer Natural Temperate Grassland currently within the reserve. The exotic grass *Phalaris* dominates along, and in the vicinity, of Sullivans Creek and other drainage lines, while Tall Spear-grass *Austrostipa bigeniculata* occupies the drier areas.

The woodland area has an understorey dominated by native grasses with a low diversity of native herbs. The age of 300 or so large trees range from 150 – 500 years old and are considered as valuable habitat.

About 4ha of habitat occurs north of Horsepark Drive in the Kenny Broadacre area. This largely consists of a mix of exotic and native grass species which grades into Red Stringybark (*Eucalyptus macrorhyncha*) – Scribbly Gum (*E. rossii*) Tableland Forest with a dry shrubby understorey.

Based on the occurrence of lizard observations, the grass structure present and the degree of shading, Biosis (2012) mapped areas of low to marginal habitat and moderate to high habitat (Figure 2). Habitat improvement will be focussed in the high habitat areas.

## Striped Legless Lizard Habitat Improvement Areas

The proposed Kenny Nature Reserve area that currently contains Striped Legless Lizard and the grassland in the vicinity of the northern Kenny Broadacre area will be managed with the objective of at least maintaining the current Striped Legless Lizard population. Part of this area is Box Gum woodland. Enhancement of this woodland type within the Gungahlin area is an objective of the Gungahlin Strategic Assessment Plan. However, this regeneration has the potential to degrade Striped Legless Lizard habitat through shading. As a result, management will differ between areas where Striped Legless Lizard is the major management focus and areas where management seeks to meet both striped legless lizard and Box Gum woodland objective. This area will be clearly defined during the initial monitoring phases for both Striped Legless Lizard and Box Gum Woodland.

Management for Striped Legless Lizard will be the primary focus over the land that currently contains Striped Legless Lizard within the proposed Kenny Nature Reserve or the extended Goorooyarroo Nature Reserve (see Figure 4). The boundary of this area may change slightly according to management implementation efficiencies or requirements such as ease of fencing or outer asset fire zone considerations. Further work is required to determine the full suite of

conservation and land management activities in Kenny. This will occur once the Nature Reserve is established.

### **Management Actions within Habitat Improvement Areas**

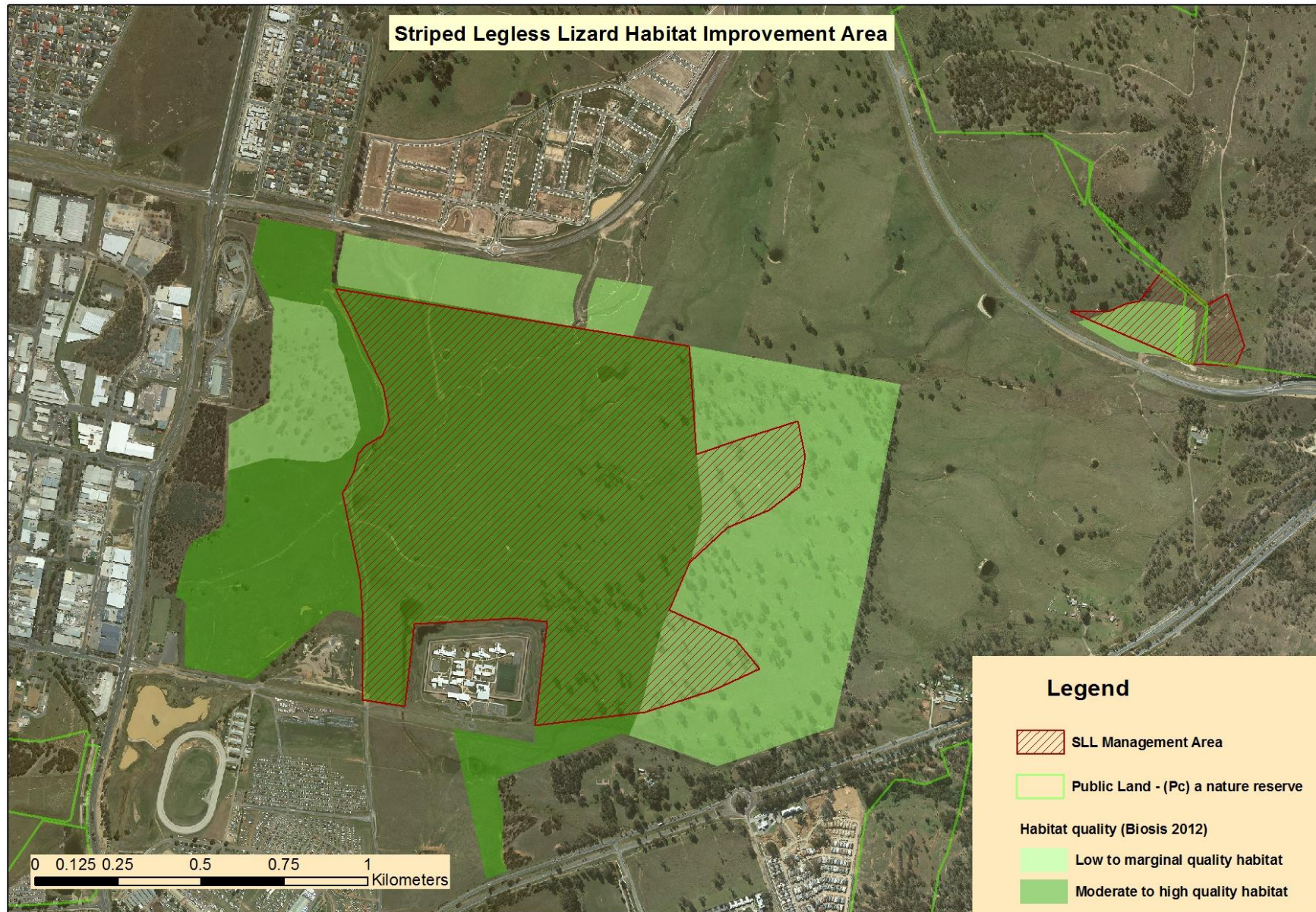
The central aim in managing Striped Legless Lizard habitat is to provide adequate grass structure, particularly vertical cover, and to minimise mowing, grazing and fire, and stop cultivation, fertilizer application and tree planting (after Smith & Robertson (2010)).

Habitat improvement must be carefully considered against bush fire management and management activities within the habitat improvement areas will:

1. Maintain grassland height of at least 20cm and limit it to no more than 80cm; and
2. Maintain grass cover to at least 75% of the understorey;
3. Ensure tree and shrub cover remains at less than 10% within each 10ha segment of the area;
4. Prohibit shrub and tree planting; and
5. Prohibit fertilizer application.

Habitat improvement areas are within the SLL Management Areas identified in Figure 2.

Figure 5 Striped Legless Lizard Habitat Improvement Area



## Management across Kenny high quality habitat areas

Management will:

1. Prohibit ploughing, ripping, and other significant soil disturbance, except for infrastructure critical for the development of the suburb and for management tracks.
2. Development or infrastructure that is required within the Nature Reserve will require a Construction Environment Management Plan to be completed and approved by the Plan Implementation Team.
3. Ensure that grass height ranges between 20 – 80 cm, primarily through cattle or kangaroo grazing, but potentially also through patch burning;
4. Pre-existing tracks to be utilised and improved for access/maintenance purposes. A vegetative cover should be maintained on the tracks where possible;
5. Allow slashed tracks, if required for fire management, only along boundary fence lines. Slasher blade height will be set at no less than 20cm where possible (unless directed by the Emergency Services Authority for bushfire management requirements) and slashing will avoid clumping or windrowing of clippings by using a flail mower. Slashing will be minimised in the striped legless lizard active season (spring and summer) and will occur in the middle of the day or afternoon, rather than early morning when the lizards may be cold and slow moving. Slashing may occur to a level less than 20cm if the track is required as a control line for a controlled burn, but this height of grass cover on the track would be the exception rather than the rule;
6. Focus weed control on exotic herbaceous species such as St John's Wort, woody weeds such as Blackberry or Briar Rose or on invasive tussock grasses such as Chilean Needlegrass, African Lovegrass, Serrated Tussock and Tall Fescue;
7. Rehabilitation works of any area disturbed by infrastructure or other activity will utilise a mixture of local grass species, particularly Tall Speargrass (*Austrostipa bigeniculata*);
8. Prior to residential occupation Kenny and the retained areas will be declared as cat containment areas;
9. Cat control may be undertaken if required and directed by the Land Manager;
10. Action will be undertaken to reduce the impacts of overgrazing within the striped legless lizard habitat areas.
11. Burning will occur in a mosaic pattern, burning less than 20% of the site at one time with at least 3 year intervals between burns. Burns will be only of a low intensity, and restricted to early spring (Sep-Oct), before the summer breeding, or early autumn (Mar-Apr). Burns will be conducted during the middle of the day or evening, rather than early morning when the lizards may be cold and slow moving;
12. Rock removal will be prohibited ; and
13. Habitat connectivity will be retained between the Kenny grassland reserve and open space to the west.

## Monitoring methods

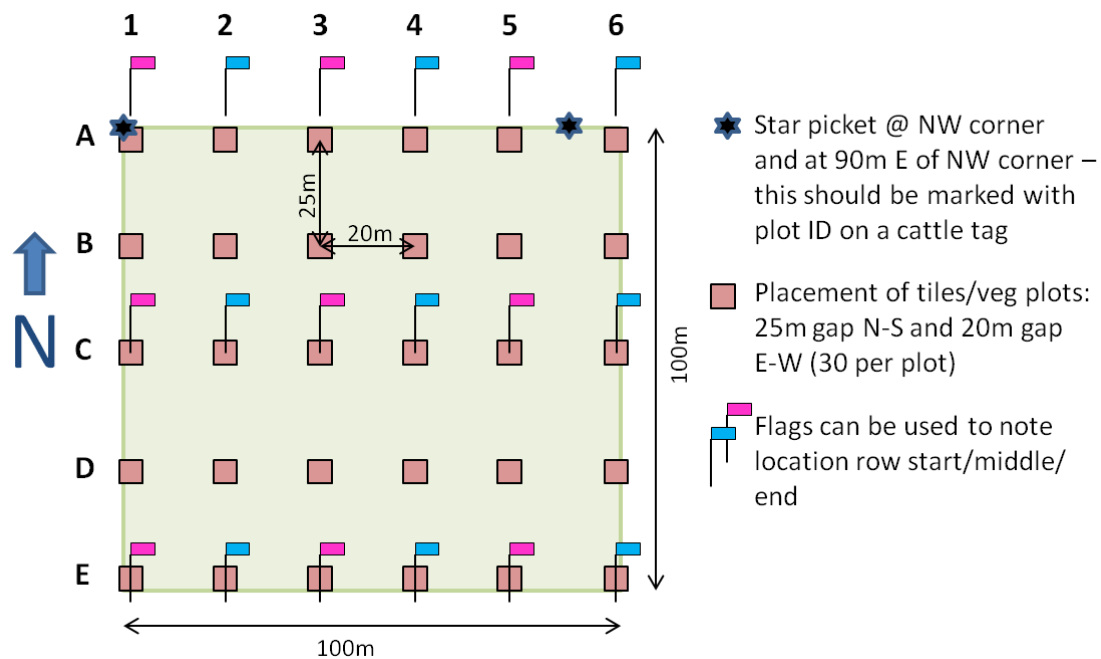
The tile survey undertaken by Biosis (2012) provides benchmark information on both the distribution and population size of Striped Legless Lizard within the offset area. The capture data is at Appendix 1. Biosis (2012) utilised two different sampling set-ups. Within Kenny proper, where they were trying to gauge the extent of distribution, arrays of 24 x 2 roof tiles 5m apart were used, while in the Kenny Broadacre area, where the survey was trying to establish presence or absence, two 10 x 5 grids with tiles 5m apart were utilised. The later is the standard survey method required under the EPBC survey guidelines for this species.

It would be advantageous if the monitoring results from Kenny could be directly compared to monitoring elsewhere in Gungahlin and the ACT to compare population data. There is currently a long-term project underway on the impacts of Kangaroo grazing pressure on reptiles and other

ground fauna. This project is expected to continue into the future and includes roof tile survey of Mulanggari, Crace, North Mitchell, Jerrabomberra East and Campbell Park, all of which contain known Striped Legless Lizard habitat. The survey design for this work involves the laying of 30 ceramic or concrete roof tiles in a grid design consisting of 6 lines (1-6) and 5 rows (A-E). Tiles are 20m apart in rows (West-East), and 25m apart in lines (North-South). Tiles are put into position 3 months prior to the start of reptile surveys (July/August) and are checked in spring (October/November). Checks are conducted once per week for 5-10 weeks (see Figure 6).

This survey design has also been adopted to monitor Striped Legless Lizard populations within the Gungaderra and Mulanggari extension areas that are offsets for development of land next to the EPIC showground, also in Kenny.

Figure 7 Grid Layout to be used for monitoring of Striped Legless Lizard at Kenny



The 30 grid design will also be utilised within the Gungahlin Strategic Assessment Area. Grids will be placed so that each grid overlaps at least one of the array or grid locations of Bosis (2012) but as the grids cover 1ha they sample across a much larger area than those employed by Bosis (2012). Two grids (60 tiles) will be located in the former Kenny Broadacre area and ten (300 tiles) in the proposed Kenny reserve. Ten checks over at least weekly intervals will be made of the tiles across October to mid-December

Striped legless lizard can readily separate (break off) parts of its tail from the body at any point (Cogger 2000). This is presumably a defence against predation. The tail is quickly re-grown, though re-grown tails are rarely as long as the original tail. Tail re-growth also diverts resources that may have been directed towards breeding. Particularly if those undertaking the survey are inexperienced or the weather is hot, lizards may shed their tails when they are being photographed for identification. Osborne (2013) suggests that in order to avoid stress on lizards that individuals only be captured if identification cannot be made readily by direct visual observation (i.e. prior to capture). The mean number of detections per grid per day would then be the measurement that is used for comparison. This will also save considerable time that would no longer be spent handling, measuring and photographing individuals.

Table 1 Difference if tile detection is utilised rather than Individual lizard observations

Location + data source	Number of arrays and tiles	No. of checks	No. of SLL captures	Number of SLL individuals	% recapture rate	Number of Tiles with SLL observed	difference between individual and tile only numbers
Kenny Block 799 - EPIC (Moore et al 2011)	4 x 50 = 200 tiles	15	80	35	64%	39	4 (+9%)
Kenny (new suburb) (Biosis 2012)	12x2 x29 transects = 696 tiles	12	128	86	33%	82	4 (-5%) but tile information not recorded for 12 of the 128 captures so is probably lower number than actually was
Mulanggari (Ecological 2013)	10x3x8 arrays spaced 10m (A grids) 240 tiles 5x10 x 5 arrays spaced at 5m (B grids) 250 tiles <b>Total = 490 tiles</b>	10	60 for A grids 50 for B grids <b>Total 110</b>	51 for A grids 39 for B grids <b>Total 90</b>	15% (Grid A) 22% (Grid B) <b>Total 18%</b>	51 for A grids 40 for B grids <b>Total 91</b>	0 for Grid A 1 (+2.5%) for Grid B <b>1 (+1%) for Total</b>
Crace (Ecological 2013)	10x3x8 arrays spaced 10m (A grids) 240 tiles 5x10 x 5 arrays spaced at 5m (B grids) 250 tiles <b>Total = 490 tiles</b>	10	38 for A grids 46 for B grids <b>Total 84</b>	31 for A grids 29 for B grids <b>Total 60</b>	18% (Grid A) 37% (Grid B) <b>Total 29%</b>	29 for A grids 29 for B grids <b>Total 58</b>	2 (-6.5%) for Grid A 0 for Grid B <b>2 (+2.5%) for Total</b>
Gungaderra (Ecological 2013)	10x3x6 arrays spaced 10m (A grids) 300 tiles 6x10 x 5 arrays spaced at 5m (B grids) 300 tiles <b>Total = 480 tiles</b>	10	55 for A grids 74 for B grids <b>Total 129</b>	43 for A grids 58 for B grids <b>Total 101</b>	22% (Grid A) 22% (Grid B) <b>Total 22 %</b>	38 for A grids 51 for B grids <b>Total 89</b>	5 (-12%) for Grid A 7 (-12%) for Grid B <b>12 (-12%) for Total</b>

As indicated in Table 1, the difference between number of individuals observed and number of tiles under which lizards are observed is small and ranges from 1-12% across Gungahlin data.

Given the advantages in relation to reducing stress on lizards, saving survey time and being consistent with the methods employed in the Kangaroo grazing research, monitoring across Kenny will utilise the mean number of detections per grid per day – which can be converted to detections per 1000 tiles per ten days for comparison against survey not utilising the 30 grid setup shown in Figure 8. The Biosis (2012) data has been converted to capture and detection rates per 1000 tiles per ten days and is provided at Table 2.

**Table 2 Benchmark Striped Legless Lizard Population Data (after Biosis 2012)**

No. of arrays and grids	No of tiles	No of checks	Individual captures	Captures per 1000 tiles per ten day	No tiles with individual tile records	No tiles with lizard or skin, including multiple lizards seen on same check	Detection per 1000 tiles per ten days
23 + 2	652	12	58	7.33	552	52	7.83

### Monitoring timing

Prior to the commencement of construction of Kenny or reserve management of the proposed Kenny conservation reserve, the offset areas will be surveyed according to the methodology described above. This will mean that there will be at least two years of pre-construction data, which will be pooled to form a benchmark pre-construction /pre conservation management benchmark figure.

As per recommendations of Osborne (2013), monitoring timeframes will be as follows:

- annual monitoring for the first three years following construction; and thereafter
- annual monitoring for two years, at five year intervals.

Where possible, monitoring at Kenny should coincide with monitoring occurring at other offset sites or conservation reserves. This may mean that the interval between survey events may not match exactly to 5 years.

### Corrective actions in relation to monitored population decline

Required actions in relation to adverse monitoring results are shown in Table 3.

Table 3 Result and corrective actions

Monitoring Result	Corrective Action
Decline of more than 20% is observed between benchmark and monitoring detection rate recorded in a yearly monitoring event	<p>Vegetation survey of reserve undertaken to check that grassland height is between 20 – 80cm, Cover is &gt;75% and shading is not more than the 10% or 20% allowable figures.</p> <p>Management actions to ensure the condition complies with these figures could include, crash grazing, removal of stock, management of kangaroos or control of woody regrowth;</p> <p>Particular focus on management actions and targets will occur in areas covered by grids that show the greatest detection declines, and that management has been consistent with the targets and actions provided under section 5.1 and 5.2.</p> <p>Tile survey monitoring must be undertaken in following season with the aim of identifying whether the decline is continuing.</p>
Decline of more than 20% is observed between benchmark and monitoring detection rate for two consecutive years	<p>Comparison undertaken with monitoring or survey undertaken elsewhere in Gungahlin. If such data for a comparative analysis is not available or the results from Kenny are more than 20% below population change figures at other areas, then monitoring will be undertaken at Kenny for next three years or until monitoring indicates a stable or increasing population size.</p> <p>Research will also commence if decline is more than 20% below that of other Gungahlin populations or if decline has occurred over three consecutive years, into why the population at Kenny is in decline, with the main objective being to provide management guidance as to how the decline may be reversed. This research may compare availability of preferred prey items, breeding locations or habitat structure between Kenny and other populations.</p>

### Research and proposed translocation program

There are no specific research requirements under the Plan or as part of the Strategic Assessment approval. However, as detailed above, research will be undertaken to inform actions in relation to adaptive management if a significant decline in the Kenny Striped Legless Lizard population is detected.

Research may also occur into the translocation of lizards from development areas into reserved or retained habitat. A proposal to translocate Striped Legless Lizards from the proposed development on Block 799, Gungahlin ACT, was discussed between officers of CPR and the Reptile Working Group, based out of the University of Canberra. This was a precursor to acquiring ethics approval for the translocation from the Ethics Committee also based within University of Canberra. Advice from the

working group was that translocation should ideally only occur into habitat from where the Legless lizard is known to have become extinct and where threats leading to local extinction have been rectified. There are no such areas within Gungahlin, and the only potential site to meet this criterion within the ACT, is Yarramundi Reach. However, prior to any possible translocation the absence of this lizard at Yarramundi, would need to be checked, through survey utilising at least 500 tiles spread across ten, 10 x 5 grids, across the Yarramundi area.

The retained area of Throsby East was surveyed for Striped Legless Lizards by Biosis (2012) with none found there, even though habitat appears suitable. One reason why it may be absent is that this area has been subject to heavy grazing in the past, and the shortness of grass may have led to its local extinction. The area is also secondary grassland and heavy grazing following clearance may have meant that it has never been suitable habitat for Striped Legless lizard to move into from nearby occupied areas. Survey across Gungahlin has also found that the elevation close to Horse Park Drive may be a natural limit to the species, and East Throsby may have always been outside the natural limit. Given this uncertainty, the Reptile Working Group suggested that if it was to be utilised as a translocation site, it would have to be subject to a detailed research study, where animals were originally restrained within an enclosure (e.g. corrugated iron pen enclosures, O'Shea 2013) were the fate of introduced lizards could be ascertained.

Watson woodlands is in a similar topographic position to Kenny and contains habitat similar to that occupied by Striped Legless Lizard at Kenny. Friends of Watson Woodlands have suggested that an open grassy area within Watson Woodlands could be a site of translocation. They would also be willing to monitor tiles to gauge whether lizards already occur at Watson, and if not, the success of any subsequent translocation.

The possibility of Throsby East becoming a translocation site will be investigated further. The results and methodology of recent Victorian translocation efforts (O'Shea 2013) will be considered as part of any translocation within the ACT.

## **Research Collaboration**

Monitoring programs and research will be presented to the research management group of The Mulligan's Flat Woodland Sanctuary, with the aim of fostering coordination and collaboration and avoiding any potential conflicts.

## **Research and Monitoring Costs**

Translocation costs are very preliminary estimates, and assume translocation into East Throsby. If lizards were to be transferred into Yarramundi Reach then it would be reasonable to expect that the managers of this land, the National Capital Authority, would bear the brunt of the costs. Translocation would have to occur no later than the spring prior to the development of the Gungahlin Town Centre extension area, which would be the source for lizard translocation.

The timing of monitoring costs also assumes that Kenny will be developed in accordance with the ACT Government Indicative Land Release Program. The research and monitoring activities may change and be subject to review by the PIT.

Table 4 Research and monitoring cost summary

Year	Description of Activity	Cost (\$) per year
1	Tile survey at Yarramundi and Watson woodlands (September to November) to identify translocation site	3000
	Translocation of Lizards from Gungahlin Town Centre - purchase of tiles - capture/handling by ACT Officers	500 0
	Construction of up to 2 enclosures (as required by Commonwealth translocation policy)	50 000
<b>Year 1 totals</b>		<b>53 500</b>
2 - 7	Habitat condition monitoring - undertaken by ACT Officers	0
8	Translocation of Lizards from Kenny (depending on timing and location of storm water works) - purchase of tiles - survey and collection - capture/handling by ACT Officers	500 2 000 0
<b>Year 8 totals</b>		<b>2 500</b>
8 - 20	Habitat condition monitoring - undertaken by ACT Officers	0
<b>TOTAL</b>		<b>56 000</b>

## References

- ARAZPA (1996) *Population and habitat viability assessment (PHVA) for the Striped Legless Lizard (Delma impar)*. Australian Capital Territory Parks and Conservation, Striped Legless Lizard Working Group, Australasian Regional Association of Zoological Parks and Aquaria (ARAZPA), Conservation Breeding Specialist Group (SSC/IUCN), Canberra
- Banks, C., Hawkes, T., Birkett, J. and Vincent, M. (1999) Captive management and breeding of Striped Legless Lizard, *Delma impar*, at Melbourne Zoo. *Herpetofauna* **29**(2): 18–30.
- Biosis Research (2012) *Kenny and Throsby. Striped legless lizard (Delma impar) survey report*. Unpublished report to the ACT government – Environment and Sustainable Development Directorate. Biosis Research Pty Ltd.
- Cogger, H.G. (2000). *Reptiles and Amphibians of Australia*. 6th Edition. Reed Books, Australia
- Coulson, G., (1995). *Management directions for the Striped Legless Lizard (Delma impar) in the Australian Capital Territory*. Technical Report No. 12. ACT Parks and Conservation Service, Canberra.
- Moore, G., Macintosh, J., Nash, K., Hogg, D., Rowell, A. (2011). *Block 799 Gungahlin - Striped Legless Lizard survey*. Report to ACT Land Development Agency. David Hogg Pty Ltd, Canberra.
- Dorrough, J., (1995). *Past and present habitat of the Striped Legless Lizard (Delma impar, Pygopodidae) in the Australian Capital Territory*. BSc (Hons) thesis, Department of Botany and Zoology, Australian National University.
- Dunford MA 1998. *1997 monitoring program for the striped legless lizard Delma impar*. Unpublished internal report 96/1. Wildlife research and monitoring, Environment ACT. Canberra
- Eco Logical Australia (2013) *Striped legless lizard surveys 2012: Gungahlin grassland nature reserves Crace, Mulanggari and Gungaderra*. Report prepared for Conservation Planning and Research, ACT Government
- Howland B, Stojanovic D, Manning A.D, Gordon I, and Lindenmayer D.B. (In Press) The impact of changes to grazing intensity of large native herbivores on ground-dwelling reptiles Australia.
- Kitchin M. and Matthews H. (2012) *2012-13 Ecological Guidelines for Fuel and Fire Management Operations*. Internal report 2012/01 Conservation Planning and Research. Environment and Sustainable Development Directorate.
- Kukolic K, McElhinney N and Osborne WS 1994. *Survey for the striped legless lizard Delma impar during 1993 in the proposed development area E1 comprising sites for the Gungahlin town centre and the suburb of Franklin*. Unpublished internal report 94/3. Wildlife Research Unit, ACT Parks and Conservation Service, Canberra.
- Kutt, A.S. (1992) *Microhabitat selection and mobility of the Striped Legless Lizard, Delma impar*. BSc Honours Thesis, The University of Melbourne, Parkville, Victoria.
- Nunan D 1995. *Diet and feeding ecology of the striped legless lizard (Delma impar) (Fisher, 1882) within the Australian Capital Territory*. BAppSc (Hons) thesis, Faculty of Applied Science, University of Canberra.

Osborne W. (2013) *Suitability of proposed offset areas at Gungahlin for Striped Legless Lizards – extent of habitat, management prescriptions and monitoring*. Institute of Applied Ecology. University of Canberra.

Osborne, W. and Dimond, W., (2008). *Survey for the Grassland Earless Dragon (Tympanocryptis pinguicolla) at Section 1 Symonston, Fyshwick, ACT*. Report commissioned by ACT Planning and Land Authority. Institute for Applied Ecology, University of Canberra.

Osborne, W.S., Kukolic, K., and Williams., K.D. (1993). *Conservation of reptiles in lowland native grasslands in the Southern Tablelands of New South Wales and the Australian Capital Territory*. pp. 151-158 In *Herpetology in Australia*.

O'Shea, M. (2005) *Methods for assessment and techniques for management of striped legless lizard Delma impar populations in south-eastern Australia*. Ph.D. Thesis. Victoria: Victoria University.

O'Shea, M. (2013) *Evaluating the effectiveness of salvage and translocation of Striped Legless Lizards*. Technical report Series 243. Arthur Rylah Institute for Environmental Reserach. Department of Sustainability and Environment. Melbourne.

Rauhala, M.A., (1996). *1995 Survey and monitoring program for the Striped Legless Lizard (Delma impar)*. Unpublished internal Report 96/1. Wildlife Research Unit, ACT Parks and Conservation Service, Canberra.

Rauhala MA. 1997. 1996 monitoring program for the striped legless lizard *Delma impar*. Unpublished internal report 97/1. Wildlife Research Unit, ACT Parks and Conservation Service, Canberra.

Robertson, P. and Smith, W., (2010). *National Recovery Plan for the Striped Legless Lizard (Delma impar)*. Department of Sustainability and Environment, Melbourne.

Appendix 1 Capture data from Biosis (2012)

Capture number	Date	Transect/ Grid	Transect/ Grid Number	Tile No.	Black/ White	Time	Day start	Day Finish	SVL	Total L	Weight	Sex	Weather	Comments
1	05/09/2011	T	20	1	W	11:00	9:00	13:00	9.5	19			Fine, following cloudy and scattered showers	Juvenile, strong colouring
2	05/09/2011	T	22	7	W	11:38	9:00	13:00	8	20.5			Fine, following cloudy and scattered showers	Damaged scales 1cm beneath vent. Pink lateral scales. Kink in tail (possibly regrowth)
3	05/09/2011	T	23	5	W	11:55	9:00	13:00	8	27		F?	Fine, following cloudy and scattered showers	Strongly striped
4	05/09/2011	G	2			12:30	9:00	13:00	7.5	25			Fine, following cloudy and scattered showers	Strongly striped
5	12/09/2011	T	6	7	B	10:35	2:24	13:50	7.5	24		F?	Fine	Orange lateral scales. Very weakly striped
6	12/09/2011	T	18	9	W	12:20	2:24	13:50	8.5	18		F?	Fine	Faint orange lateral scales. Very weakly striped
7	19/09/2011	T	25	3	W	10:38	8:00	12:00	7.5	24.0	4.0	juv	Fine Max 24	Lightly striped, orange colouration, quite thin
8	19/09/2011	T	25	3	B	10:38	8:00	12:00	9.2	28.0	6.0	F?	Fine Max 24	Strongly striped, greyish colouration
9	20/09/2011	G	1			11:48	11:45	12:30	7.5	2.4			Cloudy, some patchy rain	Strongly striped, some orange lateral scales
10	26/09/2011	T	25	4	B	9:32	9:15	13:10	76	255	3.5		Partly Cloudy	Brown with brown stripes (lightly striped). Dark head
11	26/09/2011	T	25	3	W	9:40	9:15	13:10	92	295	6.0		Partly Cloudy	Grey with strong dark grey stripes. Maybe gravid
12	26/09/2011	T	24	10	B	9:54	9:15	13:10	84	269	4.0		Partly Cloudy	Grey with strong dark grey stripes and pinky-orange lateral scales
13	26/09/2011	G	1			10:20	9:15	13:10	70	240	4.2		Partly Cloudy	
14	26/09/2011	T	9	2	W	11:58	9:15	13:10	77	251	4.0		Partly Cloudy	Moderate-strongly striped. Olive brown dorsal colour and some orange lateral scales. Some damaged scales - looking old/unhealthy
15	26/09/2011	T	29	4	W	12:10	9:15	13:10	77	244	3.5		Partly Cloudy	Weak-moderate stripes, lots of scale damage - not looking good!
16	04/10/2011	T	9	2	W	9:22	9:00	13:20	79	184	3.0		Fine	No regrowth of tail
17	04/10/2011	T	28	4	W	9:42	9:00	13:20	89	266	3.5		Fine	Strong stripes. Small scar midway on right flank
18	04/10/2011	T	10	6	W	9:56	9:00	13:20	85	265	4.0		Fine	Moderately striped.
19	04/10/2011	T	11	2	W	10:09	9:00	13:20	70	94	1.5		Fine	Tail lost during capture
20	04/10/2011	T	11	9	B	10:15	9:00	13:20	75	147	2.0		Fine	Tail lost during capture. Strong stripes
21	04/10/2011	T	3	8	B	10:29	9:00	13:20	72	192	2.5		Fine	Tail lost during capture. Lightly striped
22	04/10/2011	T	3	8	W	10:35	9:00	13:20	76	247	3.0		Fine	Light stripes
23	04/10/2011	T	6	7	B	11:00	9:00	13:20	79	260	3.0		Fine	Light stripes
24	04/10/2011	T	16	7	W	11:16	9:00	13:20	42	127	1.0		Fine	Juvenile.
25	04/10/2011	T	27	4	B	11:35	9:00	13:20	76	261	3.0		Fine	Light stripes
26	04/10/2011	T	22	7	W	11:55	9:00	13:20	93	213	4.0		Fine	Pinkish lateral scales. Heavy build. Tail lost with 45mm regrowth
27	11/10/2011	T	25	4	W	8:45	8:30	13:00	77	245	3.5		Mostly cloudy	Light orange-brown dorsal colouration with grey brown head. Lightly striped. Some scale damage on body esp left side.
28	11/10/2011	T	22			9:10	8:30	13:00	79	256	3.5		Mostly cloudy	Moderately striped. Very slight orange lateral scales.
29	11/10/2011	T	21			9:39	8:30	13:00	85	152	3.5		Mostly cloudy	Strongly striped with orange lateral scales. Recently lost tail - healed but only 1-2mm regrowth. 1 scale on head damaged.
30	11/10/2011	T	20			9:50	8:30	13:00	79	272	4.5		Mostly cloudy	Moderately-strongly striped. Some orange lateral colour.
31	11/10/2011	T	16	8	B	10:06	8:30	13:00	46	141	1.0		Mostly cloudy	Juvenile (light, no striped, dark head)
32	11/10/2011	T	4	8	B	10:50	8:30	13:00	72	190	3.0		Mostly cloudy	Lightly striped. Orange lateral scales and pink under tail. Recently lost tail tip - no regrowth.
33	11/10/2011	T	4	8	W	10:52	8:30	13:00	76	252	3.5		Mostly cloudy	Lightly striped. Some orange lateral scales.
34	11/10/2011	T	13	3	B	11:10	8:30	13:00	79	251	4.0		Mostly cloudy	Light to moderate stripes. Slight orange lateral colour.
35	11/10/2011	T	14	2	W	11:22	8:30	13:00	80	276	4.0		Mostly cloudy	Strongly striped with bright orange lateral scales.
36	11/10/2011	T	18	8	B	11:39	8:30	13:00	85	281	5.0		Mostly cloudy	Lightly striped. Some scale damage.
37	11/10/2011	T	9	2	W	11:55	8:30	13:00	78	242	3.3		Mostly cloudy	Moderate-strongly striped. Orange/pink lateral scales. Half broken tail ~5cm from tip. Dome scale damage on head.
38	11/10/2011	G	1			12:10	8:30	13:00	79	247	5.0		Mostly cloudy	Strongly striped
39	11/10/2011	T	10	6	W	12:14	8:30	13:00	87	274	4.0		Mostly cloudy	Moderately striped. Some scale damage half way down body, left side.

40	11/10/2011	T	28	4	B	12:42	8:30	13:00	89	270	4.5		Mostly cloudy	Strongly striped. Missing very tip of tail. Some scale damage.
41	17/10/2011	T	11	6	B	8:35	8:10	11:00	76	150	3.0		Fine	Strongly striped. Tail lost at 150mm - no regrowth.
42	17/10/2011	G	2			9:20	8:10	11:00	92	225	6.0		Fine	Moderately striped. 48mm regrowth
43	17/10/2011	T	21	4	B	9:45	8:10	11:00	86	159	3.5		Fine	Strongly striped. Dark with pink lateral scales.
44	17/10/2011	T	27	4	B	9:55	8:10	11:00	79	268	3.0		Fine	Lightly striped
45	17/10/2011	T	28	4	B	10:15	8:10	11:00	97	269	5.5		Fine	Moderately striped. Tip of tail lost.
46	17/10/2011	T	28	11	B	10:25	8:10	11:00	91	185	3.5		Fine	Lightly striped. Tail lost at 185 - no regrowth.
	17/10/2011	T	18	10	B	10:35	8:10	11:00					Fine	Missed - only tail seen.
47	17/10/2011	T	8	5	B	10:45	8:10	11:00	98	321	8.0		Fine	Strongly striped. Large very nice Delma.
48	17/10/2011	T	13	8	B	10:48	8:10	11:00	82	180	3.0		Fine	Light-moderately striped. 80mm tail lost during capture. Pink ventral surface.
49	17/10/2011	T	14	2	W	10:55	8:10	11:00	81	261	5.0		Fine	Strongly striped. Very yellow gular scales
50	24/10/2011	T	13	8	b	7:42	7:40	11:55	80	180	3.0		Partly cloudy, windy	Lightly striped. Strongly orange lateral scales. Tail lost at 180mm, no regrowth
51	24/10/2011	T	14	2	w	10:04	7:40	11:55	82	282	4.5		Partly cloudy, windy	Moderately striped. Light orange lateral scales.
52	24/10/2011	T	8	11	w	8:09	7:40	11:55	78	273	4.3		Partly cloudy, windy	Light-moderately striped
53	24/10/2011	T	12	11	w	8:25	7:40	11:55	97	275	6.0		Partly cloudy, windy	Light-moderately striped. Tail regrowth - ~3.5cm
54	24/10/2011	T	18	9	w	8:35	7:40	11:55	88	198	4.0		Partly cloudy, windy	Lightly striped. Tail regrowth ~4.5cm. Last 1cm tail tip skinny + rough texture -lost again?
55	24/10/2011	T	25	5	B	8:50	7:40	11:55	83	269	4.0		Partly cloudy, windy	Moderately striped. Orange lateral scales + ventral surface, esp. tail
56	24/10/2011	T	25	7	w	8:51	7:40	11:55	81	267	4.0		Partly cloudy, windy	Lightly striped.
57	24/10/2011	T	25	9	w	8:53	7:40	11:55	104	302	6.8		Partly cloudy, windy	Strongly striped. ~2.5cm regrowth.
	24/10/2011	G	1			9:20	7:40	11:55					Partly cloudy, windy	D. impar - missed
58	24/10/2011	T	22	7	w	9:26	7:40	11:55	97	224	6.0		Partly cloudy, windy	Lightly striped. Strongly pink lateral scales. ~4.5cm regrowth. Big/gravid
59	24/10/2011	T	22	3	b	9:26	7:40	11:55	80	252	3.0		Partly cloudy, windy	Lightly striped.
60	24/10/2011	G	2			9:30	7:40	11:55	93	221	5.5		Partly cloudy, windy	Lightly striped. ~55mm regrowth
61	24/10/2011	G	2			9:40	7:40	11:55	92	155	4.5		Partly cloudy, windy	Strongly striped. Tail lost during capture -63mm
62	24/10/2011	T	21	4	b	9:50	7:40	11:55	85	158	3.5		Partly cloudy, windy	Mod-strongly striped. Pink lateral scales. ~5mm regrowth.
63	24/10/2011	T	27	6	b	10:08	7:40	11:55	80	270	3.5		Partly cloudy, windy	Lightly striped.
64	24/10/2011	T	20	4	w	10:20	7:40	11:55	99	317	8.0		Partly cloudy, windy	Light-moderately striped.
65	24/10/2011	T	20	12	w	10:23	7:40	11:55	80	254	3.5		Partly cloudy, windy	Lightly striped.
66	24/10/2011	T	28	3	w	10:50	7:40	11:55	96	296	6.5		Partly cloudy, windy	Strongly striped.
	24/10/2011	T	6	8	w	10:08	7:40	11:55					Partly cloudy, windy	D. impar , missed. Lightly striped.
67	24/10/2011	T	28	5	w	11:16	7:40	11:55	52	151	0.5		Partly cloudy, windy	Juvenile. Lightly striped with dark/black head.
68	24/10/2011	T	9	1	w	11:20	7:40	11:55	77	195	3.5		Partly cloudy, windy	Moderately striped. 45mm tail lost during capture
69	24/10/2011	T	9	5	w	11:25	7:40	11:55	90	192	5.0		Partly cloudy, windy	Strongly striped. 55mm tail lost during capture.
70	24/10/2011	T	1	10	w	11:26	7:40	11:55	81	263	3.5		Partly cloudy, windy	Moderately striped. Orange/pink lateral scales
71	24/10/2011	T	10	3	w	11:40	7:40	11:55	80	266	5.0		Partly cloudy, windy	Lightly striped.
72	24/10/2011	T	11	10	w	11:44	7:40	11:55	92	220	5.5		Partly cloudy, windy	Moderately-strongly striped. ~3mm regrowth
73	31/10/2011	T	9	12	w	7:47	7:40	13:15	78	158	3.5		Fine. Max 22	Strongly striped. No regrowth
74	31/10/2011	T	11	10	w	8:12	7:40	13:15	92	222	4.3		Fine. Max 22	Moderately striped ~3mm regrowth
75	31/10/2011	T	2	2	b	8:32	7:40	13:15	96	293	7.0		Fine. Max 22	Strongly striped
76	31/10/2011	T	4	8	w	8:48	7:40	13:15	78	256	3.5		Fine. Max 22	Lightly striped
77	31/10/2011	T	3	7	b	8:58	7:40	13:15	74	236	3.5		Fine. Max 22	Lightly striped
78	31/10/2011	T	7	2	b	9:16	7:40	13:15	85	140	3.0		Fine. Max 22	Moderately striped. ~2mm regrowth
79	31/10/2011	T	16	7	w	9:40	7:40	13:15	51	151	1.0		Fine. Max 22	Lightly striped. Juvenile
80	31/10/2011	T	22	2	w	10:16	7:40	13:15	103	217	4.8		Fine. Max 22	Light-moderately striped. ~6cm regrowth

81	31/10/2011	T	22	7	w	10:20	7:40	13:15	92	228	5.5		Fine. Max 22	Lightly striped. Dark pink lateral scales and under tail. ~4cm regrowth
82	31/10/2011	T	23	4	b	10:41	7:40	13:15	96	311	6.5		Fine. Max 22	Strongly striped. Orange/pink lateral scales. Scale damage on head
83	31/10/2011	T	13	10	w	11:13	7:40	13:15	90	200	4.5		Fine. Max 22	Very strongly striped. 76mm tail lost
	31/10/2011	T		4	w	11:44	7:40	13:15					Fine. Max 22	Missed (only tail visible). Pink lateral scales
84	31/10/2011	G	1			12:15	7:40	13:15	84	290	5.0		Fine. Max 22	Light-moderately striped
85	08/11/2011	T	13	3	w	7:06	7:00	12:30	82	189	3.5		Overcast, hot	Lightly striped. Orange/pink lateral scales. 1-2mm regrowth only.
86	08/11/2011	T	8	10	b	7:25	7:00	12:30	78	140	3.5		Overcast, hot	Lightly striped. No regrowth
87	08/11/2011	T	25	5	b	7:50	7:00	12:30	102	301	8.5		Overcast, hot	Moderately striped. Big - gravid? 1.5cm regrowth. No yellow throat
88	08/11/2011	T	25	10	w	7:52	7:00	12:30	83	275	5.5		Overcast, hot	Lightly striped. Orange lateral scales
89	08/11/2011	T	25	12	w	7:54	7:00	12:30	105	321	9.5		Overcast, hot	Strongly striped. Pink/orange lateral scales
90	08/11/2011	T	25	6	b	7:56	7:00	12:30	89	280	4.5		Overcast, hot	Moderately striped. Light pink lateral scales
91	08/11/2011	T	23	6	b	8:17	7:00	12:30	85	293	5.0		Overcast, hot	Moderately striped. Very grey (no black on head)
92	08/11/2011	T	27	5	w	8:57	7:00	12:30	88	137	3.0		Overcast, hot	Lightly striped. ~1cm regrowth
93	08/11/2011	T	20	10	w	9:08	7:00	12:30	92	245	5.0		Overcast, hot	Lightly striped. ~3.5cm regrowth
94	08/11/2011	T	3	2	b	9:51	7:00	12:30	98	222	6.5		Overcast, hot	Strongly striped. ~4cm regrowth
95	08/11/2011	T	2	6	b	10:03	7:00	12:30	94	294	7.5		Overcast, hot	Strongly striped.
96	08/11/2011	T	11	4	b	10:12	7:00	12:30	88	175	4.0		Overcast, hot	Lightly striped. ~5cm regrowth
97	08/11/2011	T	11	10	w	10:13	7:00	12:30	103	239	7.0		Overcast, hot	Very strongly striped. ~3cm regrowth. Damage to dorsal side of tail ~3.5cm from vent
98	08/11/2011	T	11	11	w	10:13	7:00	12:30	94	226	5.0		Overcast, hot	Light-mod striped. ~5mm regrowth
99	08/11/2011	T	10	10	w	10:30	7:00	12:30	89	257	4.5		Overcast, hot	Lightly striped. Light orange lateral scales
100	08/11/2011	T	10	5	b	10:31	7:00	12:30	90	226	5.0		Overcast, hot	Light-mod striped. ~4cm regrowth
101	08/11/2011	T	9	11	b	10:44	7:00	12:30	109	228	8.5		Overcast, hot	Very strongly striped. ~6.5cm regrowth
102	08/11/2011	T	9	12	w	10:45	7:00	12:30	100	269	7.5		Overcast, hot	Moderately striped. Faded dark pink lateral scales. ~2cm regrowth
103	14/11/2011	T	11	11	w	7:39	7:10	10:30	103	236	7.0		Fine, some cloud cover	Strongly striped. Light orange lateral. Damage dorsad tale. Wings from vent. 2.5cm regrowth.
104	14/11/2011	T	25	1	b	7:51	7:10	10:30	78	257	3.5		Fine, some cloud cover	Lightly striped. Orange lateral.
105	14/11/2011	T	25	2	w	7:51	7:10	10:30	83	271	3.5		Fine, some cloud cover	Lightly striped. Orange dorsal colour
106	14/11/2011	T	25	6	w	7:53	7:10	10:30	100	295	8.5		Fine, some cloud cover	Mod-strongly striped. 2cm regrowth.
107	14/11/2011	T	17	2	b	8:45	7:10	10:30	81	273	4.5		Fine, some cloud cover	Lightly striped
108	14/11/2011	T	20	9	w	9:03	7:10	10:30	108	325	8.0		Fine, some cloud cover	Mod-strongly striped
109	14/11/2011	T	16	6	b	9:18	7:10	10:30	92	209	4.0		Fine, some cloud cover	Lightly-moderately striped. Orange laterals. 4.5cm regrowth
110	14/11/2011	T	7	4	w	9:37	7:10	10:30	96	292	7.0		Fine, some cloud cover	Lightly striped.
111	14/11/2011	G	2			9:45	7:10	10:30	106	302	8.5		Fine, some cloud cover	Moderately striped. Gravid female. 2cm regrowth
112	14/11/2011	T	1	3	w	9:47	7:10	10:30	105	335	9.0		Fine, some cloud cover	Strongly striped. Orange Lateral.
113	14/11/2011	G	2			9:55	7:10	10:30	112	195	7.5		Fine, some cloud cover	Strong Stripes. Gravid Female. 58mm reqrowth.
114	14/11/2011	T	12	8	w	9:59	7:10	10:30	84	166	9.0		Fine, some cloud cover	Lightly striped. 82cm tail lost.
115	14/11/2011	T	18	12	w	10:11	7:10	10:30	104	232	4.0		Fine, some cloud cover	Strongly striped. 4cm regrowth
116	14/11/2011	T	13	3	w	10:21	7:10	10:30	100	200	7.5		Fine, some cloud cover	Strongly striped. 4cm regrowth
117	14/11/2011	T	5	4	w	10:39	7:10	10:30	105	281	7.0		Fine, some cloud cover	Mod-strongly striped. 3cm regrowth
118	14/11/2011	T	5	5	w	10:40	7:10	10:30	105	309	8.0		Fine, some cloud cover	Mod-strongly striped.
119	14/11/2011	T	3	1	w	10:51	7:10	10:30	87	279	6.5		Fine, some cloud cover	Strongly striped. Orange Lateral.
120	14/11/2011	T	3	1	b	10:52	7:10	10:30	96	300	7.5		Fine, some cloud cover	Strongly striped. Possibly gravid.

121	21/11/2011	T	28	6	w	7:43	7:35	12:15	80	243	4.0		Fog, clearing to partly cloudy, max 25	Lightly striped (orange stripes)
122	21/11/2011	T	2	2	b	8:08	7:35	12:15	80	266	4.5		Fog, clearing to partly cloudy, max 25	Light-moderately striped
123	21/11/2011	T	4	5	w	8:19	7:35	12:15	80	258	3.5		Fog, clearing to partly cloudy, max 25	Lightly striped
124	21/11/2011	T	21	11	b	9:48	7:35	12:15	84	268	4.0		Fog, clearing to partly cloudy, max 25	Lightly striped
125	21/11/2011	T	22	2	w	10:06	7:35	12:15	100	214	4.0		Fog, clearing to partly cloudy, max 25	Moderately striped, orange lateral stripes. Has lost tail twice ~2.5cm regrowth total (inc 0.5cm regrowth on tail tip)
	21/11/2011	T	23	3	w	10:33	7:35	12:15					Fog, clearing to partly cloudy, max 25	Missed
126	21/11/2011	T	23	5	w	10:34	7:35	12:15	94	300	6.5		Fog, clearing to partly cloudy, max 25	Mod-strongly striped. Slight pink lateral scales. Gravid female
127	21/11/2011	T	12	9	w	10:54	7:35	12:15	83	165	3.5		Fog, clearing to partly cloudy, max 25	Lightly striped, orange lateral scales
	21/11/2011	T	18	8	w	11:14	7:35	12:15					Fog, clearing to partly cloudy, max 25	Missed
128	21/11/2011	T	13	3	w	11:23	7:35	12:15	99	202	6.5		Fog, clearing to partly cloudy, max 25	Strongly striped. Gravid female ~4.5cm regrowth
	21/11/2011	T	10	7	b	12:10	7:35	12:15						Missed