

Draft
**National Recovery Plan for the
Grassland Earless Dragon
*Tympanocryptis pinguicolla***



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Australian Government



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A Recovery Plan adopted under the *Commonwealth Environment Protection and Biodiversity Conservation Act* 1999. This plan revises that previously produced for the Grassland Earless Dragon for the period 2000-2004.

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SUMMARY

The Grassland Earless Dragon (*Tympanocryptis pinguicollis*) is a specialist inhabitant of native temperate grasslands, which have been greatly depleted since European settlement (less than 1% remain). The species is currently now known to be extant only in the ACT and adjacent parts of the southern highlands of NSW. It may have declined to extinction in Victoria. Consequently, the Grassland Earless Dragon is recognised as endangered throughout its range.

The main factors involved in the decline of the Grassland Earless Dragon are thought to be loss and fragmentation of habitat due to urban, industrial or agricultural development. In remaining areas of habitat, ongoing degradation processes have included: ploughing, changed fire regimes, changed grazing regimes (introduced and native grazers), weed invasion, use of agricultural chemicals, rock removal, and the impacts of introduced animals, either by predation or by grazing. These threats continue, to varying degrees, at all known sites. Development proposals also are imminent for a number of known sites.

Because the Grassland Earless Dragon is now known from so few sites, and its former distribution has been so reduced and fragmented, all remaining known occurrences are considered critical to the survival of the species, and should not be compromised.

A National Recovery Team for the Grassland Earless Dragon was established in December 1996, responsible for guiding the implementation of the National Recovery Plan.

The National Recovery Team considers that any development at sites known to support populations of the Grassland Earless Dragon, or at sites from which the species has been recorded in the past, would be inappropriate until a national system of reserves and managed areas is established to fulfil the primary objective of this recovery plan.

The primary, long-term, recovery objective of this plan is to ensure the ability of the Grassland Earless Dragon to survive, flourish and maintain its potential for evolutionary development in the wild, across its natural geographic range. Implicit in this is the immediate objective of ensuring the long-term survival of the species throughout its extant distribution. Criteria against which to measure the success of the plan are:

- Viable populations of Grassland Earless Dragon in all jurisdictions are maintained in systems of reserves and/or areas managed specifically for their conservation, and are able to be maintained in the long-term.
- The nature of the known threats is recognised and managed to ensure the long-term survival of these populations.

To achieve the objectives of this plan, recovery actions are designed to (i) acquire baseline ecological and biological data, (ii) assess habitat condition, including ecological and biological function, (iii) manage habitat and protect populations to maintain or increase their size, and (iv) to engage the community in recovery actions. On-ground site management will aim to mitigate threatening processes and thereby insure against extinction. The National Recovery Team considers that translocation would not currently be a useful conservation measure for inclusion in the recovery program, and that it should not be contemplated until the ecology of the species is better understood.

Because of the difficulties with ameliorating all threats, down-listing of the conservation status of all populations may not be realistic within the life of this recovery plan.

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Abbreviations

ACT – Australian Capital Territory
ANZECC – Australian and New Zealand Environment and Conservation Council
CSIRO – Commonwealth Scientific and Industrial Research Organisation
DECC – Department of Environment and Climate Change (NSW)
DEW – Australian Government Department of the Environment and Water Resources
DSE – Victorian Department of Sustainability and Environment
EA – Biodiversity Group, Environment Australia (now DEW)
EACT – Environment ACT (now Parks Conservation and Lands, ACT Department of Territory and Municipal Services)
EPBC – Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FFG – Victorian *Flora and Fauna Guarantee Act 1988*
IUCN – International Union for the Conservation of Nature
NPWS – New South Wales National Parks and Wildlife Service (now within DECC)
NSW – New South Wales
NRE – Victorian Department of Natural Resources and Environment (now DSE)
NRT – Grassland Earless Dragon National Recovery Team
MZ – Melbourne Zoo
PAS – Priorities Action Statement (NSW)
PCL – Parks Conservation and Lands (ACT)
PV – Parks Victoria
RLPB – Rural Lands Protection Board (NSW)
TRWG – Tympanocryptis Regional Working Group (ACT & NSW)
TSC – New South Wales *Threatened Species Conservation Act 1995*

PART A: SPECIES INFORMATION

A1 Name

Tympanocryptis pinguicolla (Mitchell, 1948) has been known by several common names. Prior to its recognition as a distinct species (Smith *et al.* 1999), it was included as a subspecies within the more widespread and variable *Tympanocryptis lineata*, as *T. lineata pinguicolla*, at which time it was known simply as the Lined Earless Dragon. Other common names applied to the subspecies were Southern Lined Earless Dragon or Eastern Lined Earless Dragon (ACT Govt. 1997c). Since recognition as a distinct species, the common name of 'Grassland Earless Dragon' has been widely applied and is used in this plan.

The Grassland Earless Dragon is currently recognised as a distinct species. However, mitochondrial DNA work suggests that the Cooma and ACT populations differ to the extent that these populations represent separate taxonomic units (Scott and Keogh 2000, Melville *et al.* in press).

The Grassland Earless Dragon is the only earless dragon that extends onto the Southern Tablelands of eastern Australia. It is found at higher altitudes and in regions that have cooler temperatures than any other earless dragon. The Grassland Earless Dragon is the only representative of the family Agamidae that is restricted to natural temperate grasslands.

A2 Description

The Grassland Earless Dragon, *Tympanocryptis pinguicolla*, is a small lizard of the family Agamidae. Earless dragons (only part of the genus *Tympanocryptis* as currently recognised - see Cogger 2000) differ from other members of the family by lacking an external ear opening and functional tympanum (ear drum). Adult Grassland Earless Dragons range in size from 50-70 mm snout-vent length (SVL) (Smith 1994, Langston 1996b) with a head to tail length generally less than 150 mm. The adults have stout bodies and short robust legs, with a body mass between five and nine grams. The main morphological differences separating from its congeners are the greater number of mid-dorsal scales, and the greater number of scattered, enlarged, spinous dorsal scales which are also higher than wide (Mitchell 1948, Smith *et al.* 1999). Some morphological differences have been observed between the Canberra and Cooma populations of Grassland Earless Dragons (Nelson 2004).

The Grassland Earless Dragon is light to dark brown dorsally, with three thin white lines running the length of the body (similar to *T. lineata lineata*), which separate darker transverse patches into individual segments. Some individuals have yellow or orange colouration on the throat, sides of the head, flanks, ventral surface, groin and under the tail. Such colouration has been suggested to be male reproductive colours (Jenkins and Bartell 1980), with only adult males displaying orange, predominantly in the Autumn and Spring. Females and juveniles may have some yellow colouring, but this appears to be limited to the gular region and the sides of the head. (Nelson, pers. comm.; Langston 1996a). Individuals can vary in darkness (light to dark brown) in captivity (Peter Robertson personal observation), suggesting that the integument is capable of melanin changes in association with environmental or physiological conditions.

A3 Distribution

A3.1 Former geographical distribution

Tympanocryptis pinguicolla has been recorded from as far north in NSW as Bathurst (Osborne *et al.* 1993b), south through the ACT to the natural temperate grasslands of the Monaro region in the Southern Tablelands (Mitchell 1948). There are reports of the species from grassland and cropland habitat on the Darling Downs near Toowoomba, Queensland

(Smith *et al.* 1999, Anon. 2001), though more recent work (Melville *et al.* in press) points to the Queensland population being *Tympanocryptis tetraporophora*. Within the ACT, past records suggest that the lizard was locally common prior to 1970 (Pryor 1938, Robert Jenkins and David Rowell, pers. comm.), and it was known adjacent to Northbourne Avenue in the 1950s (Young 1992). In Victoria, the species was reported typically from the basalt plains, being known from several locations to the north of Melbourne and as far west as the Geelong area (McCoy 1889, Lucas and Frost 1894, Mitchell 1948, Brereton and Backhouse 1993), where it was described as “not very uncommon” (McCoy 1889). Other old records are from Rutherglen and Maryborough in central Victoria (Lucas and Frost 1894).

A3.2 Current known distribution

Recent records indicate that the Grassland Earless Dragon has undergone a severe decrease in its geographic range. The current and historical distribution is shown in Figure 1. All known localities for the species are listed in Appendix II.

At least two populations have been recorded from the Majura and Jerrabomberra Valleys in the ACT and adjacent parts of NSW (Osborne *et al.* 1993a, Smith 1994, Biosis 1995, Langston 1996a, Nelson *et al.* 1996, 1998a, 1998b, Rowell *et al.* 2000, Dawson 2003), and individuals have been found at nine locations across the Monaro plains near Cooma in NSW (Osborne *et al.* 1993b, Dorrough *et al.* 1996, Dawson 1999, Doody *et al.* 2003, R. Rehwinkel pers. comm.). No sightings or captures of this species have been reported recently from north of the ACT, despite two targeted surveys (Lawler *et al.* 1999, Rowell *et al.* 2000).

In Victoria, five sightings believed to be this species were reported between 1988 and 1990; one from the upper reaches of Merri Creek, one from Holden Flora Reserve, and three from the Little River, west of Werribee. Intensive trapping surveys at these locations since 1994 have failed to confirm the sightings as being Grassland Earless Dragon (P. Robertson, pers. comm.). Many other potential grassland sites to the north and west of Melbourne were also surveyed during this period, and no earless dragons were located. One further reported sighting near Cragieburn in 1990 (Beardsell 1997) requires further investigation. The last confirmed sightings of the Grassland Earless Dragon in Victoria were from the Laverton area in 1960 (Museum of Victoria, coll. P. Robson), Little River in 1967 (coll. W. Bate, illustrated in Jenkins and Bartell 1980), Rockbank area in 1968 (Robson 1968), and the Geelong area in 1969 (Pescott 1969).

* (naturalists, Canberra)

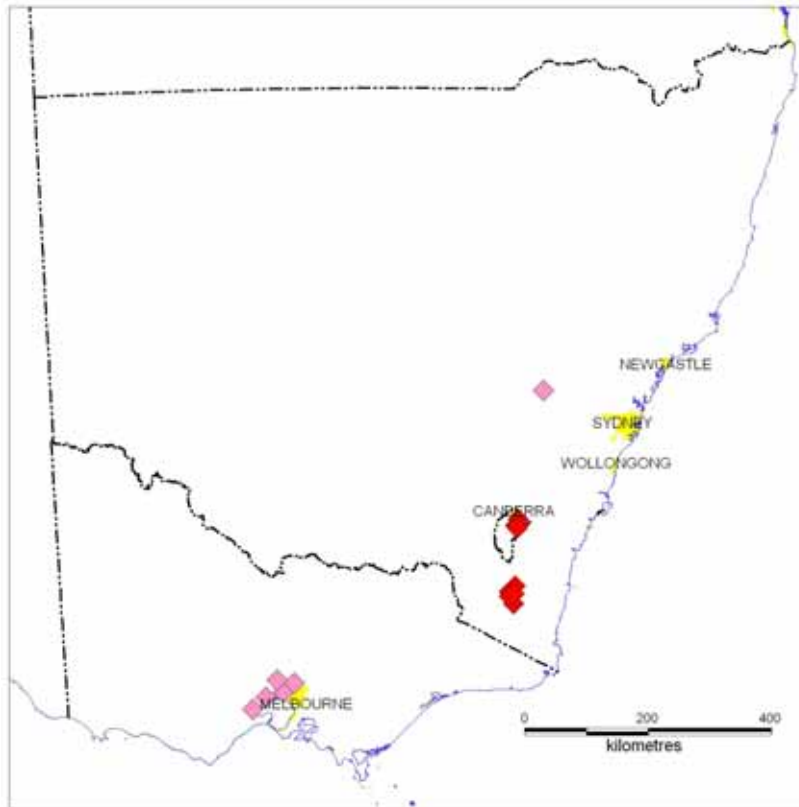


Figure 1 Map of south-eastern Australia indicating extant (♦) and historical (◆) populations of the Grassland Earless Dragon.

A3.3 Tenure of land supporting Grassland Earless Dragons

Sites in NSW known to currently support this species (confirmed from recent records) include five travelling stock reserves, council-owned land and two nature reserves, all on public land. The formal conservation reserves on which the species occurs are the Kuma Nature Reserve near Cooma on the Monaro plains, and the Queanbeyan Nature Reserve on the southern outskirts of Queanbeyan (adjacent to Grassland Earless Dragon habitat in the ACT), both managed by the Department of Environment and Climate Change (NSW). The Kuma Nature Reserve was the first reserve to protect this species. The species has also been found on privately-owned land at ‘The Poplars’ near Queanbeyan, ‘Quartz Hill’ near Cooma, and ‘Carinya’ adjacent to the Kuma Nature Reserve.

In the ACT the species occurs as two geographically separate populations in the Majura and Jerrabomberra Valleys. Sites known to currently support the species include Commonwealth land (Majura Training Area, Canberra Airport, Campbell Park, HMAS Harman), and Territory land, some of which is leasehold and agisted (“Woden”, “Callum Brae”, “Cookanalla”), and some of which is unleased (AMTECH). In 2005 Woden and Callum Brae were withdrawn from leasehold and are now managed by the ACT government to permanently protect the Grassland Earless Dragon and its natural temperate grassland habitat, itself an endangered ecological community. These areas are pending gazettal as Nature Reserve, and a review of land use in the Jerrabomberra Valley has identified additional land for future nature conservation reserves. Another site, on Commonwealth land (Majura Training Area), is subject to a ‘Memorandum of Understanding’ with the Defence Department, and several sites on leasehold land in the Jerrabomberra Valley are subject to management under a ‘Direction of the Conservator of Flora and Fauna’ (in accord with the *Nature Conservation Act 1980*) to protect habitat from incompatible land-uses.

Areas in Victoria where recent unconfirmed sightings were made are crown land (Holden Flora Reserve), and privately-owned land (Little River and Bald Hill). Another unconfirmed sighting was from an area now reserved for conservation (Craigieburn Grasslands Reserve).

The National Recovery Team would consider that any development at sites known to support populations of Grassland Earless Dragons, or at sites from which the species has been recorded in the past, would be inappropriate until a national system of reserves and managed areas is established to fulfil the primary objective of this recovery plan.

A4 Life history and ecology

The first reported study of the life history of these lizards suggested that the animals were semelparous; that is, the young hatched in late summer, grew to adult size rapidly (by late autumn-early winter), mated the following spring, and died within one year of birth (Smith 1994). However, some adults do live longer than one year – perhaps those unable to reach reproductive size in their first year (Langston 1996a, Nelson *et al.* 1996, Nelson 2004). Individuals have been maintained in captivity for in excess of five years. Females are oviparous, and have been found gravid in both spring and early summer, with the eggs laid in late spring or early summer (Langston 1996a,b). Clutches of two females have both contained 5 eggs (Langston 1996a) and clutches laid in 5 artificial burrows (Fletcher *et al.* in prep) contained 3-6 eggs (Nelson 2004). Other species in the genus lay between 5 and 12 eggs per clutch (Greer 1989). The eggs are laid in shallow burrows, and develop over 9-12 weeks before hatching (Langston 1996a). The young possibly disperse soon after hatching, as lizards as small as 0.4 g and 20-25 mm SVL are caught in pit-fall traps or artificial burrows in late summer to mid-April (Smith 1994, Dawson 2003). No information is available concerning either hatching success, juvenile mortality or over-winter survival in the field – however, a lower juvenile/adult ratio observed at the height of the 2002/03 drought may indicate a lower hatching success and/or higher juvenile mortality at that time of environmental stress (Dawson 2003).

The Grassland Earless Dragon has been reported to be torpid in winter (Brereton and Backhouse 1993), but active individuals have been observed above ground in mid-June (Cooper, pers. obs., Nelson 2004), and individuals have been trapped in pits in August in the ACT (Benson 1996). This suggests that individuals can be active throughout the year, whenever weather conditions are appropriate for activity.

Individual adult animals have been shown to move as much as 40 to 110 m per day (Langston 1996, Nelson 2004), with some movements in excess of 230 m over longer periods. Nothing is known about movements of juveniles, although this stage may be when dispersal occurs. Movement patterns of juveniles may be the most important observation necessary for understanding the area requirements for success of populations. Population density may be influenced by social interactions, as aggressive encounters between individual lizards, involving vocalisations and displays, have been observed in captive animals (Smith 1994) and in the field (Nelson, pers. comm.). Such interactions may also influence dispersal patterns.

A5 Habitat

Little information has been available about the habitat of the Grassland Earless Dragon until recently. Observations in NSW and the ACT indicate that the species is found in natural temperate grasslands, dominated by wallaby grasses (*Danthonia* spp.), spear grasses (*Stipa* spp.), tussock grasses (*Poa* sp.) and possibly Kangaroo Grass (*Themeda triandra*). Captures in the ACT using pit-fall traps and artificial arthropod burrows suggest that the animals prefer well-drained natural temperate grasslands that are relatively undisturbed and with minimal pasture improvement. There appears to be a preference for shorter grassland with an open structure or with open areas, and some aspects of the structure of the grassland (such as distribution of tussocks and low, open grass) may be important (Smith 1994, Benson 1996, Langston 1996, Nelson *et al.* 2000, Dunford *et al.* 2001). However, the

apparently patchy occurrence of Grassland Earless Dragons, even within such areas, may indicate more subtle relationships within their grassland habitats.

The Grassland Earless Dragon is known to make use of arthropod burrows in the ACT region (Jenkins and Bartell 1980, Osborne *et al.* 1993b, Smith 1994, Langston 1996) and in Victoria (McCoy 1889), but also shelters beneath rocks in Victoria (Lucas and Frost 1894, Brereton and Backhouse 1993) and in NSW (Osborne *et al.* 1993b, Dawson 1999), or within *Stipa* tussocks in the ACT (Langston 1996a,b). The use of various shelter sites may vary with season and local environmental conditions, and individuals have been observed to move between natural burrows (Benson 1996) and between artificial burrows (Evans and Ormay 2002). Individuals have been reported to retreat into arthropod burrows (McCoy 1889, Evans pers. comm.) or into tussocks and under rocks when alarmed (Nelson pers. comm.).

The importance of invertebrate burrows or lightly embedded surface rocks as shelter and refuge sites has become apparent, and the availability of such sites may be the predominant factor influencing persistence of the species at some sites, rather than the structure or floristics of the grasslands *per se*. Indeed, the species is known from areas where the native grasslands are quite species poor, or 'degraded', yet the lizards find shelter in or under these alternative structures (Dawson 1999, 2003, Nelson *et al.* 2000, Dunford *et al.* 2001).

A5.1 Critical habitat

Because the Grassland Earless Dragon is now known from so few sites, and its former distribution has been so reduced, all remaining known occurrences are considered critical to the survival of the species.

No critical habitat, as defined under Part 3 of the TSC Act, has been declared for the species in NSW. No critical habitat, as defined under the FFG Act, has been declared for the species in Victoria.

Whilst the ACT Nature Conservation Act 1980 does not specifically provide for declaration of critical habitat, it does provide mechanisms to protect off-reserve habitat, such as Land Management Agreements and Conservation Directions. Both of these legal mechanisms have been used to protect habitat considered to be crucial to the survival of the species in the ACT. Most of the critical habitat for the Grassland Earless Dragon is also listed as an endangered ecological community under the Nature Conservation Act 1980 and the EPBC Act 1999. Much of the habitat considered critical for the Grassland Earless Dragon on Commonwealth land within the ACT is protected through a Memorandum of Understanding between the ACT and Australian Governments, in addition to the requirements of the EPBC Act 1999. However, development at the Canberra Airport does not require the approval of the Minister for the Environment (under Section 160 of the EPBC Act) and proposals both underway and in planning at that site have resulted in the loss of known habitat and threaten further areas of occupied habitat.

A5.2 Mapping of habitat critical to survival of the species

At this stage it is not possible to refine this appreciation of the extent of habitat that is critical to the survival of the Grassland Earless Dragon (see above). One of the actions of this Recovery Plan is to gain a greater understanding of the critical components of this species' habitat (see Section C9).

A6 Threats

The main factors involved in the decline of the Grassland Earless Dragon are thought to be loss and fragmentation of habitat due to urban, industrial or agricultural development, and these processes still threaten extant populations. In remaining areas of habitat, degradation processes are thought to have included: ploughing, changed fire regimes, changed grazing regimes (both stock and kangaroos), weed invasion, use of agricultural chemicals and rock removal. Introduced animals (fox, cat, rabbit, mouse, sheep, cow) have caused impacts to a

range of biota in Australia and may negatively affect the Grassland Earless Dragon, either by predation or by grazing.

Synergistic effects of a combination of these threats may also be important. For example, cat predation may be more important closer to urban developments or in areas where vegetation cover has been reduced by grazing.

These threats continue, to varying degrees, at all known sites. Populations are now fragmented in distribution – while there is little likelihood of the creation of ecological links for some of these (ACT Government 1997c), for others currently unsuitable habitat could be enhanced to provide links. Development proposals are planned for a number of known sites. These include: airport modifications, railway expansion, new roads, a freeway, a technology park, a prison, environmental trade zones, landfill extension, and urban or rural residential development.

Native grasslands are periodically exposed to fire. During a fire (late February 1997) at the Majura Training Area (Majura Valley, ACT), some mortality was observed, although some individuals were able to escape by retreating to burrows (L. Nelson, pers. comm.). The species was recorded in burnt areas during monitoring of the site the year following the fire (Nelson *et al.* 1998a) and in subsequent years (Evans and Ormay 2002), although body condition of individuals was reduced immediately following the fire (Nelson pers. comm.).

Low-intensity grazing (such as on “Woden”, ACT) and regular mowing (e.g. Canberra airport) may not severely disrupt populations, as indicated by consistent trapping records at both of these sites (Nelson *et al.* 1998b, Evans and Ormay 2002). Locations on the Monaro where continuous grazing has occurred also are capable of maintaining a population of dragons (Tim Fletcher, pers. comm.). Seasonal grazing (autumn and winter) is currently employed as a habitat management tool at Kuma NR. Observations indicate that arthropod burrows, surface rocks, or other similar refuge sites may be necessary for the continued persistence of populations of these dragons, by providing thermal refugia (Nelson 2004).

The highly changeable nature of grasslands through time, and the occurrence of periodic catastrophic events (such as fire or prolonged, heavy grazing from stock or kangaroos) may in the past have excluded Grassland Earless Dragons from areas that now appear to support suitable habitat.

Grassland Earless Dragons are generally not present where native grassland has been substantially modified through cultivation (ploughing or cropping). Cultivation results in changes to plant species composition, structure and possibly food availability (arthropods) that is likely to result in severe degradation or complete removal of suitable habitat for the species. Soil disturbance, such as ploughing or compaction, might also result in destruction of arthropod burrows (shelter sites) and possibly a reduction in the abundance, at least in the short-term, of burrow forming arthropods. However, Grassland Earless Dragons have been recorded in areas that have been ploughed in the past, but still support native grassland and are adjacent to high quality habitat.

A7 Conservation status

The Grassland Earless Dragon, *Tympanocryptis pinguicolla*, is listed as threatened under the following international, Commonwealth, state and territory legislation and documentation: IUCN (1996); *Environment Protection and Biodiversity Conservation Act* 1999 (Commonwealth); Action Plan for Australian Reptiles (Cogger *et al.* 1993); Section 21 of the *Nature Conservation Act* 1980 (ACT); Schedule 6 of the *Nature Conservation Act* 1980 (ACT); Schedule 1 of the *Threatened Species Conservation Act* 1995 (NSW); Schedule 2 of the *Flora and Fauna Guarantee Act* 1988 (Vic).

Current conservation status:

International

IUCN (1996). Vulnerable

National

Environment Protection and Biodiversity Conservation Act 1999. Endangered.

ESAC. Priority B.

Action Plan for Australian Reptiles (Cogger *et al.* 1993). Vulnerable

Australian Capital Territory

Section 21 of the *Nature Conservation Act 1980*, Determination No. 29 of 1996, and Determination No. 89 of 1997. Endangered

Schedule 6 of the *Nature Conservation Act 1980.*, Determination No. 77 of 1996.

Special Protection Status Species

New South Wales

Schedule 1 of the *Threatened Species Conservation Act 1995. Endangered*

Victoria

Schedule 2 of the *Flora and Fauna Guarantee Act 1988.*

Threatened Taxon (Action Statement No. 35 prepared 1993, due for review 1995).

DSE 2003 - *Threatened Fauna in Victoria. Critically Endangered*

A8 Important populations

The apparent extent of decline of the Grassland Earless Dragon and its grassland habitat indicates that all extant populations are extremely important for the survival of the taxon. The relevant state and territory conservation agencies, which generally assess the status of threatened species by considering populations only within their boundaries, have reflected this by placing the species in categories of very high conservation concern. All currently known and subsequently discovered populations should be considered in conservation strategies for this species. Known populations are listed in Appendix II.

PART B: GENERAL REQUIREMENTS

B1 Objects of the Environment Protection and Biodiversity Conservation Act 1999

- a) to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance; and
- b) to promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources; and
- c) to promote the conservation of biodiversity; and
- d) to promote a cooperative approach to the protection and management of the environment involving governments, the community, land-holders and indigenous peoples; and
- e) to assist in the cooperative implementation of Australia's international environmental responsibilities; and
- f) to recognise the role of indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity; and
- g) to promote the use of indigenous peoples' knowledge of biodiversity with the involvement of, and in cooperation with, the owners of the knowledge.

B2 Relevant legislation

Legislation relevant to the management and conservation of the Grassland Earless Dragon includes:

Commonwealth

- *Native Title Act 1993*
- *Environment Protection and Biodiversity Conservation Act 1999*

New South Wales

- *National Parks and Wildlife Act 1974*
- *Environmental Planning and Assessment Act 1979*
- *Rural Fires Act 1997*
- *Threatened Species Conservation Act 1995*
- *Threatened Species Legislation Amendment Act 2004*
- *Native Vegetation Act 2003*
- *Rural Lands Protection Act 1998*

ACT

- *Nature Conservation Act 1980*
- *Land (Planning and Environment) Act 1991*

Victoria

- *Country Fire Authority Act 1958*
- *Soil Conservation and Land Utilisation Act 1958*
- *Forests Act 1958*
- *Land Conservation Act 1970*
- *Environment Protection Act 1970*
- *National Parks Act 1975*
- *Wildlife Act 1975*
- *Environmental Effects Act 1978*
- *Conservation, Forests and Lands Act 1987*
- *Flora and Fauna Guarantee Act 1988*

- *Water Act 1989*
- *Catchment and Land Protection Act 1994*

B3 International obligations

As the Grassland Earless Dragon is not listed under any international agreement, the implementation of Australia's international environmental responsibilities is not affected by this plan.

However, the implementation of this Recovery Plan will further support the principles of the following international conventions and agreements:

- *1992 United Nations Convention on Biological Diversity*
- *1992 Rio Declaration on Environment and Development (Agenda 21)*

B4 Affected interests

Several organisations have legislative responsibilities relating to the Grassland Earless Dragon, and will be involved in all stages of this Recovery Plan. At a national level, the taxon is listed as threatened on the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), administered by the federal Department of Environment and Water Resources. Any action that will have, or is likely to have, a significant impact on a taxon listed on this legislation will trigger the EPBC provisions, necessitating approval from the Commonwealth Environment Minister. Critical habitat may be listed for any nationally listed taxon or ecological community under the EPBC Act.

In the ACT a significant part of the habitat for the species is found on land for which Australian Government agencies have some regulatory or planning responsibility. The Majura Military Training Area is managed by the Department of Defence with a Memorandum of Understanding with the ACT Government and Department of the Environment and Water Resources, covering biodiversity management issues. The privately owned Canberra International Airport is responsible for management of Grassland Earless Dragon habitat found at the airport, but the land is also governed by the National Capital Plan, administered by the National Capital Authority, and the Airport's Major Development Plan, Environment Strategy and Grassland Management Plan are approved by the Minister for Transport and Regional Services. Development at this site does not require the approval of the Minister for the Environment, though any actions that may result in harm to Grassland Earless Dragons or their habitat require a permit from DEW under Section 201 of the EPBC Act.

Agencies involved:

National

- *Department of Environment and Water Resources*
- *Department of Defence*
- *Department of Transport and Regional Services*
- *National Capital Authority*

ACT

- *Parks, Conservation and Lands*
- *Canberra International Airport*
- *ACT Planning and Land Authority*

NSW

- *DEC (NPWS)*
- *Department of Natural Resources*
- *Catchment Management Authorities*
- *Local Governments*
- *Rural Land Protection Boards*

Victoria

- *Department of Sustainability and Environment*
- *Parks Victoria*
- *Local Governments*

Within New South Wales, the Grassland Earless Dragon is listed under the *Threatened Species Conservation Act 1995*. This Act outlines the duties of the Department of Environment and Climate Change in protecting threatened species, ecological communities and critical habitat in NSW. An independent Scientific Committee has been set up under the Act to determine which species, populations and ecological communities should be listed as endangered, vulnerable or extinct under the act, and also to determine key threatening processes. The TSC Act provides an exemption for the carrying out of “*routine agricultural activities*”. As such there not likely to be economic implications for primary producers in NSW under the TSC Act – however, the Commonwealth EPBC Act offers no such exemption for agricultural activities. Actions for the recovery of the species in NSW have been identified in the Threatened Species Priorities Action Statement (PAS), a mechanism recently provided for by the *Threatened Species Legislation Amendment Act 2004*. While this legislation removes the statutory requirement to prepare a recovery plan for a species, the actions previously identified in a draft recovery plan for the Grassland Earless Dragon have been included in the PAS.

In the Australian Capital Territory, the Grassland Earless Dragon is listed as endangered under the Nature Conservation Act 1980. Natural Temperate Grassland, which is the main habitat of Grassland Earless Dragons in the ACT, is also listed under the Act as an endangered Ecological Community. An independent scientific committee set up under the Act determines which species and ecological communities should be listed as threatened (endangered, vulnerable or extinct) under the Act. The Act outlines the requirement for preparation of Action Plans for the conservation of listed threatened species and ecological communities. Action Plans identify actions that have been or will be taken to conserve the listed species or community. An Action Plan for the Grassland Earless Dragon was prepared in 1997 (ACT Government 1997c) and was subsequently revised as part of a multi-species Action Plan for the Natural Temperate Grassland ecological community and component species (Action Plan 28: ACT Lowland Native Grassland Conservation Strategy, ACT Government 2005). Primary responsibility for the conservation of fauna and flora (including threatened species and communities) and management of the reserve system rests with Parks, Conservation and Lands (ACT Government). The Nature Conservation Act 1980 also has provisions (‘Directions of the Conservator of Flora and Fauna’) for directing landholders to undertake, or to not undertake, specified land management actions for conservation purposes. These provisions were invoked for the first time in 2004 when they were applied to certain rural leases for the protection of Grassland Earless Dragons and their habitat.

In Victoria, the Grassland Earless Dragon is listed on the *Advisory List of Threatened Vertebrate Fauna in Victoria* (DSE 2003) as well as the *Flora and Fauna Guarantee Act 1988* (FFG). This Act provides the main legal framework for the protection of Victoria's biodiversity. When a listing occurs, an ‘Action Statement’ must be prepared; this is a document that identifies actions that have been or will be taken to conserve the taxon. An Action Statement targeting the Grassland Earless Dragon has been prepared (Brereton & Backhouse 1993). The Department of Sustainability and Environment (DSE) has ultimate responsibility for the management of threatened species in Victoria, and is the primary agency involved in management on public and private land, with the exception of the parks and reserves system. Parks Victoria (PV) manages the parks and reserves system. As a proportion of the species’ former Victorian distribution occurs in the parks system, PV has management responsibilities to this taxon within their estate.

Grassland Earless Dragons occur on freehold land at some sites, necessitating the involvement of private individuals. Under the EPBC Act, these individuals have a responsibility to ensure that any development on their properties does not harm the species. Any such developments commencing since the inception of the EPBC Act will trigger a

referral. An action that would remove, modify or degrade habitat of Grassland Earless Dragons and that results in a significant impact on the species may require referral to the Commonwealth Environment Minister under the EPBC Act for a decision on whether assessment and approval of the action is required.

Private landowners can facilitate monitoring and recovery actions for Grassland Earless Dragons by permitting access to habitat on their land, consulting with agencies and individuals involved in these activities, and ensuring that their own activities do not negatively impact the species or its habitat on or near their properties.

B5 Role and interests of indigenous people

In the ACT and region, the Ngunnawal people are the traditional users of the native grasslands that are habitat for Grassland Earless Dragons. The Ngunnawal are a diverse people composed of several subgroups.

In NSW the indigenous communities involved in the regions affected by this plan have not yet been identified. Implementation of recovery actions under this plan will include consideration of the role and interests of indigenous communities in the region.

In Victoria, the Wurundjeri people are the traditional occupiers of the Port Phillip region, with the Woiwurrung subgroup occupying the northern plains and the Wathaurong subgroup occupying the western area that includes the Little River site. The Victorian Government has developed an Indigenous Partnership Strategy and is preparing Regional Indigenous Action Plans (RIAP). The DSE Port Phillip Region RIAP includes actions to consult with indigenous communities on land management and threatened species programs.

B6 Social and economic impacts

Conservation of the habitat of Grassland Earless Dragons may affect activities that conflict with objectives of this Recovery Plan. Examples of where habitat conservation may affect certain activities include restrictions on developments on private property, or restrictions on particular land-uses. Development of urban land and infrastructure such as roads can conflict with efforts to conserve habitat for Grassland Earless Dragons, particularly adjacent to the suburbs of Canberra and Queanbeyan. Similarly, management of the species in rural areas may affect development of infrastructure, or the type of utilisation of land.

Where conflict occurs between actions outlined in this Recovery Plan and the interests of others, consultation between the appropriate land management agency and the affected individuals shall occur with the aim of negotiating a desirable outcome for all parties.

There are considerable positive benefits in protecting Grassland Earless Dragon habitats. The protection of these areas will augment intrinsic natural values enjoyed by visitors to such areas. These benefits complement the management aims of national parks and other reserved land where this species occurs, and visitors to these areas provide economic benefits for the local districts. Involving the community and private landholders in recovery efforts can foster a sense of pride in contributing to conservation programs.

B6.1 Economic considerations

There is a variety of conservation-based actions that may be appropriate and necessary to alleviate perceived threats and secure the conservation of the Grassland Earless Dragon in different land tenure situations. These actions have economic implications for both private individuals and various government organisations/agencies. These are summarised in the following table.

Action	Affected parties
Altered stocking rates	Rural landowners/lessees.
Restrictions on certain management practices, e.g. pasture improvement, controlled burning and slashing.	All managers of land with Grassland Earless Dragon populations. (Altered stocking rates and restriction on agricultural management practices do not necessarily apply on private agricultural land in NSW.)
Rejection of, or alteration to, proposed urban, infrastructure or industrial developments.	Developers. Land owners. Any parties to be serviced by the proposed developments. Transport facilities, such as Majura Parkway and Canberra International Airport. Governments, or corporations such as Telstra and RTA.
Land acquisition for reservation.	State/Territory and Australian Government conservation agencies. Rural landowners/lessees. Potential location of future urban centres.

B6.2 Social considerations

There are both positive and negative social consequences of implementing this Recovery Plan. The major positive consequence is the long-term conservation of both the Grassland Earless Dragon and its grassland habitat for the enjoyment of present and future Australians. The protection of these areas will augment intrinsic natural values enjoyed by visitors to such areas. These benefits complement the management aims of national parks and other reserved land where this species occurs, and visitors to these areas provide economic benefits for the local districts. Involving the community and private landholders in recovery efforts can foster a sense of pride in contributing to conservation programs.

B6.3 Practical considerations

Surveys for Grassland Earless Dragons are expensive and time-consuming, and access to private lands is sometimes problematic. Therefore, it may not be practical to survey all potential habitat within the time-frame of this Recovery Plan. Conservation agencies should therefore use all other means at their disposal for obtaining this information. Many records of this and other threatened species come from work undertaken by consultants and students for other purposes. Conservation agencies should encourage consultants to undertake targeted surveys for Grassland Earless Dragons whenever they are working in potential habitat, and recommended methodologies should be developed by the NRT. It is extremely important that these records are incorporated by conservation agencies into their databases. In this way, even without targeted surveys, increasing knowledge of distribution can be obtained.

Nevertheless, in comparison to the costs associated with major infrastructure works, Grassland Earless Dragon surveys are an insignificant cost and should be undertaken in the early planning phases of such works. Such surveys will provide certainty in the planning process and permit implementation of developments, thus saving development costs. Detailed and standardised survey guidelines for such investigations will be developed during the implementation of this plan – interim guidelines are included here as Appendix IV.

Similarly, land acquisition to establish a system of grassland reserves is extremely expensive, and must be viewed as a long-term and on-going process, to be achieved in concert with sympathetic management of private and other lands via various agreements or legislative mechanisms. Planning of such a system will rely upon a thorough understanding of the distribution and habitat requirements of the species, as well as insights into the size of areas required to support long-term viable populations.

B7 Benefits to other species/ecological communities

The Recovery Plan includes a number of potential biodiversity benefits for other species and vegetation communities throughout the range of the Grassland Earless Dragon. Principally, this will be through the protection and management of habitat.

There is a broad range of potentially threatening processes that are likely to be acting upon populations of Grassland Earless Dragons; mitigation of these processes will have wide-ranging benefits for maintenance of ecological processes and biodiversity conservation. The distribution of the Grassland Earless Dragon partly overlaps with habitat critical for the conservation of other threatened species and communities. For example, this species occurs in and adjacent to threatened grassland communities fringing Canberra and nearby Queanbeyan - these grasslands provide habitat for threatened or rare fauna such as the Striped Legless Lizard (*Delma impar*), Pink-tailed Worm Lizard (*Aprasia parapulchella*), Golden Sun Moth (*Synemon plana*), Perunga Grasshopper (*Perunga ochracea*) and Canberra Raspy Cricket (*Cooraboorama canberrae*), as well as a suite of threatened plant species. Conservation measures for Grassland Earless Dragons in these areas are likely to benefit these other species and the overall grassland community. However, conservation measures for Grassland Earless Dragons cannot be limited to these areas of overlap with other values, as important populations of the species do occur in otherwise degraded areas.

The conservation of the Grassland Earless Dragon and its habitat will assist in the conservation of natural temperate grasslands, which are among Australia's most threatened ecological communities (Australian and New Zealand Environment and Conservation Council and Biological Diversity Advisory Committee 2001). Natural temperate grasslands have been reduced to just 0.5% of their extent at the time of European settlement (Kirkpatrick *et al.* 1995). The broad habitat of the Grassland Earless Dragon is natural temperate grassland. Consequently, the conservation of Grassland Earless Dragons involves conservation of such grassland areas and the suite of threatened species associated with them. Natural Temperate Grasslands of the Southern Tablelands have been listed as an endangered ecological community (EACT 2003). *Tympanocryptis pinguicolla* has, in some instances, acted as a 'flagship' species in the conservation of natural temperate grasslands, because conservation activities attracted considerable attention, based upon the 'novelty' of the species. The promotion of grassland conservation is problematic, however, because grasslands do not have the broad public appreciation of forests, rivers or wetlands. Because of this, having a species such as the Grassland Earless Dragon as a well-known 'flagship' can be invaluable in the overall conservation of natural temperate grasslands.

B8 Related plans

ACT Government. (1997a). *Natural temperate grassland: An endangered ecological community*. Action Plan No. 1. Environment ACT, Canberra.

ACT Government. (1997b). *Striped Legless Lizard (Delma impar): A vulnerable species*. Action Plan No. 2. Environment ACT, Canberra.

ACT Government. (1997c). *Eastern Lined Earless Dragon (Tympanocryptis pinguicolla): An endangered species*. Action Plan No. 3. Environment ACT, Canberra.

EACT. (2003). National Recovery Plan for Natural Temperate Grassland of the Southern Tablelands (NSW and ACT): an endangered ecological community. Environment ACT, Canberra.

NSW Draft Threatened Species Priorities Action Statement (2006). Department of Environment and Conservation (NSW). Sydney.

Port Phillip & Westernport Catchment Management Authority (2005). Regional Catchment Strategy. PPWCMA, Frankston, Vic.

- Department of Sustainability & Environment (2004). Donnybrook Biodiversity Local Area Plan. DSE, Port Phillip Region, Melbourne.
- Parks Victoria (2004). Craigieburn Grasslands Flora & Fauna Reserve - Management Guidelines. Parks Victoria, Melbourne.
- Parks Victoria (2005). Merri Creek Regional Park – Draft Management Plan. Parks Victoria, Melbourne.
- Parks Victoria (2005). Holden Flora & Fauna Reserve – Management Guidelines. Parks Victoria, Melbourne.
- Brereton, R. & Backhouse, G. (1993). *Southern Lined Earless Dragon* – FFG Action Statement No. 35. CNR, Melbourne.
- Muir, A. (1995). *Western Basalt Plains Grassland Community*. – FFG Action Statement No. 5. NRE, Melbourne.

PART C: RECOVERY OBJECTIVES, CRITERIA AND ACTIONS

C1 Objectives

C1.1 Primary objective

The primary, long-term, recovery objective is to ensure the ability of the Grassland Earless Dragon to survive, flourish and maintain its potential for evolutionary development in the wild, across its natural geographic range.

Implicit in this is the immediate objective of ensuring the long-term survival of the species throughout its extant distribution.

C1.2 Specific objectives

1. Determine the distribution and abundance of Grassland Earless Dragons in order to define habitats critical to the survival of the species.
2. Maintain or increase the abundance/distribution of the species by better understanding those aspects of the biology of the Grassland Earless Dragon that will enable effective management of populations and habitat.
3. Identify the nature and extent of the processes that threaten Grassland Earless Dragons and their habitat, and the measures needed to abate these.
4. Establish a system of reserves and other areas under appropriate protection and management such that all populations¹ are maintained or increased.
5. Monitor populations and habitats of Grassland Earless Dragons and the implementation and effectiveness of management prescriptions to provide a basis for adaptive management and to identify new threats.
6. Determine if there is a need for salvage of individuals from doomed sites, determine the feasibility of such measures, and develop and implement a protocol. Determine if there is a need for translocation, determine its feasibility, and develop and implement a protocol.

C2 Recovery performance criteria

C2.1 Primary recovery criteria

- Viable populations of Grassland Earless Dragons in all jurisdictions are maintained in systems of reserves and/or areas managed specifically for their conservation, and are able to be maintained or increased in the long-term.
- The nature of the known threats is recognised and managed to ensure the long-term survival of these populations.

Because of the difficulties with ameliorating all threats, down-listing of the conservation status of all populations may not be realistic within the life of this Recovery Plan.

C2.2 Specific recovery criteria

Objective 1.

- Potential Grassland Earless Dragon habitat in NSW, Victoria and the ACT has been identified by 2010.
- Vegetation and Grassland Earless Dragon surveys completed in representative areas of potential habitat in NSW, Victoria and the ACT by 2010.

¹ The term 'population', as used herein, is used to indicate one potentially interbreeding unit.

- Grassland Earless Dragon distribution in NSW, Victoria and the ACT comprehensively documented/mapped by 2010.
- Minimum recommended survey methodology established by 2010.
- Habitats critical to the survival of the Grassland Earless Dragon have been defined and mapped/documentated by 2010.

Objective 2.

- Key habitat requirements have been determined within 2010 and are used to establish the extent and use of potential habitat.
- Home range, densities, movements, seasonal activity patterns, and dispersal of Grassland Earless Dragons are understood.
- Key elements of the life history and demography of the Grassland Earless Dragon are known.
- The effects of fire in grasslands on Grassland Earless Dragons and their prey are understood.
- Appropriate grazing levels (stock, kangaroos) for habitats have been identified.
- The diet of the Grassland Earless Dragon is known, and the influence of diet and food availability on distribution and habitat use is understood.
- The interactions of Grassland Earless Dragons with burrow forming/using arthropods, and the influence of these interactions on distribution and habitat use, are understood.
- The genetic variability within the species, and the geographic distribution of this variability, is understood.
- Management practices are informed by the most up-to-date knowledge of the ecology of the Grassland Earless Dragon.

Objective 3.

- The nature and extent of threats to the species are well understood.
- Appropriate research has been undertaken by 2010 to enable guidelines to be formulated to reduce or eliminate the effects of threatening processes.
- A program for ameliorating the effects of critical threatening processes is established at each site throughout the range of the species.

Objective 4.

- All known viable populations of Grassland Earless Dragon are under secure management in reserves and other managed areas across the natural distribution of the species by 2010.
- Beneficial management of Grassland Earless Dragon habitat has been determined and is being implemented across all known habitat by 2010.
- Threatening processes that modify habitat have been identified and managed appropriately.
- Any proposed developments in potential or known sites trigger referrals to appropriate authorities under planning/environment legislation.
- A stable and/or increasing total population is maintained, as determined by appropriate techniques for estimating and monitoring Grassland Earless Dragon populations.

Objective 5.

- A monitoring program of the species and its habitat, which is efficient and causes minimal habitat and behavioural disturbance, is established across the distribution of the species by 2010.
- The effectiveness of management prescriptions is continually assessed using the results of the monitoring program.
- Any threats are identified as they may arise.

Objective 6.

- The need for salvage of animals has been examined, and any potential benefits for the conservation of the species clearly identified by 2010.
- The feasibility and likelihood of success of salvage has been determined by 2010.
- Criteria for the circumstances under which salvage may be considered, and a methodology for doing so, have been developed, and there is general agreement on these protocols by 2010.
- Once agreed to, protocols relating to salvage are followed in all relevant circumstances.
- The need for translocation of animals has been examined by 2010.
- The feasibility and likelihood of success of translocation has been assessed.
- Criteria for the circumstances under which translocation may be considered have been formulated, a methodology for doing so has been developed, and there is general agreement on these protocols by 2010.
- Once agreed to, protocols relating to translocation are followed in all relevant circumstances.

C3 Previous conservation measures

C3.1 Co-ordination and communication of research and recovery actions

An Action Statement for the Grassland Earless Dragon has been prepared in Victoria (Brereton and Backhouse 1993), in accordance with the *Flora and Fauna Guarantee Act 1988*. This Action Statement documents the range of actions previously undertaken in Victoria, and lists actions required for the conservation of the species in that State. It is now due for review.

An Action Plan for the Grassland Earless Dragon has been prepared in the ACT (ACT Government 1997c), in accordance with section 23 of the *Nature Conservation Act 1980*. Similarly, it documents current understanding of the biology of the species, lists its conservation requirements in the ACT, and proposes research priorities. The guidelines for achieving protection of the species via reservation and management agreements are particularly useful. In 2004 this Action Plan was reviewed and combined with several other action plans into a multi-species/community Action Plan for lowland native grasslands (Action Plan 28, ACT Government 2005).

Actions for the recovery of the species in NSW have been identified in the Threatened Species Priorities Action Statement (PAS), provided for by the *Threatened Species Legislation Amendment Act 2004*. These actions outline the survey, mapping, monitoring, habitat protection, habitat management and community education and awareness measures required promote the recovery of the species in the State.

A National Recovery Team (NRT) for the Grassland Earless Dragon was established in December 1996. This team has been co-ordinating national research and management efforts since its establishment. Survey and other research directions are planned and acted upon primarily by three bodies: the Victorian Department of Sustainability and Environment (DSE), the ACT and NSW *Tympanocryptis* Regional Working Group (TRWG, which includes ACT Parks Conservation and Lands and the NSW Department of Environment and Climate Change). These regional bodies deal with the specific issues faced by their regions, and report back to the National Recovery Team regarding progress on recovery actions. Both the regional bodies and the National Recovery Team liaise closely with university research groups, other relevant working groups, and recovery teams such as the Striped Legless Lizard National Recovery Team and various grassland recovery groups. The studies co-ordinated by the TRWG and DSE, in conjunction with university and other workers, have provided most of the current knowledge of Grassland Earless Dragon distribution and biology.

Organisations that are, or have been, represented on the NRT include:

ACT Herpetological Association
Australian National University
CSIRO Sustainable Ecosystems
Department of Defence
Department of Environment and Climate Change (NSW)
Department of Environment and Water Resources (Australian Government)
Department of Sustainability and Environment, Victoria
Parks, Conservation and Lands (ACT)
Friends of Grasslands (ACT)
University of Canberra
Zoos Victoria

C3.2 Surveys and research

Survey programs to investigate the distribution of Grassland Earless Dragons commenced in 1992 in the ACT (Osborne *et al.* 1993a, Fletcher *et al.* 1995, Rauhala 1996, Langston 1996, Nelson *et al.* 1996, 1998a, 1998b), in 1994 in Victoria (Robertson and Webster, in prep.) and in 1999 in NSW (Lawler *et al.* 1999).

Extensive survey programs in the ACT found the species at some survey sites (see Appendix II), and have identified the locations of key habitat and populations. Additional survey work is required to determine the exact geographic extent of these populations.

In Victoria, survey efforts have concentrated in the Melbourne and Geelong regions, at sites of reported sightings and in areas of potentially suitable habitat within the former distribution of the species. No Grassland Earless Dragons were located, but large areas are still to be examined.

Preliminary surveys were undertaken in NSW (Osborne *et al.* 1993b, Biosis 1995, Dorough *et al.* 1996, Langston 1996a,b), during which the species was located around the Monaro Plains. Targeted surveys were undertaken in the Yass district in 1998-99 (Lawler *et al.* 1999), the Goulburn and Queanbeyan region in 2000 (Rowell *et al.* 2000), and the Queanbeyan/Michelago region in 2001 (Rowell unpublished data). As further refinement of remote sensing identifies more potential habitat, it is possible that further targeted surveys will be undertaken (Rehwinkel 1997; Fallding 2002). Targeted surveys have also been undertaken at sites where developments have been proposed, confirming the presence and refining the extent of populations at 'The Poplars' near Queanbeyan (Dawson 2003) and council-owned land between the Cooma landfill site and the Kuma Nature Reserve (Dawson 1999).

The biology of the Grassland Earless Dragon is the subject of ongoing research, initiated by university workers in the ACT (Osborne *et al.* 1993a, Smith 1994, Langston 1996), with support from the ACT government (Fletcher *et al.* 1995, Nelson *et al.* 1996, Benson 1999, Nelson 2004). Much of what we now know about this species is the result of these studies. Further ecological work is currently being undertaken as part of PhD and Honours studies through the University of Canberra, with support from the ACT Government.

Appendix I includes details of key ecological investigations undertaken on this species and its habitat.

C3.3 Reservation

Tympanocryptis pinguicolla currently occurs in two conservation reserves in NSW; the Kuma Nature Reserve near Cooma and the Queanbeyan Nature Reserve near Queanbeyan. In Victoria, a large grassland area to the north of Melbourne (Craigieburn Grasslands Reserve) was acquired by government for conservation. An unconfirmed sighting of a Grassland Earless Dragon had previously been reported from this area (Beardsell 1997). In 2005 Woden and Callum Brae grazing properties were withdrawn from leasehold and are now

managed by the ACT government to permanently protect the species' grassland habitat. Other areas in the Jerrabomberra Valley have also been identified for future reserves.

C4 Species ability to recover

There is evidence to suggest that Grassland Earless Dragons may survive short-term disturbance from fire (Nelson *et al.* 1998a), but the effects of differing frequencies and timing of fires undoubtedly will be important in determining the species' ability to persist. Appropriate fire regimes have yet to be determined.

Most sites where Grassland Earless Dragons persist are subject to grazing by native and/or introduced herbivores. The grassland habitats of the species may require some level of grazing to maintain their structure as optimal habitat. It is not known whether heavy grazing will be detrimental to the species, but this is likely, particularly if significant soil disturbance disrupts burrow refuge sites. Appropriate grazing regimes have yet to be determined.

The effect of introduced predators is not understood, but it may be significantly detrimental, especially in grasslands adjacent to urban areas. Similarly, the impact of native predatory birds is not understood in areas where cover has been removed through overgrazing, slashing or burning, or where artificial perches (posts, fences, buildings) are present.

Low recaptures between years (Smith 1994; Langston 1996a; Nelson *et al.* 1996; Nelson 2004) suggest high annual population turnover. If this is the case, the species is likely to be vulnerable to unpredictable perturbations that cause low recruitment in any one year. When population sizes are reduced by catastrophes, the ability of the species to recover will be limited by its comparatively low fecundity.

Because populations of Grassland Earless Dragons are now severely fragmented, it is unknown whether the species will persist in the long-term in reserved or managed areas, or whether active intervention will be required. This will depend upon the size of the reserves, on the threats present, and on the management regimes implemented. Gene flow between populations is unlikely to be possible naturally. Appropriate management with regard to threatening processes is yet to be determined.

C5 Further research overview

This Recovery Plan advocates strategies to improve our knowledge of the species and its ecology. These include an understanding of the mechanisms underlying recruitment and the use of habitat. Successful *in situ* population management will be founded on understanding the relationships between Grassland Earless Dragons and associated habitat, and the species' responses to environmental processes. Demographic studies will be necessary to improve understanding of mechanisms influencing population processes, and to monitor the success of particular management actions.

The existence of potential habitat in areas that have not been adequately surveyed (such as parts of the Monaro Plains in NSW) indicates that further survey work is necessary. Survey may be aided by an overview of grassland habitat from satellite information, as well as by historical records of the extent of grasslands on the western side of the Great Dividing Range. This should be a priority for future research. In addition, searches of known and potential habitat should continue in order to determine the current distribution and extent of populations. Any such surveys should report relevant detection probability parameters, to allow reliability of results to be assessed.

Knowledge of the degree of isolation between known extant populations is necessary for determining the most appropriate management; such information might be gained from studies of the genetic structuring of these populations. Currently, comparison of Monaro and ACT populations suggests that these populations are genetically isolated (Scott & Keogh 2000). The collection of additional genetic material from these and other sites will assist in resolving the genetic relatedness amongst populations. Within this context, a technique that

may be useful is DNA microsatellite analysis. The population effects of recent habitat fragmentation and the potential effects of artificial barriers (e.g. roads) may also be examined by utilising molecular biological techniques. The potential for creating habitat links between currently isolated populations should be explored, as should the potential for recolonisation of sites at which the species has become locally extinct.

Comparative ecological studies similar to those initiated on the Monaro and ACT populations should be carried out elsewhere if possible, as local differences may markedly affect lizard habitat use and activity, especially in areas where land-uses differ and/or where only small islands of habitat are available. Particular ecological questions to be investigated should include:

- Interactions between Grassland Earless Dragons and various sympatric arthropods, particularly with regard to burrows as a resource, possible competition with other burrow-using animals, and significance of burrows for the species.
- Dispersal of juveniles, particularly with regard to factors affecting survival and dispersal distances.
- Diet and food availability, and relationship to habitat structure (grass height, inter-tussock spaces etc.).
- Relationships between the soil characteristics (including hydrology), current and past land-use and the distribution of microhabitats used by Grassland Earless Dragons (including arthropod burrows), and how these may vary through time.
- Reproductive behaviour, including identification of key resources for breeding (oviposition sites) and factors that affect survival of eggs.
- Significance of predation in affecting population sizes or distributions.
- Effectiveness of survey techniques and influence of grassland structure on detectability.

The Recovery Team should coordinate collation of data and results from all pertinent research and monitoring that has been undertaken, such that it is readily available to all potential researchers and managers.

C6 Management practices

The underlying premise for this Plan is that recovery of the Grassland Earless Dragon will depend on a multi-pronged approach involving habitat conservation, restoration and management, combined with an understanding of the ecological and biological requirements of the species. The framework for information acquisition is based on the approach outlined by the Australian and New Zealand Environment and Conservation Council and Biological Diversity Advisory Committee (2001). The emphasis is on using knowledge to better implement *in situ* management techniques that protect populations and promote breeding and recruitment. To achieve this, recovery actions are primarily structured to (i) acquire baseline ecological and biological data, (ii) assess habitat condition including ecological and biological function, (iii) protect populations to maintain or increase their size, and (iv) to engage the community in recovery actions. On-ground site management will aim to mitigate threatening processes and thereby insure against extinction. The Recovery Team considers that translocation would not currently be a useful conservation measure for inclusion in this recovery program, and that it should not be contemplated until the species' ecology is better understood. However, this does not preclude translocation as part of research that will, in the view of the Recovery Team, significantly add to knowledge of the species biology or conservation management. The view of the Recovery Team is that the salvage of animals from doomed sites (developments) is not to be considered as an offset or action that in any way mitigates the loss of habitat.

Broad scale protection measures applicable to all populations include legal protection of sites (where possible – it will not be possible to provide full legal protection on some private land), habitat retention and liaison with land managers including private landholders to secure

sympathetic management of the species on their land. Management agreements with non-government landholders will play a crucial role in the conservation of the Grassland Earless Dragon. It is clear that Grassland Earless Dragon populations can persist in the long-term on rural grazing land that is appropriately managed. Consequently, reserves are not the only solution to conserving the species, and should be viewed as only part of the management strategy for this species. ACT Action Plans Nos. 1, 2, 3 and 28 give details of current proposed reservation and agreement strategies for the ACT grasslands or their component species (ACT Government 1997a, 1997b, 1997c, 2005). Other tools for securing sympathetic management on land in the ACT include 'Memoranda of Understanding', 'Directions of the Conservator of Flora and Fauna', and 'Land Management Agreements', the latter negotiated during leasing of rural lands. In NSW, Joint Management Agreements (under the TSC Act) for several Travelling Stock Reserves (TSR) on the Monaro are being negotiated with the Cooma RLPB. In addition, management agreements between land holders (and possibly RLPB's) and the Southern Rivers and Murrumbidgee Catchment Management Authorities in NSW will provide scope for stewardship and incentive payments to be provided for ongoing conservation management of lands known to support the species. These agreements deal with management of habitat, and may be applied more widely across the Monaro to include sites known to support Grassland Earless Dragons. Similar arrangements may be appropriate for other government lands and private lands in NSW, and for areas of habitat in Victoria.

Protection measures on private land in Victoria include Conservation Covenants arranged with Trust For Nature, Land Management Plans tied to Section 173 Agreements under the Planning & Environment Act 1987, and endorsed plans as prescribed in planning permit conditions. Other more voluntary arrangements include the registration of properties under the Land for Wildlife Program or the inclusion of properties identified in local Biodiversity Action Plan networks and Landcare projects.

Any actions contemplated which involve potential changes to the habitat of the Grassland Earless Dragon, in all jurisdictions, should be referred to the Department of Environment and Water Resources, in accord with requirements of the *EPBC Act*.

C7 Community involvement

There is great potential for community involvement in the conservation of the Grassland Earless Dragon and natural temperate grasslands. Because many of the remaining patches of natural temperate grasslands are on private or leased land, or in close proximity to suburban areas, community involvement will play a key role in the successful recovery of both the Grassland Earless Dragon and its grassland habitat. Landholder participation in conservation programs will be crucial.

There are already several community groups which have made great contributions to both grassland and lizard conservation. In the ACT and surrounding locales, the Friends of Grasslands community group is dedicated to the conservation and recovery of native grasslands and their associated fauna. The Friends of the Striped Legless Lizard is a Victorian community group which has been involved in several conservation-oriented programs, including salvage operations, and this group may be broadened to include Grassland Earless Dragons in its scope.

The Victorian National Parks Association, the ACT Herpetological Association, the Conservation Council of the South-East Region and Canberra, and Landcare may be pivotal in co-ordinating community efforts. All of these organisations, other similar groups, and individuals will be instrumental in the implementation of this Recovery Plan, and will be included in many actions. Organising more such groups will be a high priority as the Recovery Plan is implemented.

In Victoria, the Threatened Species Network has prepared media releases highlighting the plight of the Grassland Earless Dragon in Victoria, including the development of Fact Sheets on grassy ecosystem habitats.

C8 Resource allocation

Recovery and management of threatened fauna is heavily reliant on sound information utilised by a strong and communicative network of organisations and individuals from within government, universities, private consultants and other nature conservation interests. Implementation of this Recovery Plan will involve an integrated approach using a team of committed scientists, students, consultants and on-ground natural resource managers to ensure the most efficient and effective use of resources.

This Recovery Plan complements the ACT, NSW and Victorian conservation plans for the Grassland Earless Dragon. Recovery actions identified in each of these plans are complementary, and coordination by the Recovery Team will ensure that resources are used efficiently and unnecessary duplications are avoided.

C9 Recovery actions

C9.1 Specific recovery objective - determine distribution and abundance

Objective 1 - Determine the distribution and abundance of Grassland Earless Dragons in order to define habitats critical to the survival of the species.

Substantial surveys have been conducted in Victoria, NSW and the ACT. In Victoria, no populations have been located in recent years despite historical records indicating that Grassland Earless Dragons were formerly present.

C9.1.1 ACTION: Determine the broad distribution and status of potential Grassland Earless Dragon habitat, by reference to existing vegetation and management information, or, if these data are inadequate, gather the required information.

Remote sensing (*sensu* Langston 1996b) should be further investigated for its potential broader application in addressing this action. This technique is currently being investigated in Victoria for determining the distribution of potential *Delma impar* habitat, and may be extended to include Grassland Earless Dragon requirements. The planning framework outlined by Fallding (2002) for the Southern Tablelands will assist in guiding this process in NSW.

Priority: 1

Agency(s) responsible for implementation of action: NRT, PCL, DECC, DSE.

C9.1.2 ACTION: Define the extent of potential Grassland Earless Dragon habitat, based upon detailed vegetation information from field surveys targeting areas identified in C9.2.1.

Identification of potential grassland habitat of the species is well-advanced in the ACT (Sharp 1992, Langston 1996b, ACT Government 1997a, 2005). Extensive surveys of grassland vegetation are planned in southern NSW. Note, however, that *quality* of grassland habitat is not necessarily an indicator of potential Grassland Earless Dragon habitat, as the species does sometimes occur in areas that would otherwise be classified as *degraded* – rather, distribution of the broad vegetation community should be used as the primary guide to identification of areas of potential habitat.

Priority: 1

Agency(s) responsible for implementation of action: NRT, PCL, DECC, DSE.

C9.1.3 ACTION: Determine the current distribution and abundance of Grassland Earless Dragons in Victoria, NSW and ACT, by undertaking extensive targeted surveys in areas of potential habitat identified in C9.1.2. and map/document the distribution.

Targeted surveys for Grassland Earless Dragons have been undertaken in the ACT and Victoria in recent years, but further surveys, directed by actions C9.1.1. and C9.1.2 are required and planned.

In NSW, targeted surveys commenced in 1999 - Yass, Goulburn, Mulwaree, Gunning, Queanbeyan, Palerang and Cooma-Monaro local government areas. New populations were located in Queanbeyan and Cooma-Monaro. Future targeted surveys should concentrate further on the large amount of suitable habitat on the Monaro plains.

In the ACT, all potential habitat has been surveyed – there is now a need to determine area of occupancy of known populations (ACT Government 2005).

In Victoria there has been some recent survey in Craigieburn Grassland Reserve – no Grassland Earless Dragons were located.

Information from opportunistic surveys undertaken as part of development planning should be used to assist with implementation of this action. Accordingly, a minimum survey methodology to be adopted for any such survey is required (see below).

Priority: 1

Agency(s) responsible for implementation of action: NRT, PCL, DECC, DSE.

C9.1.4 ACTION: Develop and advocate a recommended survey methodology, including minimum survey effort, to be implemented during all distributional and pre-development surveys in potential habitat of the Grassland Earless Dragon.

Information from opportunistic surveys, undertaken as part of development planning, could be valuable in assisting with determining the distribution of the species. Accordingly, a minimum survey methodology to be adopted for any such survey is required, and will be formulated by the NRT. Regulatory authorities should ensure that this methodology is adopted for any Grassland Earless Dragon surveys within their jurisdictions.

Furthermore, any development proposals within the broad area(s) of potential habitat identified in actions 9.1.1 and 9.1.2 above should be required to undertake and adequate (as defined by the NRT) survey for this species. Any occurrence of habitat of the species in an area to be modified would trigger a requirement for referral under the EPBC Act.

Priority: 1

Agency(s) responsible for implementation of action: NRT, DEW, PCL, DECC, DSE.

C9.1.5 ACTION: Use the data obtained from surveys of habitat, distribution and abundance to define habitats that are critical to the survival of the Grassland Earless Dragon.

Determine which habitats are critical to the long-term survival of the species based on knowledge of the distribution of Grassland Earless Dragon habitats, distribution and abundance of Grassland Earless Dragon populations, population parameters such as genetic variation and threats. Critical habitats are those necessary for achieving the primary recovery objective C1.1.

Priority: 1

Agency(s) responsible for implementation of action: NRT, DEW, PCL, DECC, DSE.

C9.2 Specific recovery objective - ecological research to enable effective management

Objective 2 - Maintain or increase the abundance/distribution of the species by better understanding those aspects of the biology of the Grassland Earless Dragon that will enable effective management of populations and habitat.

Current knowledge of the ecology of the Grassland Earless Dragon is inadequate for the informed formulation of appropriate management guidelines. A program of targeted research is urgently required to address specific management questions.

C9.2.1 ACTION: Determine the relationships between the vegetation structure, fire, soil conditions, availability of refugia, land-use histories of grasslands and the distribution of Grassland Earless Dragon microhabitats, and how these may vary through time.

This action is urgently required to assist in directing the targeted surveys of potential habitat (actions C9.1.2. and C9.1.3), and management of that habitat (Objective 4). It is ongoing, requires collation of existing data, and needs further research.

Priority: 1

Agency(s) responsible for implementation of action: NRT, PCL and DECC to coordinate appropriate research.

C9.2.2 ACTION: Determine movements and habitat use by Grassland Earless Dragons, particularly in relation to fragmentation of habitats and populations.

Some studies have been undertaken looking at short-term movement capacity of the species. Knowledge of dispersal capacities will be important in determining the potential effects of artificial barriers, such as roads, in fragmenting populations and reducing their viability.

Priority: 1

Agency(s) responsible for implementation of action: NRT to co-ordinate appropriate research.

C9.2.3 ACTION: Determine key ecological parameters of the life history of Grassland Earless Dragons.

Part of this research has been undertaken as a PhD project, investigating how thermoregulation and activity patterns influence life-history and habitat use (Nelson 2004). Information on reproductive biology, population structure and juvenile recruitment/dispersal is required.

Priority: 1

Agency(s) responsible for implementation of action: NRT to co-ordinate appropriate research.

C9.2.4 ACTION: Investigate the effects of management activities such as fire, mowing and grazing on the ecology of Grassland Earless Dragons, particularly with respect to structural variability of grassland types and their seasonal changes.

It is essential to understand the effects of these disturbances on populations so that optimal management guidelines can be formulated.

Priority: 1

Agency(s) responsible for implementation of action: NRT to co-ordinate appropriate research.

C9.2.5 ACTION: Determine the diet of Grassland Earless Dragons and factors affecting food availability in different grassland types.

Temporal variability in grassland structure due to a range of factors, including fire, may influence the availability of food for the species.

Priority: 2

Agency(s) responsible for implementation of action: NRT to co-ordinate appropriate research.

C9.2.6 ACTION: Investigate the interactions between Grassland Earless Dragons and various sympatric arthropod populations, particularly with regard to burrow development and use.

The potential interactions between Grassland Earless Dragons and burrow forming/using arthropods may be an important factor influencing the distribution and habitat use of some populations, and knowledge of these interactions will be important in determining appropriate management actions for Grassland Earless Dragon habitat. Information is required on the arthropod community structure and on factors influencing distribution and abundance of burrow-forming taxa. The influence of refuge site (including, but not restricted to, burrows) availability on distribution of Grassland Earless Dragons needs investigation, as does the potential for management by artificial enhancement of these refugia. Part of this research is currently underway at the University of Canberra.

Priority: 1

Agency(s) responsible for implementation of action: NRT to co-ordinate appropriate research.

C9.2.7 ACTION: Investigate the genetic variability of the species, and of representative populations, to determine what measures may be required to maintain this variability.

Knowledge of the levels of genetic variability within and between Grassland Earless Dragon populations is essential to assist in determining various management requirements, such as: minimum population sizes; population area requirements; distribution of reserves/managed areas; and the desirability/requirement for, and methodology of, any translocations. Molecular biological techniques could be useful in examining the population effects of habitat fragmentation and artificial barriers to movement. Part of this research is currently underway at the University of Canberra.

Priority: 1

Agency(s) responsible for implementation of action: NRT to co-ordinate appropriate research.

C9.2.8 ACTION: Investigate the effects of predation on Grassland Earless Dragon populations.

These effects are currently unknown, but may be significant, particularly given the proximity of most extant Grassland Earless Dragon populations to urban areas. The need for management of predators, and appropriate methods to achieve effective management, must be determined. Artificial perches (posts) for predatory birds in grasslands have been identified as a potential threat.

Priority: 2

Agency(s) responsible for implementation of action: NRT to co-ordinate appropriate research.

C9.3 Specific recovery objective – threats

Objective 3 – Identify the nature and extent of the processes that threaten Grassland Earless Dragons and their habitat, and the measures needed to abate these.

Apart from establishing reserves and managed areas (Objective 4), this is probably the most critical measure required for the conservation of the species. All threats, including development proposals, must be identified and their potential effects assessed. Ongoing research (Objective 2) and monitoring (Objective 5) will be required to enable formulation and continued refinement of management measures (Objective 4).

C9.3.1 *ACTION: Identify potential threats to Grassland Earless Dragons and their habitat at known and potential sites, and determine the relative priority for management of these threats at each site.*

Some threats have been identified at sites in NSW, and amelioration activities included in management plans. Threats have also been identified for sites in the ACT in terms of future development, and discussions are being held with relevant stakeholders.

The NRT is to periodically review threats at each site, and report to DEW.

Priority: 1 ongoing

Agency(s) responsible for implementation of action: NRT to co-ordinate, with participation from relevant state, territory, Australian Government conservation agencies and land holders.

C9.3.2 *ACTION: Identify the threats to Grassland Earless Dragons and their habitat from various potential land-uses, and initiate the research required to address this issue.*

Priority: 1 ongoing

Agency(s) responsible for implementation of action: NRT to co-ordinate, with participation from relevant state, territory, Australian Government conservation agencies and land holders.

C9.4 Specific recovery objective - habitat protection and management

Objective 4 - Establish a system of reserves and other areas under appropriate protection and management such that all populations are maintained or increased.

Any reduction in the extent of habitat at extant sites should be avoided. Currently only three populations of Grassland Earless Dragon are included within reserves. Others are not considered secure. A system of reserves and other managed areas is urgently required to secure the conservation of the species. Appropriate management of this system is essential to provide for the long-term maintenance of suitable habitat. Current knowledge of the ecology of the Grassland Earless Dragon is inadequate to enable optimal management to be determined, and the research actions (Objective 2) will address this problem. However, to wait for the results of this research before implementing some habitat management measures would be unacceptable and potentially disastrous for the species. Accordingly, the National Recovery Team has provided interim management guidelines for Grassland Earless Dragon habitat in Appendix III. As further information becomes available from research for appropriate management (Objective 2), monitoring (Objective 5) and identification of threats (Objective 3), management guidelines will be continually refined and updated, *i.e.* an adaptive management approach will be used.

C9.4.1 ACTION: Develop reservation proposals, management agreements and management guidelines for all known sites.

A national strategy for a system of managed sites will be developed by members of the National Recovery Team. It should be regionally based, and regular review is required.

Priorities for acquiring reserves and managed areas should be governed by consideration of the distribution and characteristics of sites. Reservation should always be the first preference for a site – however, this is not always possible given existing land tenures and departmental resources.

Investigation of the potential and desirability for links between sites is essential, as is the interim protection of areas supporting potential links from development.

Priority: 1

Agency(s) responsible for implementation of action: NRT to co-ordinate PCL, DECC and DSE.

C9.4.2 ACTION: Secure in conservation reserves multiple areas of the habitat of the Grassland Earless Dragon throughout its extant geographic range, with regional representation in the reserve system.

In accordance with the principles and sites identified in action C9.4.1 above, a series of high priority sites will be acquired and permanently reserved. The ACT government has suggested priorities and categories of reservation for areas of land supporting Grassland Earless Dragon habitat within the ACT (ACT Government 1997c, 2005), but notes that further work is required to assess the potential importance of other known sites. In 2005, the ACT Government withdrew land in the Jerrabomberra Valley from leasehold (“Woden”) to permanently protect natural temperate grassland habitat for the species.

In NSW, populations of Grassland Earless Dragons occur at the Queanbeyan Nature Reserve and Kuma Nature Reserve, managed primarily for the conservation of threatened grassland reptiles, plants and invertebrates by the DECC.

Priority: 1

Agency(s) responsible for implementation of action: PCL, DECC, DSE.

C9.4.3 ACTION: Ensure long-term sympathetic management of Grassland Earless Dragons and their habitat on non-reserve land, by developing conservation management agreements with landholders controlling Grassland Earless Dragon habitat throughout the extant geographic range of the species.

Many of the known sites that support Grassland Earless Dragons are on non-reserve public land or private rural land. In the majority of cases, the land managers or owners have no obligation to manage the land sympathetically for Grassland Earless Dragons, and they have the ability to exterminate populations through inappropriate land-use practices. Land management agreements must be made with these land managers or owners (or land must be acquired for reserves in order to adequately conserve the species across its current range – action C9.4.2 above). This is particularly important in regions where Grassland Earless Dragon populations are not included in reserves. Private landowners must be informed about the species and native grassland conservation, and assured that the presence of Grassland Earless Dragons on their properties does not mean that they will lose their land or incur significant loss in productivity. It is generally true that significant changes in land management practices are not advised in areas that contain Grassland Earless Dragons, because their very presence indicates at least a base level of appropriate land-use history. ACT Action Plan 28 (ACT Government 2005) gives details of current proposed reservation and agreement strategies for the ACT grasslands. This Action Plan supersedes Action Plans 1 and 3 (ACT Government 1997a, 1997c).

Differing mechanisms for developing these co-operative conservation management agreements will be available in each jurisdiction, some examples of which include: Memoranda of Understanding (Commonwealth), Property Management Agreements, Conservator's Powers (ACT), Land for Wildlife, Conservation Covenants, Public Area Management Agreements (Victoria), Voluntary Conservation Agreements, Threatened Species Property Management Plans (NSW).

In the ACT, there is currently a Memorandum of Understanding with the Defence Department for management of the Majura Training Area, and Grassland Earless Dragon habitat in the Jerrabomberra Valley is subject to a Direction to Landholders from the Conservator of Flora and Fauna. Under Section 160 of the *EPBC Act*, the Transport Minister must refer any proposed Major Development Plan under the Airports Act to the Environment Minister for assessment and advice before making a decision on approval. In such instances any actions that will impact on the species require a permit to take or kill under Section 201 of the *EPBC Act*. In issuing such a permit the Minister for the Environment must be satisfied that the action will contribute significantly to the conservation of the species (S.201(3)(a)). Where the action will result in the loss of individuals or known habitat of the Grassland Earless Dragon the National Recovery Team recommends that this be achieved by identifying additional off-site offsets that result in an outcome that will maintain or improve the conservation of populations of the species in the region.

In NSW, joint management agreements are under negotiation for some sites, and landowner management is in place for others. The joint management agreement (under s.121-126 of TSC Act) being discussed on the Monaro is between DECC and public authorities, with inclusion of landowners on management committees, and ongoing extension work by WWF. Threatened Species Property Vegetation Plans (under the *Native Vegetation Act 2003*) are another potential mechanism for ensuring appropriate habitat management.

Priority: 1 ongoing

Agency(s) responsible for implementation of action: DEW, PCL, DECC, DSE.

C9.4.4 ACTION: Establish management arrangements and guidelines based on best available knowledge for reserves containing Grassland Earless Dragons.

Management of grassland habitat on reserves containing Grassland Earless Dragons will be based on the best available information and will be continually refined and updated as further information becomes available. Currently, a key document in this respect is 'Managing Native Grassland: a guide to management for conservation, production and landscape protection' by D. Eddy (published by WWF in 2002). Plans of Management are being prepared by the DECC for both NSW reserves containing populations of the species. In Victoria, the management guidelines for both the Holden Flora & Fauna Reserve and Craigieburn Grasslands Flora & Fauna Reserve recognise their importance as habitat for the species. Also, the site at Bald Hills on the Merri Creek has been identified as an area requiring long-term protection and management in the event that land-use change occurs in that area.

As a general principle, until it is understood what management regime is appropriate on sites where the species is known to occur, an interim regime of *status quo* will be maintained, *i.e.* if grazing, continue grazing; or if long unburnt, protect from fire.

Priority: 1

Agency(s) responsible for implementation of action: PCL, DECC, DSE.

C9.4.5 ACTION: Liaise with grassland ecologists to establish interim management guidelines for landholders responsible for non-reserve land which contains Grassland Earless Dragons and/or their habitat.

All landholders with land supporting Grassland Earless Dragons will be contacted by the relevant government conservation agency. Workshops will be held where landholders will be provided with information about Grassland Earless Dragon conservation and where open discussion of the issues relevant to the landholders can lead to appropriate conservation agreements. The exact nature of the implementation of this action will vary from state to state and site to site. Guidelines for management of native grassland on private properties has been identified as a priority of the Grassy Ecosystems Reference Group, and is being pursued by the Victorian National Parks Association and the Recovery Team for Natural Temperate Grassland in the Southern Tablelands.

Landholder participation in conservation management activities is to be encouraged and assisted. Other programs of potential benefit to management of Grassland Earless Dragon habitat should be investigated and utilised (e.g. Landcare).

Needs documentation and regular review by NRT.

Priority: 1

Agency(s) responsible for implementation of action: PCL, DECC, DSE.

C9.4.6 ACTION: Periodically review guidelines for the management of Grassland Earless Dragon habitat, as new information on the biology of the species, and on threats and their amelioration, becomes available.

Management guidelines will be continually refined and updated as further information becomes available from the research actions (Objective 2) and identification of threats (Objective 3). These revised guidelines will be forwarded to landowners and land managers. As well as site specific guidelines, the general guidelines as included in Appendix III should be considered.

Priority: 1 ongoing

Agency(s) responsible for implementation of action: NRT, PCL, DECC, DSE.

C9.4.7 ACTION: Do not allow the habitat of any population to decrease in extent.

Because all populations are considered essential for the conservation of the species, and because the extent of habitat required to support long-term viable populations is currently unknown (although the amount of available habitat is small at all known sites), it is important not to allow any reduction or shrinking of the extent or suitability of these areas of habitat at any site. Furthermore, the areas between current populations, in which it may be possible to establish links of habitat in the future, should be similarly protected. Undisturbed buffers around current sites should be an integral part of their protection.

Priority: 1 ongoing

Agency(s) responsible for implementation of action: DEW, NRT, PCL, DECC, DSE.

C9.5 Specific recovery objective – monitoring to enable adaptive management

Objective 5 – Monitor populations and habitats of Grassland Earless Dragons and the implementation and effectiveness of management prescriptions to provide a basis for adaptive management and to identify new threats.

Monitoring of Grassland Earless Dragon populations and of their habitats and threats to continually assess the effects of management actions is essential to enable rapid response should populations decline, and to provide feedback such that management is continually refined. Currently, the most practical method of surveying Grassland Earless Dragons is by using roofed artificial arthropod burrows, which provide shelter. Trapping rates (or more correctly 'occupancy' rates because the animal is free to enter and leave the artificial burrow) have been found to be highly variable within and between years (Nelson 2004, M. Evans pers. comm.), which markedly reduces the ability to detect changes in trapping rate between years or to detect trends. It is also not known how trapping rate is influenced by prevailing environmental factors, such as availability of alternative shelter, nor how trapping rate relates to absolute abundance. Methods for assessing population 'health' that do not rely on abundance estimates (such as evidence of recruitment, age structure, condition or reproductive status) may provide more potential for assessing the effects of management actions. In addition, habitat for Grassland Earless Dragons requires monitoring to facilitate adaptive management, to identify threatening processes and to enable early detection of deleterious changes in habitat quality. Which population parameters or habitat variables are chosen to be monitored will depend upon the particular objective of the monitoring program.

There is a need to examine methods of monitoring populations, and the potential for genetic techniques to contribute to this monitoring.

C9.5.1 ACTION: Formulate and implement a minimum disturbance monitoring strategy for Grassland Earless Dragons and their habitat, particularly in response to imposed management or disturbance/fragmentation.

Guidelines for effective monitoring need to be established by the NRT, and agreed upon by all agencies. Specific guidelines for monitoring the species at the Kuma Nature Reserve have been prepared (Cooper *et al.* 1999) and are being implemented.

Priority: 1 ongoing

Agency(s) responsible for implementation of action: NRT, PCL, DECC, DSE.

C9.5.2 ACTION: Use the monitoring program to assess the effectiveness of management measures on a continuous basis and to identify any threats as they may arise.

Priority: 1 ongoing

Agency(s) responsible for implementation of action: NRT, PCL, DECC, DSE.

C9.6 Specific recovery objective - salvage & translocation

Objective 6 - Determine if there is a need for salvage of individuals from doomed sites, determine the feasibility of such measures, and develop and implement a protocol. Determine if there is a need for translocation, determine its feasibility, and develop and implement a protocol.

Periodically, development decisions may cause sites, or parts of sites, supporting populations of Grassland Earless Dragons to be destroyed. If such developments proceed, then contingencies must be made to minimise effects on the overall conservation of the species. One suggested contingency has been the 'salvage' of animals, either for captive maintenance and/or research. Currently, the National Recovery Team believes that removal of lizards from doomed sites cannot make a meaningful contribution to the conservation of the species, and should not be viewed as an action that in any way compensates or mitigates loss of habitat – conservation efforts must concentrate upon *in situ* measures.

However, were such a salvage action deemed of some value, then clear guidelines are needed on the circumstances under which such measures might be contemplated, their potential contribution to the recovery program, and their feasibility. A protocol must be established for their conduct.

The available evidence from a range of reptile species shows that translocated animals do not readily re-establish (Dodd and Seigel 1991) and the potential effects on the source populations are unknown. Therefore, the National Recovery Team considers that translocation would not currently be a useful management or conservation measure for inclusion in the recovery program, and that it should not be contemplated until the ecology of the species is better understood.

However, this does not preclude translocation as part of research that will, in the view of the Recovery Team, significantly add to knowledge of the species biology or conservation management. Whilst translocation of animals for genetic purposes or for reintroduction may be a potentially valuable tool in wildlife management, such a program is a complex and long-term undertaking, for which rigorous protocols must be in place in accordance with international, Commonwealth and state, territory and/or professional organisation (*i.e.* Australasian Wildlife Management Society) guidelines, and the need for such action must be based on sound science.

In the case of the Grassland Earless Dragon, a clear need must be established before translocation(s) are contemplated. For re-introductions, it will then be necessary firstly to identify sites where Grassland Earless Dragon populations were once present but have since disappeared, and secondly to understand the cause of the local extinction, and eliminate or minimise/manage the threat to maximise the chances of re-establishment.

Currently, the priority must be to adequately conserve existing populations, rather than attempting to restore or create others. The NRT will deliver an unequivocal message that translocation is not an acceptable mitigation strategy for populations threatened by development.

C9.6.1 ACTION: Determine the circumstances under which Grassland Earless Dragons may be salvaged from doomed sites, and develop agreed protocols for each State and Territory.

For any approved project, protocol must include provision of specialist holding facilities that include capacity for maintaining appropriate temperature regimes. Other appropriate resources must be available, with any costs of removal and ongoing maintenance borne by the proponent.

Priority: 2

Agency(s) responsible for implementation of action: NRT to co-ordinate, with resources provided by any proponent of such actions.

C9.6.2 ACTION: Ensure that agreed salvage protocols are followed.

Priority: 2

Agency(s) responsible for implementation of action: NRT to co-ordinate, with resources provided by any proponent of such actions; relevant State, Territory and Australian Government agencies responsible for licensing approvals and issue.

C9.6.3 ACTION: Determine the potential objectives, feasibility and appropriateness of translocation.

Priority: 3

Agency(s) responsible for implementation of action: Further investigation into the need for this work and the likelihood of success is required before substantial effort is committed to it (see Objective 2, research). NRT to co-ordinate.

C9.6.4 ACTION: Determine the circumstances under which Grassland Earless Dragons may be translocated, and develop agreed protocols for each State and Territory.

If translocation is considered appropriate, either for genetic reasons or for re-establishing populations, an agreed protocol will be developed according to current international, Australian Government and state guidelines (for example, see Coulson 1995). One important consideration in any translocation program is the development of effective procedures for long-term monitoring of translocated animals and the management of "threats", without which it is impossible to determine the success or failure of the translocation. Furthermore, it is vital that there is a commitment to funding this monitoring and subsequent reporting for the agreed duration of the project.

Priority: dependent on outcomes of Actions under Objective 2.

Agency(s) responsible for implementation of action: The NRT will be responsible for considering reintroduction guidelines, deriving an agreed protocol and advising relevant state and territory agencies.

C9.6.5 ACTION: Ensure that agreed translocation protocols are followed.

This action is dependent on the outcome of Action 9.6.4

Priority: 2

Agency(s) responsible for implementation of action: NRT to co-ordinate, with resources provided by any proponent of such actions; relevant State, Territory and Australian Government agencies responsible for licensing approvals and issue.

C9.7 Supporting actions

C9.7.1 *Action: Maintain the National Recovery Team and regional working groups.*

A national coordinator dedicated to facilitating the National Recovery Team(s) and recovery programs for a range of threatened grassland fauna, including Grassland Earless Dragons, is required.

Priority: 1 ongoing

Agency(s) responsible for implementation of action: PCL, DECC, DSE.

C9.7.2 *Action: Establish coordinated databases for use by the National Recovery Team and each State or Territory agency.*

Co-ordinate recording of all known occurrences of Grassland Earless Dragons. Access to distributional and habitat data is crucial for the effective planning of conservation management. Nationally coordinated databases will facilitate rapid communication of information and coordinated management.

Victoria has developed a threatened species database entitled 'Actions for Biodiversity Conservation' (ABC), which builds on existing Action Statements and periodically updates management actions and outcomes to ensure ongoing relevance and application. The ABC database is also made available to DEW and other state wildlife authorities.

Priority: 1 ongoing

Agency(s) responsible for implementation of action: NRT, PCL, DECC, DSE.

C9.7.3 *Action: Encourage tertiary institutions to participate in a coordinated research effort for the Grassland Earless Dragon. Compile a list of research projects.*

The contributions made to the conservation of the Grassland Earless Dragon to date by tertiary institutions have been significant. There are several institutions that have shown a continuing interest in this field and are encouraged and assisted by the National Recovery Team. These associations will continue and student research could continue to provide valuable contributions to the recovery of the species. A list of all relevant past and current research projects will be maintained by the NRT (see Appendix I for a preliminary listing). The NRT will compile and circulate to prospective researchers a list of research questions considered important to assist with implementation of the recovery program.

Priority: 1 ongoing

Agency(s) responsible for implementation of action: NRT will compile a prioritised list of potential research projects, and circulate to appropriate tertiary institutions.

C9.7.4 *ACTION: Provide training for land managers involved in activities which may affect Grassland Earless Dragons and their habitat.*

NPWS has held several field days and workshops for those managing natural temperate grasslands. Those groups targeted for this training include councils and landowners in the Queanbeyan, Palerang and Cooma-Monaro local government areas.

The ACT government (Parks, Conservation and Lands) has held meetings with landholders to discuss conservation issues regarding Grassland Earless Dragons and the use of Land Management Agreements and Conservation Directions.

In Victoria, DSE has arranged with construction companies building roadways in the vicinity of Grassland Earless Dragon habitat to undertake surveys, to provide induction training for workers that focuses on animal identification, and to prepare information posters of grassland species.

Priority: 1 ongoing

Agency(s) responsible for implementation of action: PCL, DECC, DSE.

C9.7.5 ACTION: Approach interested landholders and other community groups to provide a forum for community participation in recovery actions.

Agricultural extension officers may be instrumental in building these contacts – they need appropriate support and information from NRT and relevant government agencies.

Priority: 1

Agency(s) responsible for implementation of action: NRT, PCL, DECC, DSE.

C9.7.6 ACTION: Encourage landholder and other community involvement in projects directed at the conservation of Grassland Earless Dragons and native grasslands, and where possible provide support to these groups undertaking approved projects.

Priority: 2 ongoing

Agency(s) responsible for implementation of action: NRT, PCL, DECC, DSE.

C9.7.7 ACTION: Encourage local groups or individuals to re-investigate sites with historical records of Grassland Earless Dragons.

Priority: 3 ongoing

Agency(s) responsible for implementation of action: NRT to guide community groups.

C9.7.8 ACTION: Produce a 'Web' site and other materials on grasslands and Grassland Earless Dragon conservation and management, for access by community groups, landholders, and private and government organisations.

Existing material on the Web needs to be referenced with appropriate links.

In NSW profiles and management actions for the species have been developed and are available on the Threatened Species online website, to be launched in late 2005. The NSW Threatened Species Priorities Action Statement will also be available on the internet. In the ACT, threatened species profiles (fact sheets) and threatened species Action Plans are available on the ACT government website.

In Victoria, the ABC threatened species database has been developed which is available to community groups including the Threatened Species Network, Trust for Nature, Victorian National Parks Association and Catchment Management Authorities in Victoria. The DSE website has a Threatened Species page that includes the Grassland (Southern Lined) Earless Dragon Action Statement.

Priority: 1 ongoing

Agency(s) responsible for implementation of action: DEW, NRT, PCL, DECC, DSE.

C9.7.9 ACTION: Use captive populations to conduct biological studies.

The extent to which captive populations could be used for behavioural studies to date has been very limited because of the difficulty of simulating natural environmental conditions, and the shortage of captive individuals. Individuals may become available from salvage operations (see section C9.6). Maintenance of any captive individuals currently held should be investigated, and their optimal use determined.

Priority: 2 ongoing

Agency(s) responsible for implementation of action: Relevant zoos. The NRT will coordinate and direct actions in consultation with relevant agencies.

C9.7.10 ACTION: Use captive animals to heighten community understanding of the conservation of Grassland Earless Dragons and their grassland habitat.

The well-interpreted display of threatened species is an acknowledged role of zoos in conservation, with the aim of increasing visitor understanding of the range of

threats and their respective solutions. Melbourne Zoo and Tidbinbilla Nature Reserve have established facilities suitable for this display and interpretation of this species.

Priority: 2 ongoing

Agency(s) responsible for implementation of action: Relevant zoos. The NRT will coordinate and direct actions in consultation with relevant agencies.

C10 Evaluation of success or failure

The Recovery Plan will be reviewed five years from the time of implementation, by the ACT Department of Territory and Municipal Services in conjunction with the NSW Department of Environment and Climate Change, the Victorian Department of Sustainability and Environment and the Australian Government Department of the Environment and Water Resources. The Grassland Earless Dragon Recovery Team will oversee the research and management of the species. The Recovery Team shall meet on an annual basis to review objectives and performance, and to (re)direct recovery actions.

An evaluation of the success or failure of this Recovery Plan will be conducted by the Recovery Team – broad factors to examine, in addition to the detailed lists of criteria for each objective, include:

- The area of land currently managed for the conservation of Grassland Earless Dragons, especially in relation to the area of known occupancy;
- The number and security of new populations identified;
- Research questions resolved, particularly in relation to the key areas of knowledge required for management, as identified in section C9.2.

PART D: RECOVERY COSTS

Action No.	Action Description	Estimated Cost 2006-10
C9.1.1	Determine the broad distribution and status of potential Grassland Earless Dragon habitat, by reference to existing vegetation and management information, or, if these data are inadequate, gather the required information.	\$10K
C9.1.2	Define the extent of potential Grassland Earless Dragon habitat, based upon detailed vegetation information from field surveys targeting areas identified in C9.2.1.	\$20K
C9.1.3	Determine the current distribution and abundance of Grassland Earless Dragons in Victoria, NSW and ACT, by undertaking extensive targeted surveys in areas of potential habitat identified in C9.1.2. and map/document the distribution.	\$40K
C9.1.4	Develop and advocate a recommended survey methodology, including minimum survey effort, to be implemented during all distributional and pre-development surveys in potential habitat of the Grassland Earless Dragon.	\$5K
C9.1.5	Use the data obtained from surveys of habitat, distribution and abundance to define habitats that are critical to the survival of the Grassland Earless Dragon.	\$5K
C9.2.1	Determine the relationships between the vegetation structure, fire, soil conditions, availability of refugia, land-use histories of grasslands and the distribution of Grassland Earless Dragon microhabitats, and how these may vary through time.	\$100K
C9.2.2	Determine movements and habitat use by Grassland Earless Dragons, particularly in relation to fragmentation of habitats and populations.	\$100K
C9.2.3	Determine key ecological parameters of the life history of Grassland Earless Dragons.	\$100K
C9.2.4	Investigate the effects of management activities such as fire, mowing and grazing on the ecology of Grassland Earless Dragons, particularly with respect to structural variability of grassland types and their seasonal changes.	\$100K
C9.2.5	Determine the diet of Grassland Earless Dragons and factors affecting food availability in different grassland types.	\$50K
C9.2.6	Investigate the interactions between Grassland Earless Dragons and various sympatric arthropod populations, particularly with regard to burrow development and use.	\$100K
C9.2.7	Investigate the genetic variability of the species, and of representative populations, to determine what measures may be required to maintain this variability.	\$75K
C9.2.8	Investigate the effects of predation on Grassland Earless Dragon populations.	\$50K
C9.3.1	Identify potential threats to Grassland Earless Dragons and their habitat at known and potential sites, and determine the relative priority for management of these threats at each site.	\$10K
C9.3.2	Identify the threats to Grassland Earless Dragons and their habitat from various potential land-uses, and initiate the research required to address this issue.	\$10K
C9.4.1	Develop reservation proposals, management agreements and management guidelines for all known sites.	\$15K
C9.4.2	Secure in conservation reserves multiple areas of the habitat of the Grassland Earless Dragon throughout its extant geographic range, with regional representation in the reserve system.	As appropriate
C9.4.3	Ensure long-term sympathetic management of Grassland Earless	\$10K

Action No.	Action Description	Estimated Cost 2006-10
	Dragons and their habitat on non-reserve land, by developing conservation management agreements with landholders controlling Grassland Earless Dragon habitat throughout the extant geographic range of the species.	
C9.4.4	Establish management arrangements and guidelines based on best available knowledge for reserves containing Grassland Earless Dragons.	\$10K
C9.4.5	Liaise with grassland ecologists to establish interim management guidelines for landholders responsible for non-reserve land which contains Grassland Earless Dragons and/or their habitat.	\$5K
C9.4.6	Periodically review guidelines for the management of Grassland Earless Dragon habitat, as new information on the biology of the species, and on threats and their amelioration, becomes available.	\$5K
C9.4.7	Do not allow the habitat of any population to decrease in extent.	As appropriate
C9.5.1	Formulate and implement a minimum disturbance monitoring strategy for Grassland Earless Dragons and their habitat, particularly in response to imposed management or disturbance/fragmentation.	\$10K
C9.5.2	Use the monitoring program to assess the effectiveness of management measures on a continuous basis and to identify any threats as they may arise.	\$10K
C9.6.1	Determine the circumstances under which Grassland Earless Dragons may be salvaged from doomed sites, and develop agreed protocols for each State and Territory.	\$3K
C9.6.2	Ensure that agreed salvage protocols are followed.	As appropriate
C9.6.3	Determine the potential objectives, feasibility and appropriateness of translocation.	\$10K
C9.6.4	Determine the circumstances under which Grassland Earless Dragons may be translocated, and develop agreed protocols for each State and Territory.	\$3K
C9.6.5	Ensure that agreed translocation protocols are followed.	As appropriate
C9.7.1	Maintain the National Recovery Team and regional working groups.	\$10K
C9.7.2	Establish coordinated databases for use by the National Recovery Team and each State or Territory agency.	\$3K
C9.7.3	Encourage tertiary institutions to participate in a coordinated research effort for the Grassland Earless Dragon. Compile a list of research projects.	\$2K
C9.7.4	Provide training for land managers involved in activities which may affect Grassland Earless Dragons and their habitat.	\$20K
C9.7.5	Approach interested landholders and other community groups to provide a forum for community participation in recovery actions.	\$5K
C9.7.6	Encourage landholder and other community involvement in projects directed at the conservation of Grassland Earless Dragons and native grasslands, and where possible provide support to these groups undertaking approved projects.	\$20K
C9.7.7	Encourage local groups or individuals to re-investigate sites with historical records of Grassland Earless Dragons.	\$3K
C9.7.8	Produce a 'Web' site and other materials on grasslands and Grassland Earless Dragon conservation and management, for access by community groups, landholders, and private and government organisations.	\$10K
C9.7.9	Use captive populations to conduct biological studies.	As appropriate
C9.7.10	Use captive animals to heighten community understanding of the conservation of Grassland Earless Dragons and their grassland habitat.	As appropriate
		\$929K

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Appendix I: Directory of relevant past and current research.

- Benson, Kelly – UCAN (1999).
Resource use and habitat selection in the ACT.
- Dimond, Wendy – PhD candidate, UCAN (2005 to 2008).
Ecological study of earless dragons: towards the development of a population model.
- Evans, Murray– PCL (2001 – continuing).
Monitoring of populations and survey techniques in the Majura and Jerrabomberra valleys in the ACT, and effectiveness of methods of detection.
- Hoehn, Dr Marion – Post Doctoral Fellow, UFZ.
Genetic analysis of earless dragons: possibilities and prospects.
- Langston, Art – UCAN (1996).
Life history, habitat utilisation, distribution in the ACT and surrounding area.
Determination of possible habitat using satellite imaging techniques.
- Mills, Alison – ANU (1997).
Temperature preferences, environmental temperature availability and standard metabolic rate of *T. pinguicolla*. Woden.
- Nelson, Lyn – ANU and EACT (1996-2005).
Distribution of *T. pinguicolla* in Majura and Jerrabomberra Valleys (ACT); post-fire monitoring at Majura Training Area; effectiveness of small pitfall traps vs artificial spider tubes; temperature preferences, home range, diet and life history parameters of ACT populations compared with Cooma populations
- Osborne, Will and Benson, K. – UCAN (1996).
Habitat use and ecological examination of burrow requirements in the ACT.
- Robertson, Peter and Alan Webster – DSE (1994-95).
Victorian survey.
- Rehwinkel, Rainer – NSW NPWS (1997 - continuing).
Conservation of grasslands in NSW. (Also refer to Fallding 2002 – ongoing remote sensing work to identify natural grasslands as potential habitat)
- Richter, Anett PhD candidate, UCAN.
Impacts of fragmentation and urbanisation on grassland invertebrates.
- Smith, Warwick – ANU and NSW NPWS (1994).
Taxonomy and ecology of the Eastern lined earless dragon in the ACT.
- Stevens, Toni – Honours candidate, UCAN (current).
Radio-telemetry study of Grassland Earless Dragons.

Appendix II: List of all known populations of Grassland Earless Dragon, sites surveyed, and management status of sites and populations.

Australian Capital Territory

Known populations in the ACT.

1. East and West of Jerrabomberra Valley
(“Woden”, “Callum Brae”, “Harman”, “Bonshaw”, “Cookanalla”).
2. East and West of Majura Valley
(Campbell Park, Scott’s Paddock, Airport, Majura Training Area, Majura Beacon, “Malcom Vale”).
3. AMTECH – proposed Stage 2 of industrial estate.

Sites surveyed in the ACT where the species was not detected.

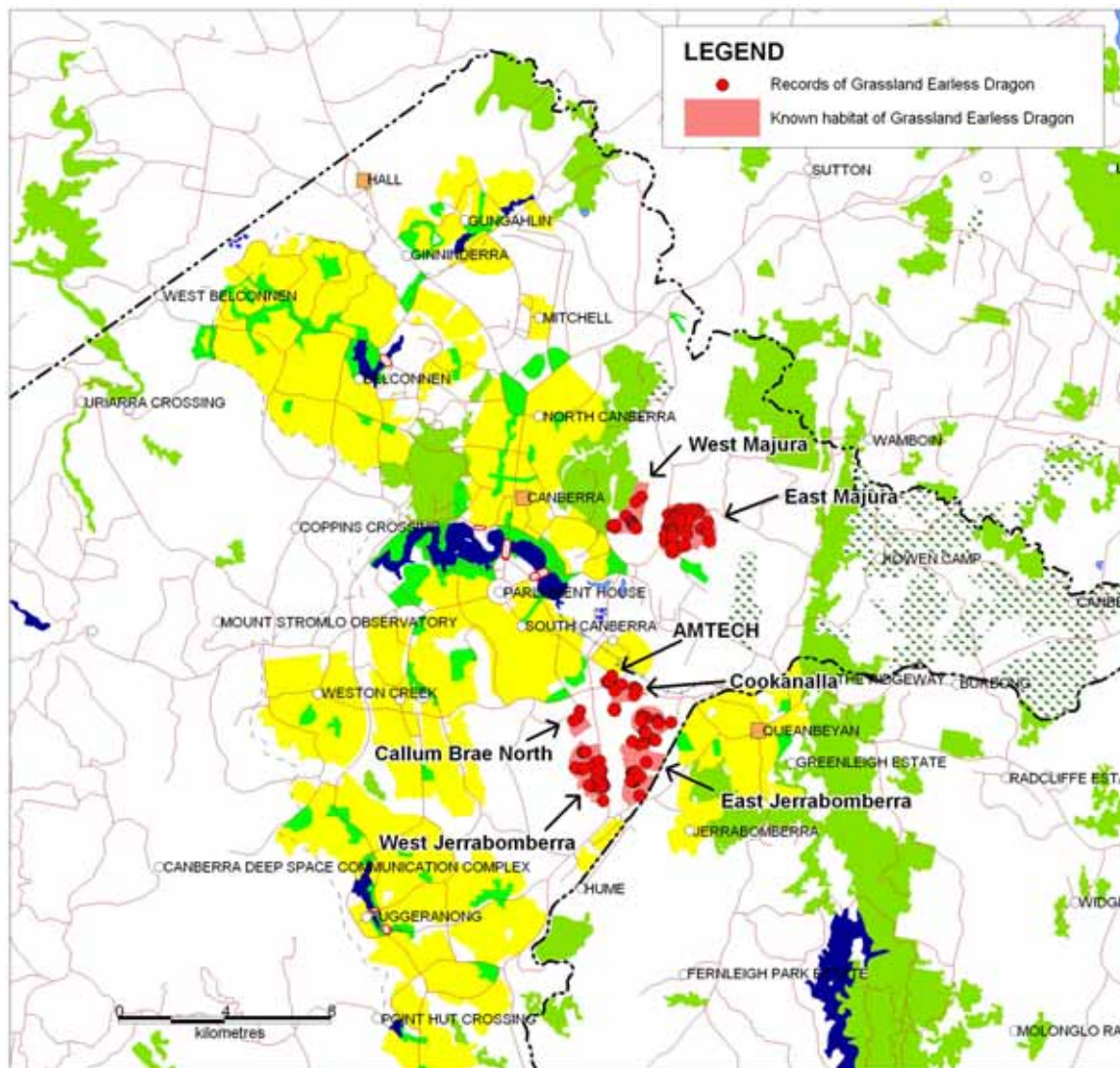
1. Belconnen Naval Base (Summer 1996, Summer 2001).
2. “Avonley” (Summer 1998).
3. Adjacent to Pialligo Avenue (Summer 1998).
4. Opposite airport on Majura Road (Summer 1998).
5. RAAF Fairbairn (Summer 1998).
6. “Dundee” (Summer 1998).

Sites supporting Grassland Earless Dragons in the ACT. From workshop report of July & August 1998 (Anon 1998).

Site Name	Area (ha)	Land Jurisdiction	Land use policy
East Majura	332.7	Commonwealth	Broadacre (military training)
West Majura	160.0	Territory and Commonwealth	Broadacre
West Jerrabomberra	217.0	Territory	Broadacre / Reserve
East Jerrabomberra	394.4	Territory and Commonwealth	Broadacre
AMTECH	24.2	Territory	Industrial / Broadacre
Callum Brae North	53.4	Territory	Broadacre (future industrial)
Cookanalla	99.4	Territory	Broadacre (future industrial)

Broadacre refers to agriculture and certain other 'large area' uses under Territory planning legislation

Map of localities of Grassland Earless Dragons in the ACT.



New South Wales

Known populations in NSW.

1. "The Poplars" – approximately 100 ha of private land in the Jerrabomberra Valley adjacent to the ACT, under a development application for rezoning and sub-division as residential. Northern-most population in NSW.
2. Kuma Nature Reserve – 182 ha, purchased by the DECC in 1998 for management as a grassland reserve approximately 4km south-east of Cooma.
3. Queanbeyan Nature Reserve – 52 ha at southern edge of Queanbeyan, adjacent to ACT sites in West Jerrabomberra Valley.
4. "Quartz Hill" - Private property, also south-east of Cooma.
5. "Carinya" – private property adjacent to the Kuma Nature Reserve.
6. Cooma Tip site – 54 ha of council owned land between the Cooma tip and the Kuma Nature Reserve, currently partly under a development application for expansion of the tip.
7. "Myalla" Travelling Stock Reserve (TSR) in the Cooma district.
8. "Hazeldean" TSR in the Cooma district.
9. "Four Mile" TSR in the Cooma district.
10. "Ravensworth" TSR in the Cooma district.

Sites surveyed in NSW where the species was not detected.

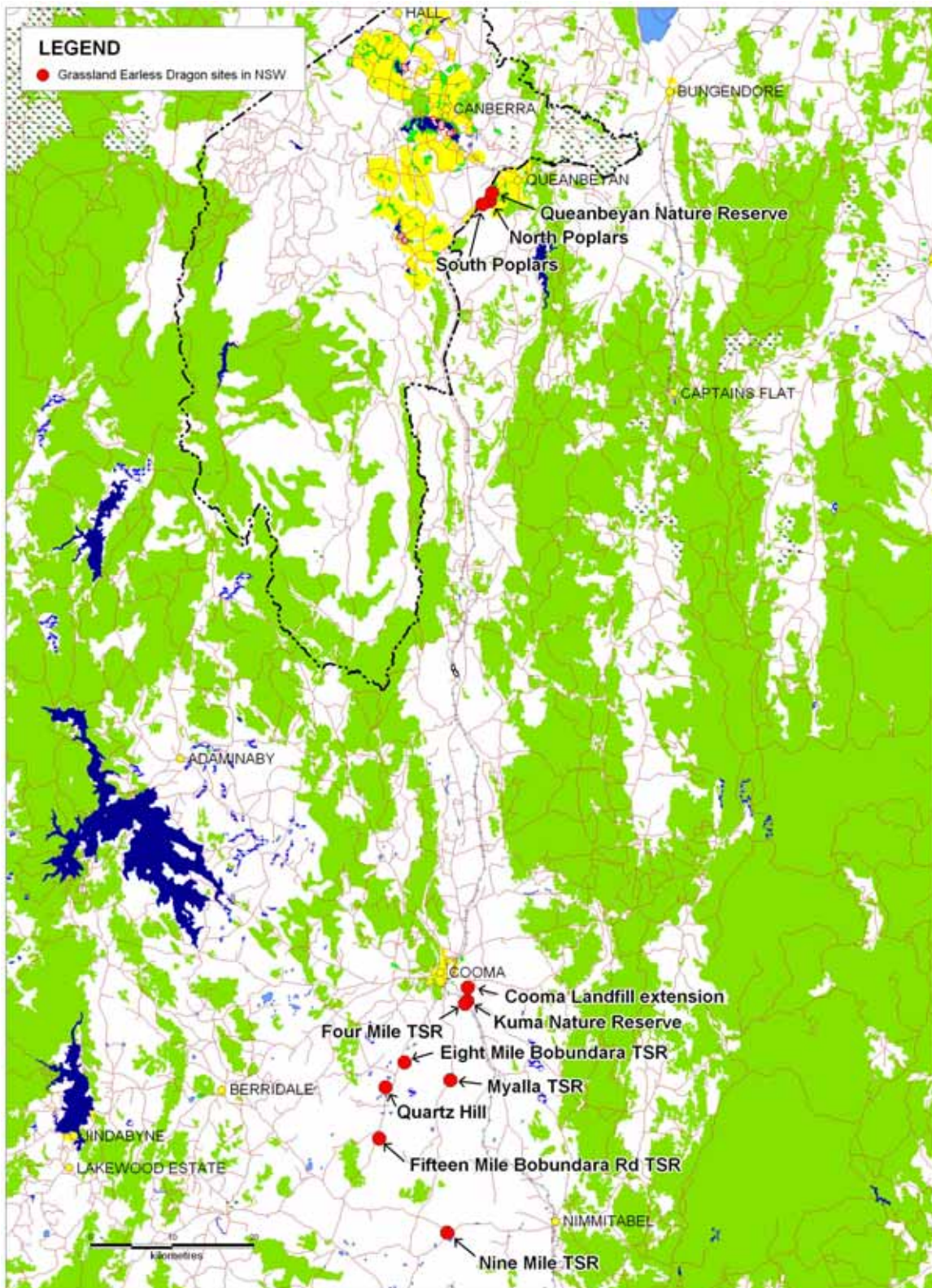
1. "Gundry" TSR near Goulburn (Summer-Autumn 1998) (J. Dawson pers. comm.).
2. 3 sites between Gundaroo and Sutton (Summer 1996) (Langston 1996).
3. 4 sites south of Bungendore (Summer 1996) (Langston 1996).
4. 1 site north of Hoskinstown (Summer 1996) (Langston 1996).
5. "Bedduluck" TSR (TSR 52). Roadside beside Barton Highway, just south of Murrumbateman (Summer 1999) (Lawler *et al.* 1999).
6. Bowning Cemetery, beside Hume Highway, Bowning. (Summer 1999) (Lawler *et al.* 1999).
7. "Chain of Ponds" TSR (TSR 44). Next to Hume Highway, ~10 km west of Gunning. (Summer 1999) (Lawler *et al.* 1999).
8. Gundaroo Common, Gundaroo. (Summer 1999) (Lawler *et al.* 1999).
9. Jones property, 5 Gums Lane, Yass. (Summer 1999) (Lawler *et al.* 1999).
10. "Lamb's" TSR (TSR 41), 5 km N of Yass centre (Summer 1999) (Lawler *et al.* 1999).
11. "McInerney's" TSR (TSR 27) (Summer 1999) (Lawler *et al.* 1999).
12. McGregor's property, 12 Cottrell Close, Yass (Summer 1999) (Lawler *et al.* 1999).
13. "Nanima" TSR (TSR 50), Murrumbateman-Gundaroo road (Summer 1999) (Lawler *et al.* 1999).
14. "Rifle Range" TSR (TSR 25) (Summer 1999) (Lawler *et al.* 1999).
15. Thompson's property. Yass River Rd., Yass (Summer 1999) (Lawler *et al.* 1999).
16. "Gundry" TSR. South of Goulburn (Summer 2000).
17. Collector TSR. Collector (Summer 2000).

NB: TSR's are managed by the Rural Lands Protection Board (RLPB).

Sites supporting Grassland Earless Dragons in NSW.

Site Name	Area (ha)	Land Jurisdiction	Land use policy
North Poplars	50	Private	Broadacre
South Poplars	50	Private	Broadacre
Queanbeyan Nature Reserve	56	DECC	Conservation
Kuma Nature Reserve	181	DECC	Conservation
Cooma Landfill "extension"	50	Cooma-Monaro Shire Council	Broadacre
"Quartz Hill"		Private	Broadacre
Myalla TSR		TSR, Cooma RLPB	Broadacre
Eight Mile Bobundara TSR (southern section)		TSR, Cooma RLPB	Broadacre
Four Mile TSR		TSR, Cooma RLPB	Broadacre
Fifteen Mile Bobundara Rd (Ravensworth) TSR		TSR, Bombala RLPB	Broadacre
Nine Mile TSR (large section)		TSR, Cooma RLPB	Broadacre

Map of localities of Grassland Earless Dragons in NSW.



Victoria

Known populations in Victoria.

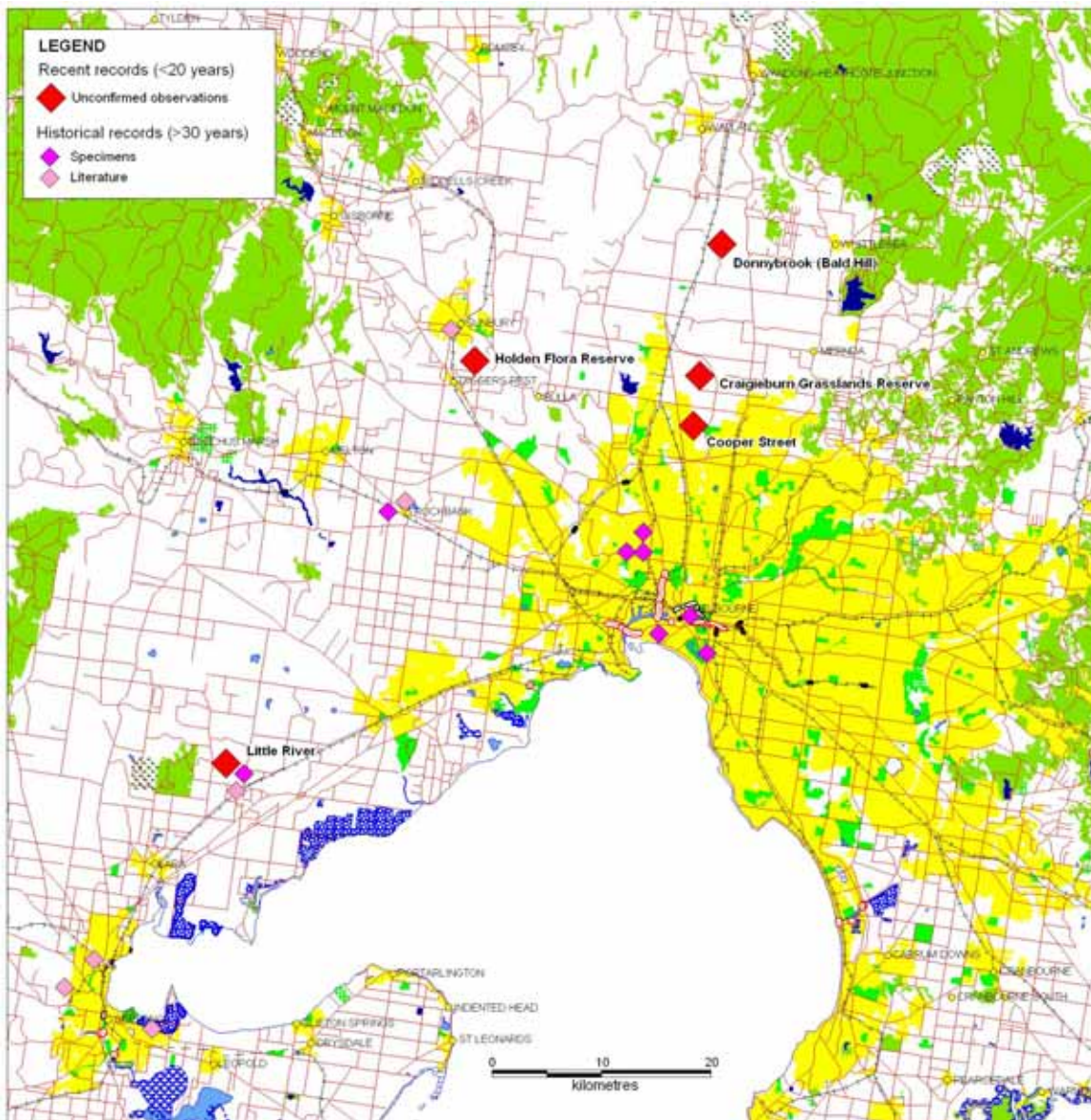
None known to be extant, although unconfirmed sightings within the last 25 years at:

- Craigieburn Grasslands (4 March 1990) (Beardsell 1997).
- Little River (January and February 1990) (Beardsell 1997).
- Holden Flora Reserve (1990) (Beardsell 1991).
- Donnybrook (Bald Hill) (18 October 1988) (Beardsell 1997).
- Cooper Street Grasslands (November 1985) (R. Valentic pers.comm.).

Older records (>30 years ago) from:

- Geelong Area – North Geelong (July 1969), Newcomb (September 1968), Hamlyn Heights (circa 1964) (Pescott 1969, G. Carr pers .comm.).
- Rockbank area, March 1968 (Robson 1968, Museum Victoria).
- Little River, 6 June 1967 (W. Baker – F. Collett photograph, illustrated in Jenkins and Bartell 1980).
- Records from late 1800's and early 1900's – Port Melbourne, Coode Island, Prahran, Essendon. Moonee Ponds, Sunbury (Lucas and Frost 1894, Mc Coy 1889, Museum Victoria).

Map of localities of Grassland Earless Dragons in Victoria.



Sites surveyed in Victoria where the species was not detected.

Robertson & Webster survey sites, 1994-1996 (small pitfalls and/or 'spider tubes'), as follows:

- Donnybrook (Bald Hill), 14 sites;
- Craigieburn Grasslands Reserve, 12 sites;
- Sunbury (Holden Flora Reserve), 5 sites;
- Little River, 6 sites;
- Werribee (Ballan Road) Target Range;
- Laverton North ('Peterleigh'), 3 sites;
- Geelong, 2 sites;
- Organ pipes NP.

Braelands, late 1990's (spider tubes).

Little River follow-up surveys, late 1990's (spider tubes).

Craigieburn Grasslands Reserve, late 1990's (spider tubes).

Craigieburn Grasslands Reserve, 2002 (hand searching) (Clemann 2003).

Melbourne Airport, 2001-2004 (pitfalls and endoscopic inspection of invertebrate burrows).

In Victoria, areas that may be subject to proposed land-use changes, and which support remnant native grassland, are generally subject to targeted surveys for threatened species, including Grassland Earless Dragons.

Appendix III: Interim management guidelines currently recommended by the National Recovery Team.

In accordance with Specific Recovery Objective 5 (Section C9.5), this appendix provides guidelines for managing Grassland Earless Dragon habitat that include general principles and more specific management recommendations. These guidelines should be considered when managing sites where the Grassland Earless Dragon is known to occur. The incorporation of these guidelines into management plans for Grassland Earless Dragon sites will ensure that specific actions required for the conservation management of Grassland Earless Dragons are recognised and given appropriate priority in these plans.

It is assumed and recommended that at all sites where Grassland Earless Dragons are known to occur the conservation of this endangered species is one of the major values to be considered by management. It is possible that conflicts with other values may occur at particular sites and in such cases management aimed at providing for these other values should not compromise the conservation of the species.

These guidelines are considered 'interim' until research actions outlined in this Recovery Plan are able to better define optimal management requirements of the Grassland Earless Dragon. As such, these guidelines may periodically be revised by the National Recovery Team to ensure they are updated with the most recent information relating to habitat management. For Grassland Earless Dragon sites that do not have specific management plans it is recommended that these guidelines be immediately adopted as a priority. Land managers proposing to depart from these guidelines should consult the National Recovery Team or respective state conservation agency for the latest information and guidelines relating to habitat management for Grassland Earless Dragons.

General principles for Grassland Earless Dragon management:

1. An overarching principle for management of Grassland Earless Dragon sites is to maintain current management regimes unless there are compelling reasons to do otherwise (such as amelioration of known threats to the conservation of the species). Any change to the current management regime that is not grounded in sound research (as outlined in this Recovery Plan) risks implementing management actions that have adverse impacts on Grassland Earless Dragon habitat.
2. If changes to management of a site are contemplated, and can be justified, then they should be applied only to a portion of the site, followed by careful monitoring of their efficacy and of their effects on the Grassland Earless Dragon population. The results of this monitoring should be reviewed before the changes to management are more widely applied.
3. Monitoring of Grassland Earless Dragon populations and carefully-selected habitat attributes should be considered at all sites where Grassland Earless Dragons occur. The objectives and methods to be used should be detailed in management plans (see 'Monitoring Regime for Kuma Nature Reserve' as an example (Cooper, Dorrrough & Nelson 1999)). Monitoring is an essential part of assessing and understanding the effect of current or new management actions. It enables habitat management to be undertaken within an adaptive management framework, whereby knowledge of the effects of current management is used to inform future management actions. Monitoring should be designed to allow for timely management responses if adverse effects are detected.
4. Management of Grassland Earless Dragon habitat values at sites must be integrated with the management of other grassland conservation values at those sites.

5. Provision for research into effects of management actions should be incorporated into management plans.
6. Management Plans for Grassland Earless Dragon sites should be reviewed periodically, and at least every five years.

Recommended management of Grassland Earless Dragon habitat:

1. The habitat at any site should not be allowed to decrease in area or become further fragmented, either by gradual attrition, deterioration of quality or through conflict with other potential land uses.
2. Access to Grassland Earless Dragon sites should be regulated to avoid damage to habitat and lizards that can be caused by vehicular or foot traffic. (Current vehicular access provided for some activities, such as balloon flights, must be curtailed.)
3. Potentially conflicting land-uses at Grassland Earless Dragon sites should be excluded, minimised or moderated to reduce their impact, in consultation with the land managers.
4. Pasture management should not include ploughing and application of fertiliser should only be permitted when it can be demonstrated that Grassland Earless Dragon habitat values will not be compromised.
5. Clearing of vegetation, removal of dead timber, removal or disturbance of rocks, or removal or disturbance of soil, should not be permitted.
6. Planting of exotic vegetation should not be permitted. Planting of native species should only be contemplated if it is considered necessary for Grassland Earless Dragon habitat improvement or maintenance.
7. Application of pesticides to control invertebrates must be avoided.
8. Grazing, by either native animals or domestic stock, may be required to maintain structural or floristic attributes of Grassland Earless Dragon habitat. Such grazing should be carefully regulated and monitored, with maintenance of these habitat attributes as the primary objective.
9. Fire should be excluded from Grassland Earless Dragon habitat unless there are compelling reasons for its application (such as ecological maintenance of grassland habitat attributes which, without fire, would irreversibly decline), and it can be demonstrated that such fire can be applied without comprising the Grassland Earless Dragon population at the site.
10. The methods for control and suppression of wildfire in Grassland Earless Dragon habitat must be carefully considered. Methods permitted must be determined in advance, agreed to by fire management authorities, and included within standard operating procedures.
11. Weed control should only be undertaken in such a manner as to avoid compromising Grassland Earless Dragon habitat, and to avoid any potential direct effects on lizards. However, weed control may be essential at some sites to prevent deterioration of Grassland Earless Dragon habitat values.
12. Active and ongoing vertebrate predator management should be considered at all Grassland Earless Dragon sites. It must be implemented so as not to compromise Grassland Earless Dragon habitat values.
13. Fences and other structures (eg. posts, antennas, marker stakes) should be minimised within Grassland Earless Dragon habitat to avoid providing perching sites for predatory birds. (Note that in some circumstances, fencing may be necessary for other

recommended management of Grassland Earless Dragon habitat, in particular, grazing to maintain structural or floristic attributes of habitat.)

Appendix IV: Interim standardised survey guidelines for detection of Grassland Earless Dragons, as recommended by the National Recovery Team.

The National Recovery Team has identified the need for standardised methodology to be applied during all broad distributional or pre-development surveys for Grassland Earless Dragons to provide a level of confidence in the outcomes of such surveys.

For the purposes of this Plan, surveys for Grassland Earless Dragons are divided into three categories:

- Survey – a broad distribution or pre-development assessment of presence;
- Monitoring – repeated visits to assess trends in abundance (or some other population parameter) or persistence at sites;
- Research.

The following guidelines are intended for only the first of these categories (Survey), although the methods may be useful as a starting point for the other two categories. The objective of surveys conducted according to the methodology recommended below is to determine the presence or absence of Grassland Earless Dragons at a site. If the species is detected during such surveys, the supervising authority must be contacted without delay for guidance on how to proceed and for any further requirements.

General requirements for Grassland Earless Dragon surveys:

1. The objective of the survey must be clearly stated. For a pre-development survey the objective will usually be to determine the presence or absence of Grassland Earless Dragons at the site.
2. A 'site' is defined here as the area to be developed and any grassland in the immediate vicinity that is contiguous with the development area.
3. All surveys require project-specific approvals (permits or licences) issued by the relevant State or Territory wildlife authority. Note that animal ethics approvals may also be required. Detailed plans of the proposed survey project will be required for both of these approvals. To avoid delays, consultants should allow ample time for these administrative processes. Detailed reporting of results (whether the species is detected or not) is a usual condition of the permit/licence.
4. Permits/licences are issued only to suitably qualified and experienced personnel, as determined by the authorities. Authorities issuing permits/licences may require training and certification of personnel undertaking survey.
5. Adequate resourcing to meet the survey objectives must be demonstrated. To avoid delays, consultants should plan for adequate resources well in advance of the proposed field program.
6. It may be desirable and/or required to survey known population(s) at the same time as the pre-development survey, to determine whether Grassland Earless Dragons are active during the survey period.
7. Surveys must be undertaken in a manner that avoids risk to Grassland Earless Dragons, such as avoiding putting in posts (which act as perches for predatory birds), avoid driving vehicles through site and avoid damaging habitat (trampling, soil disturbance). Opening 'traps' from October to December should be avoided unless extra precautions are taken to minimise the risk of desiccation of any eggs laid in traps (i.e. checking of traps every

second day and immediately contacting the supervising authority if lizard eggs are found in traps).

8. Should Grassland Earless Dragons be detected at a site the supervising authority should be informed without delay. The authority will then determine subsequent activities required at the site (with reference to the National Recovery Team).
9. Full reporting of surveys to relevant authorities is a usual condition of approvals. The license application and post-survey report must include a detailed description of the methods and accurate location information, as well as results of the survey. Some authorities may require additional reporting formats (e.g. Atlas cards). Forwarding of reports by the licensing authority to the National Recovery Team will enable the result to be recorded in a national database of Grassland Earless Dragon surveys and locations, and also enable the NRT to provide feedback to the authority on the adequacy of the survey (i.e. confidence in the results, particularly an 'absence' result).
10. Rehabilitation/restoration of the survey site to pre-survey conditions will be required.

Recommended survey methodology:

NOTE: This standardised methodology is recommended by the National Recovery Team as a minimum requirement for surveys aimed at determining the presence or absence of Grassland Earless Dragons at a site. By requiring this methodology as a minimum in licence and permit conditions, State and Territory authorities will ensure an acceptable level of confidence in the results of such surveys (including where the species was not detected). Additional survey may be stipulated in some circumstances.

1. SURVEY LAYOUT

The survey (trapping) layout within a site should be planned to achieve a comprehensive geographic coverage and to include the range of habitat types present. Consideration should also be given to adequately sampling the range of slope and aspect. Transects or grids are usually a more practical layout for traps than randomly scattering traps across a site. Trap spacing within a grid or transect should be 10 metres apart.

2. SURVEY METHODS

(a) The use of artificial arthropod burrows ('spider tubes') is the basic method to be applied at all sites. Spider tubes will be installed in the ground with a shade roof elevated above each tube. For details of the design and installation of these tubes and rooves, contact the relevant State or Territory conservation authority.

(b) Where rocks are present at a site, rocks must also be manually turned to search for lizards sheltering beneath. Turning rocks is in addition to the spider tube sampling. Each rock must be replaced in the original position after turning.

(c) Where soil cracks are present, 'mini pitfall traps' should be used in addition to the spider tubes and rock turning (where rocks are present). Pitfall traps should be shaded as for the spider tubes, but they do not require drift fences. For design details of mini-pitfall traps, contact the relevant State or Territory conservation authority.

(d) Where soil cracks are present, inspection of soil cracks or arthropod burrows using an endoscope (or similar) will be required, in addition to the previously mentioned methods.

3. SURVEY EFFORT

(a) A minimum of 100 spider tubes will be required per site in the layout specified in (1) above.

After installation, spider tubes should be allowed to sit undisturbed for at least seven days before checking. Subsequently they should be checked no more frequently than every second day, for at least 30 checks per tube (i.e. tubes in field for a minimum of 67 days).

(b) At least 50 rocks should be turned per hectare, with a least 1000 turned at the site (if that many are present). All rocks must be returned to original position and orientation.

(c) At least 100 mini pitfall traps will be required at each site with cracking soils, in the layout specified in (1) above. After installation pitfall traps should be checked at least daily and for at least 10 consecutive days.

(d) At least 100 invertebrate burrows and/or soil cracks must be examined with an endoscope at each site with cracking soils.

NOTE: Not all of the above survey effort will be necessary if the species is found during the survey, at which point the primary objective has been fulfilled (*i.e.* to determine the presence or absence of Grassland Earless Dragons) and further survey effort is not required.

4. SURVEY TIMING

Survey timing is dependent on the particular technique being used.

Spider tubes and mini-pitfalls: January to April inclusive. This period is specified because the presence of juveniles at this time markedly increases the chance of detecting the species. If trapping is undertaken outside this period and no Grassland Earless Dragons are found, then the trapping survey will need to be repeated between January and April.

Rock turning should be undertaken during autumn, winter or spring.

Endoscopic inspections should be undertaken February to April (inclusive).