Australian Capital Territory

Nature Conservation (Threatened Ecological Communities and Species) Action Plan 2004 (No 2)*

Disallowable instrument DI2004— 44

made under the

Nature Conservation Act 1980, s 23C (Preparation of action plan)

1 Name of instrument

This instrument is Nature Conservation (Threatened Ecological Communities and Species) Action Plan 2004 (No 2).

2 Details of instrument

I have prepared Action Plans for the following declared species as attached to this instrument:

Action Plan No 1 – Natural Temperate Grassland (an ecological community)
Action Plan No 2 – Striped Legless Lizard (*Delma impar*)
Action Plan No 3 – Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*)
Action Plan No 5 – A Subalpine Herb (*Gentiana baeuerlenii*)
Action Plan No 6 – Corroboree Frog (*Pseudophryne corroboree*)
Action Plan No 7 – Golden Sun Moth (*Synemon plana*)
Action Plan No 8 – Button Wrinklewort (*Rutidosis leptorrhynchoides*)
Action Plan No 21 – Perunga Grasshopper (*Perunga ochracea*)
Action Plan No 22 – Brush-tailed Rock Wallaby (*Petrogale penicillata*)

3 Commencement

This instrument commences on the day after notification.

Maxine Cooper
Conservator of Flora and Fauna
7 April 2004

*Name amended under Legislation Act 2001 s 60

ACTION PLAN No. 1

In accordance with section 21 of the *Nature Conservation Act 1980*, **Natural Temperate Grassland** was declared an **endangered ecological community** on 15 April 1996 (formerly Determination No. 29 of 1996 and currently Determination No. 89 of 1997). Section 23 of the Act requires the Conservator of Flora and Fauna to prepare an Action Plan in response to each declaration. This is the Action Plan for the:

Natural Temperate Grassland - An Endangered Ecological Community

Preamble

The *Nature Conservation Act 1980* establishes the ACT Flora and Fauna Committee with responsibilities for assessing the conservation status of the ACT's flora and fauna and the ecological significance of potentially threatening processes. Where the Committee believes that a species or ecological community is threatened with extinction or a process is an ecological threat, it is required to advise the Minister for the Environment, Land and Planning, and recommend that a declaration be made accordingly.

Flora and Fauna Committee assessments are made on nature conservation grounds only and are guided by specified criteria as set out in its publication "*Threatened Species and Communities in the ACT,* July 1995".

In making its assessment of the natural temperate grassland, the Committee concluded that it satisfied the criteria indicated in the adjacent table.

An Action Plan is required in response to each declaration. It must include proposals for the identification, protection and survival of a threatened species or ecological community, or, in the case of a threatening process, proposals to minimise its effect.

While the legal authority of this Action Plan is confined to the Australian Capital Territory, management considerations are addressed in a regional context.

Criteria Satisfied

3.2 The Community is subject to current and continuing threats or other processes likely to lead to premature extinction as demonstrated by:

3.2.1 Severe decline in distribution.

3.2.2 Marked alteration of composition or structure.

Links with other Action Plans

This Action Plan interrelates with the Action Plan for component threatened species of Natural Temperate Grassland, eg. Striped Legless Lizard (*Delma impar*) and the Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*). Action Plans are listed at the end of this document.

Description

Natural grassland is a native ecological community that is dominated by native species of perennial grasses. There is also a diversity of native herbaceous plants (forbs) present. An important characteristic of the community is that it is naturally treeless, or has less than 10% projective foliage cover of trees, shrubs and sedges in its tallest stratum (Moore 1964, Kirkpatrick 1993). In the ACT, natural temperate grassland occurs up to an altitude of 625 m asl.

Native grassland communities in the south-east of the continent and Tasmania with a mean annual rainfall of 500 to 1000 mm are

ACT DEPARTMENT OF URBAN SERVICES
ENVIRONMENT ACT

referred to as **natural temperate grassland**, or lowland native grassland. Natural temperate grassland occurs in the Monaro, a region of south eastern Australia that encompasses the Australian Capital Territory and adjacent parts of the Southern Tablelands of New South Wales. It also occurs in areas near Goulburn and Braidwood and at Yass and evidence suggests that there were grasslands in the Tumut area (Rehwinkel, pers. comm.).

Secondary grassland is an ecological community that develops when the tree canopy cover of grassy woodland is permanently removed. Secondary grassland is not classified as natural temperate grassland, even where both ecological communities have apparently similar structure and component species.

Natural temperate grassland intergrades on slopes with grassy woodland (defined as having a tree cover greater than 10%). Yellow Box/ Red Gum Grassy Woodland has been declared an endangered ecological community in the ACT under the *Nature Conservation Act 1980.*

STRUCTURE

Perennial tussock grasses impart a characteristic structure to natural temperate grassland. The tussocks are often closely spaced, forming an upper stratum of loosely interlacing leaf canopies (Costin 1954, Sharp 1997). This upper canopy stratum generally varies in height from mid high (0.25 to 0.5 metres) to tall (0.5 to 1.0 metres), and in cover from open to dense (greater than 70% ground cover) (Walker and Hopkins 1984).

A second, lower stratum may be discernible below the upper canopy. This lower canopy layer typically comprises shorter perennial and annual grasses, and herbaceous plants called forbs, growing between the tussocks. At ground level, there may also be a third discontinuous stratum of dwarf forbs and grasses, with occasional mosses and lichens also present (Costin 1954). The community sometimes includes areas of embedded rocks, which provide habitat for fauna.

FLORISTICS

The characteristic dominant genera of natural temperate grassland in Australia include *Themeda*, *Poa* and *Stipa* (Groves and Williams 1981). In other areas in the Southern Tablelands, the dominant plant species include Kangaroo Grass *(Themeda triandra)*) Wallaby Grasses *(Danthonia* spp.), Spear grasses *(Stipa* spp.), Red Grass *(Bothriochloa macra)* and Tussock Grasses *(Poa* spp.) (Benson and Wyse Jackson 1993, Benson 1994, Sharp 1997).

Five floristic associations have been defined for natural temperate grassland in the ACT (Sharp and Shorthouse 1996, Sharp 1997). This compares with 8 floristic associations described for natural temperate grassland in the broader Monaro region (Benson 1994). All of the ACT associations can be related to those described for the Monaro region. The ACT floristic associations comprise both wet tussock grasslands including: "Wet *Themeda*" Grassland and "*Poa labillardieri*" Grassland, and dry tussock grasslands including "*Danthonia*" Grassland, "Dry *Themeda*" Grassland and "*Stipa*" Grassland (Sharp 1997).

Most natural temperate grassland has been subject to grazing by domestic stock or by rabbits, which has modified its species composition and structure. Exotic plant species are common in natural temperate grassland, which may vary from a semi-natural state with few exotic species, to a highly-modified state in which exotic species form a dominant component of the community (Groves and Williams 1981, McIntyre 1994, Sharp 1997). Surveys show that exotic species comprise over 35% of the flora at most natural grassland sites in the Monaro region (Benson 1994, Sharp 1997). The majority of these exotic species are annuals (Sharp 1997).

The following descriptions of the ACT floristic associations are based on detailed studies by Sharp (1997), and Benson (1994). Refer to Appendix 1 for a list of common names.

Wet *Themeda* Grassland

Wet *Themeda* grassland is a tall, dense, closed tussock grassland. It is often degraded, with a low native species diversity and high weed content. It includes some species found only in poorly-drained seepage sites.

Dominant native grasses: - *Themeda triandra*, *Poa labillardieri*, *Poa* spp. and *Danthonia* spp.

Other characteristic native species: - *Carex inversa*, *Juncus* spp., *Asperula conferta*, *Bulbine bulbosa*, *Anguillaria dioica*.

Common exotic species: - *Trifolium glomeratum*, *Trifolium campestre*, *Vulpia myuros*, *Tragopogon dubius*, *Hypochaeris radicata*, *Cerastium glomeratum*, *Bromus hordeaceus*, *Holcus lanatus*, *Phalaris aquatica*.

Poa labillardieri Grassland

Poa labillardieri grassland is a tall, dense, closed tussock grassland. It occurs in the ACT as small, often degraded remnants which are part of larger grassland sites.

Dominant native grasses: - *Poa labillardieri*, *Themeda triandra*.

Other characteristic native species: - *Carex appressa*, *Carex inversa, Juncus* spp., *Haloragis heterophylla*, *Hydrocotyle laxiflora.*

Common exotic species: - *Poa pratensis*, *Rumex crispus*, *Trifolium repens*, *Trifolium dubium*, *Cirsium vulgare*, *Holcus lanatus*, *Phalaris aquatica*.

Danthonia Grassland

Danthonia grassland is a mid-high, open tussock grassland. Despite moderate to high levels of disturbance, it exhibits a high native species diversity, and often includes low growing species not found in other floristic associations.

Dominant native grasses: - *Danthonia carphoides*, *D. caespitosa*, *D. laevis*., *Stipa bigeniculata*, *S. scabra* spp. *falcata, Bothriochloa macra*.

Other characteristic native species: - *Chloris truncata*, *Elymus scaber*, *Triptilodiscus pygmaeus*, *Panicum effusum*, *Oxalis perennans*, *Goodenia pinnatifida*, *Vittadinia muelleri*, *Chrysocephalum apiculatum*, *Plantago varia*, *Wahlenbergia* spp., *Solenogyne dominii*.

Common exotic species: - *Hypochaeris radicata*, *Trifolium* spp., *Aira elegantissima*, *Vulpia* spp., *Tolpis umbellata*.

Dry *Themeda* Grassland

Dry *Themeda* grassland is a tall, dense, closed tussock grassland. The only remaining sites with this association in the ACT have had low levels of past disturbance. Dry *Themeda* grassland sometimes includes species no longer found in other grasslands due to their higher levels of disturbance.

Dominant native grasses: - *Themeda triandra*, *Stipa* spp., *Poa sieberiana*, *Danthonia* spp.

Other characteristic native species: - *Leptorhynchus squamatus*, *Plantago varia*, *Stackhousia monogyna*.

Common exotic species: - *Avena* spp., *Centaurium erythraea*, *Tragopogon porrifolius*, *Trifolium* spp., *Bromus hordaceous*.

Stipa Grassland

Stipa grassland is a tall, open tussock grassland. Most sites were previously dominated by *Themeda triandra*. Sites are usually degraded, with a low diversity of native species. The association often includes shorter grasses interspersed between the tussocks.

Dominant native grasses: - *Stipa bigeniculata*, *Stipa scabra* ssp. *falcata*, *Elymus scaber, Danthonia caespitosa*, *Enneapogon nigricans.*

Other characteristic native species: - *Danthonia* spp*., Bothriochloa macra*, *Themeda triandra*, *Wahlenbergia* spp., *Chrysocephalum apiculatum.*

Common exotic species: - *Trifolium arvense*, *Vulpia myuros*, *Hypochaeris glabra*, *Hypochaeris radicata*, *Carthamnus lanatus*, *Paronychia brasiliana*, *Aira caryophyllea*, *Dactylis glomerata*, *Arctotheca calendula*.

FAUNA

A range of small vertebrate and invertebrate animals are characteristic inhabitants of natural temperate grassland in the Southern Tablelands. In the ACT, the more common vertebrates of this ecological community include reptiles and amphibians such as the Delicate Skink (*Lampropholis delicata*), the Orange-groined Toadlet (*Uperoleia laevigata*), the Spotted Burrowing Frog (*Neobatrachus sudelli*) and the Eastern Banjo Frog (*Lymnodynastes dumerilii*).

Many birds also use the habitat provided by natural temperate grassland. These include common species such as the Australian Magpie (*Gymnorhina tibicen*), and the Willy Wagtail (*Rhipidura leucophrys*) as well as a variety of birds including raptors. Although relatively few birds are restricted to natural temperate grassland, the Stubble Quail (*Coturnix novaezeelandiae*) and the Brown Quail (*Coturnix australis*) are predominantly found in this habitat in the ACT. Latham's Snipe (*Gallinago hardwickii*), which is protected under both the China and Japan Migratory Birds Agreements, has been recorded in wetlands occurring in natural temperate grasslands in the region. The White-fronted Chat (*Ephthianura albifrons*) seems to be largely dependent on wet grasslands in the region (Rehwinkel, pers. comm.).

Prior to European settlement, the fauna of natural temperate grassland of the ACT and adjacent parts of NSW included a wide range of both larger and smaller vertebrate animals. Large vertebrates included emus, kangaroos, bustards, rat kangaroos and predatory birds. The smaller animals typically included marsupials, rodents, birds, reptiles and amphibians (Osborne *et al*. 1995). Many of these have suffered significant decline as their habitat was modified and reduced in extent following European settlement. For example, the Australian Bustard (*Ardeotis australis*) and the Plains Wanderer (*Pedionomus torquatus*) no longer occur in the region (Ride and Wilson 1982, Baker-Gabb *et al*. 1990). Other species

such as the Striped Legless Lizard (*Delma impar*) and the Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*) have declined significantly in the region (Osborne *et al*. 1995).

Relatively little is known of the past and present distribution and the ecology of the many species of invertebrate animals of natural temperate grassland in the ACT and surrounding parts of the Monaro region. However, some invertebrate species are known to have declined in their distribution in the region. Two grassland invertebrates have been declared threatened, these being the Golden Sun Moth, (*Synemon plana*) and the Perunga Grasshopper (*Perunga ochracea*). Other species of concern are Key's Matchstick (*Keyacris scurra*), and Canberra Raspy Cricket (*Cooraboorama canberrae*) (Driscoll 1994). Several recent studies have shown that floristic diversity does not equate to invertebrate diversity (Melbourne *et al.* 1997; Greenslade 1997). Further studies are required to determine habitat utilisation in grassland by invertebrates.

Distribution

FORMER DISTRIBUTION

Natural temperate grassland was formerly widespread in the temperate regions of south-eastern Australia. Areas with the ecological community typically occurred from north of Adelaide in South Australia, to northern New South Wales and Tasmania (Groves and Williams 1981).

In the Southern Tablelands region, natural temperate grassland was widespread at the time of European settlement (Costin 1954). A total of 250,000 hectares of the ecological community is estimated to have occurred throughout the region, including about 20,000 hectares in the ACT (Benson and Wyse Jackson 1993). Natural grassland was particularly common in areas of lower elevation in the Southern Tablelands, often extending across large parts of the plains and the river valleys. The Monaro Plains, Bungendore Plains, Goulburn Plains, Yass Plains and Limestone Plains (ACT) supported large areas of natural temperate grassland. Smaller areas, with various substrates and topographics located from Braidwood to Crookwell and from Murrumbateman to Tumut also supported natural temperate grassland (Rehwinkel 1997).

Geological formations which supported the ecological community included Cainozoic sediments, Silurian and Ordovician volcanics, mudstones, shales and limestones. Typical soils were derived from volcanic and sedimentary substrates and included red, grey and brown clay podsols and laterites (Benson 1994).

In the ACT, natural temperate grassland occurs below 625 metres elevation (Sharp 1997). It was the dominant ecological community at sites of lower elevation in the Molonglo River Valley, which forms the central part of the Canberra region and includes Jerrabomberra Valley and the Majura Valley. Natural grasslands also dominated large areas of the lowland plains at Tuggeranong in the south, and the plains at Belconnen and Gungahlin to the north (Benson and Wyse Jackson 1993, Wildlife Research Unit 1994).

The pre-European distribution of natural grasslands in the region is believed to have been influenced by a combination of environmental factors, including low temperatures due to cold air drainage in winter, periods of low soil moisture availability in summer associated with the heavy clay soils, and low rainfall in some areas (Chan 1980, Groves and Williams 1981, Benson and Wyse Jackson 1993, Benson 1994). The effects of seasonal burning by Aborigines are also thought to have been an important factor determining distribution of the ecological community (Story 1969). In environments where these factors did not preclude tree growth, natural temperate grassland graded into open grassy woodlands and other vegetation formations.

PRESENT KNOWN DISTRIBUTION

European land uses, particularly grazing, pasture improvement, cropping, the introduction of exotic species (including pasture species) and changes to the pattern of burning, have greatly reduced the extent and integrity of natural temperate grassland in the region. Tree planting on natural temperate grassland also threatens their integrity. Urban development has contributed significantly to the further loss of this ecological community in the region, particularly in parts of the ACT associated with the establishment and expansion of Canberra.

Current estimates indicate that, with the exception of some areas of semi-natural grassland near Cooma in NSW, less than 1% of natural temperate grassland in the Monaro region remains in good condition (Benson and Wyse Jackson 1993).

In the ACT, an estimated 5% (about 1,000 hectares) of natural temperate grassland is all

that remains in moderate to good condition (Office of the Commissioner of the Environment 1995). Additional areas of lower quality natural grassland totalling approximately 500 hectares provide important buffers and corridors for native grassland species and habitat for some grassland fauna. Remnant natural grassland has been recorded at 39 locations ranging in size from less than one hectare to about 300 hectares. Of these, the majority are of small size, including 18 (45%) which are less than five hectares in area. Only five locations are more than 100 hectares. Nine locations are in Gungahlin in areas programmed for urban development.

Other areas, in which only one or several native grassland species occur within an exotic plant matrix, are not considered to be natural temperate grassland because they lack the native species diversity that is a characteristic of natural temperate grassland in the ACT.

The current distribution of natural temperate grassland in the ACT, together with the estimated distribution of entirely treeless grassland prior to European settlement, is shown in Figure 1. Grassland sites outside the treeless area identified by Pryor (1938) occur where records, visual estimation and presence of cold drainage areas indicate that tree cover was less than 10% prior to European settlement. Remnant sites characterised by the five floristic associations are listed in Table 1. Because some of the 39 locations include more than one floristic association (Sharp 1997) or are subject to different land uses or are under separate leases they may be represented by more than one entry in Table 1. The sites are listed in numerical order in Appendix 2.

The botanical significance, area, major floristic association, and species of conservation significance are also listed for each site. Sites that are currently in reserves are highlighted. The botanical significance (Table 2) has been developed by Environment ACT (Wildlife Research and Monitoring), and also is used by the NSW National Parks and Wildlife Service. At some sites patches of grassland occur with higher or lower botanical significance. The botanical significance of these smaller patches is indicated in brackets. A more detailed description of the botanical significance ranking system is provided in Appendix 3.

CHARACTERISTICS OF THE ECOLOGICAL COMMUNITY

The present distribution in the ACT of the floristic grassland associations described above has resulted from the combination of site factors and patterns of land use since European settlement (Sharp and Shorthouse 1996). The small size of remaining natural grassland sites is largely the result of land uses and management. Past and present land uses in adjacent areas have also contributed to fragmentation and isolation of the majority of these remnant sites. Current land uses for the remaining natural grassland sites in the ACT include urban open space, rural leases, roadside verges, and special purpose areas including Defence land, the airport, and telecommunication facilities (Sharp 1995).

Aspects of the distribution of each floristic association are summarised below, based on studies by Sharp (1997) and Benson (1994).

Wet *Themeda* Grassland

Total area in ACT - 73.6 hectares; number of sites - 9

The wet and dry tussock grasslands dominated by *Themeda triandra* are, together, the most widespread of the eight grassland associations described for the broader Monaro region by Benson (1994). These *Themeda* dominated grasslands extend from the Goulburn region to Bombala in the south, and Adaminaby in the west (Benson 1994; Rehwinkel 1997).

Wet *Themeda* grasslands occur at a range of altitudes in the ACT, predominantly at lower slope and valley bottom sites. The sites are poorly drained, and occur on a range of substrates, with moderately deep loam soils.

Table 1. List of Site Locations with Floristic Associations

Location and Site	Grassland Action Plan Location No. (GAP)	Floristic Association	Area (ha)	Botanical Significance 1=high; 5=low	Species of Conservation Significance
West Belconnen (Site A, Dunlop)	3	Wet Themeda	10.8	2	#
Majura Valley East (Site B, FAC Beacon)	28	Wet Themeda	5.6	3(2)	#
"Horse Park" entrance, Gungahlin (Site A)	1	Wet Themeda	10.3	3	#
Mulanggary Grassland Reserve (Site B)	6	Wet Themeda	6.1	3	Di, #
Caswell Drive, Roadside (Site A)	22	Wet Themeda	1.4	3	#
Dudley Street, Yarralumla	30	Wet Themeda	0.9	3	Sp
Gungaderra Grassland Reserve (Site B)	9	Wet Themeda	12.8	3(5)	Di #
Caswell Drive, Paddock (Site B)	22	Wet Themeda	5.4	4	
Yarramundi Reach (Site B)	24	Wet Themeda	4.1	4	Di
Gungaderra Nature Reserve (Site C)	9	Poa	2.0	3	Di
Yarramundi Reach (Site C)	24	Poa	1.0	4	Sp
Majura Valley East (Site A, Firing Ra.)	28	Danthonia	142.2	1(3)	Di, Tlp, Sp, Rl, #
Belconnen Naval Station (Site A)	20	Danthonia	106.5	2	Sp, #
Jerrabomberra West (Site A, "Woden")	36	Danthonia	72.4	2	Tlp, Ap, Sp, #
Majura Valley East (Site D, Airport,)	28	Danthonia	47.1	2	Tlp, Sp, #
Majura Valley East (Site C FAC Beacon)	28	Danthonia	7.0	2(3)	Di, Tlp, #
Majura Valley East (Site E, Airport)	28	Danthonia	72.7	3	Tlp, #
Jerrabomberra East (Site B, Mike's Hill)	37	Danthonia	43.8	3	Tlp
Kaleen east paddocks	21	Danthonia	28.6	3	
North Mitchell (Site A)	10	Danthonia	14.8	3	
Campbell Park paddocks	27	Danthonia	9.0	3	Rl, Tlp, Sp, #
Campbell Park Offices	27	Danthonia	3.3	3	Rl, Tlp, Sp, #
Crace Hill Grassland Reserve (Site B)	13	Danthonia	8.7	3	Di
Black Street, Yarralumla	32	Danthonia	4.1	3	Sp
Mulanggary Grassland Reserve (Site A)	6	Danthonia	3.3	3	#
Lady Denman Drive, Yarralumla	29	Danthonia	2.5	3	Sp, #
York Park, Barton	34	Danthonia	0.4	3	Sp
Lake Ginninderra (Site A)	19	Danthonia	0.1	3	Sp
Jerrabomberra East (Site C, East Woden)	37	Danthonia	20.1	3(4)	Tlp
Mugga Mugga	39	Danthonia	3.0	3(4)	
AMTECH, Fyshwick	35	Danthonia	24.2	4(3)	Tlp
Jerrabomberra West (Site D Callum Brae)	36	Danthonia	53.5	4	Tlp
"Horse Park" entrance, Gungahlin (Site B)	1	Danthonia	21.8	4	Sp, #
Lake Ginninderra (Site B)	19	Danthonia	1.6	4	
Lake Ginninderra (Site C)	19	Danthonia	0.4	4	
Novar Street, Yarralumla	31	Danthonia	0.3	4	
St Mark's, Barton	33	Dry Themeda	3.1	1	Rl, #
Yarramundi Reach (Site A)	24	Dry Themeda	8.0	3	
Constitution Avenue, Reid	26	Dry Themeda	3.0	3	Sp, #
Umbagong Park South, Florey	17	Dry Themeda	2.8	3	
CSIRO Limestone Avenue, Campbell	25	Dry Themeda	2.8	3	Sp
North Mitchell (Site B)	10	Dry Themeda	1.9	3	Di
Glenloch Interchange	23	Dry Themeda	1.5	3	
Kosciusko Avenue, Palmerston (Site A),	7	Dry Themeda	1.2	3	Di
Lake Isabella, Monash	38	Dry Themeda	1.2	3	
"Kooringal" property	2	Dry Themeda	18.8	3(4)	
Jerrabomberra East (Site D, Tharwa Rd)	37	Dry Themeda	2.0	3(4)	Rl
Belconnen Naval Stn (Site C, paddocks)	20	Dry Themeda	12.4	4	
Evatt powerlines	18	Dry Themeda	2.3	4	
Umbagong Park North, Florey	16	Dry Themeda	5.0	5	
Belconnen Naval Stn (Site B, paddocks)	20	Stipa	53.7	3	
Gungaderra Grassland Reserve (Site A)	9	Stipa	14.8	3	Di
West Belconnen (Site B)	3	Stipa	20.0	3	Sp, #
Mulanggary Grassland Reserve (Site C)	6	Stipa	82.8	3(5)	Di, Sp, #
Jerrabomberra West (Site C Callum Brae)	36	Stipa	85.8	4	Tlp
Jerrabomberra West (Site B, "Woden")	36	Stipa	53.7	4	Tlp
Crace Hill Grassland Reserve (Site A)	13	Stipa	44.7	4	Di
Kosciusko Avenue, Palmerston (Site B)	7	Stipa	13.1	4	Di
Kenny North, Gungahlin	11	Stipa	11.4	4	
Harrison, Gungahlin	5	Stipa	8.7	4	
Belconnen Naval Stn (Site D, paddocks)	20	Stipa	6.3	4	
"Stray Leaf" property, Gungahlin	4	Stipa	4.8	4	
Gundaroo Rd sth, Gungahlin	8	Stipa	4.2	4	
Kenny, Gungahlin	12	Stipa	1.7	4	Di
Racecourse, Gungahlin	14	Stipa	1.5	4	
Jerrabomberra East (Site A, HMAS Harman)	37	Stipa	171.3	5(4)	Di, Tlp
Jarramlee	15	Stipa	53.8	5(4)	
Total of 68 sites at 39 locations			**1450.1**		

Shaded areas indicate sites that are Public Land - Nature Reserve

Ap = *Aprasia parapulchella*, Di = *Delma impar*, Rl = *Rutidosis leptorrhynchoides*, Sp = *Synemon plana*, Tlp = *Tympanocryptis lineata pinguicolla*, # = uncommon or declining species which are not formally listed.

GAP = Grassland Action Plan Location Number - this number is used as a location reference in this Action Plan (see Figure 1) and as a reference to grassland sites in other Action Plans. The sites are listed in numerical order in Appendix 3.

Note: Some sites may be represented by more than one entry - this is because some locations include more than one floristic association or are subject to different land uses or are under separate leases.

Poa labillardieri Grassland

Total area in ACT - 3 hectares; number of sites - 2

Tussock grasslands dominated by *Poa labillardieri* were described by Benson (1994) as widespread in the tableland and montane parts of the Monaro, where they are restricted locally to drainage lines and river flats.

Poa labillardieri grassland occurs at a range of altitudes. However, only two small areas of this floristic association remain as mappable units in temperate grasslands in the ACT. It is locally restricted to sites along drainage lines, including seepage areas and creeks. The sites are poorly drained, and include loam substrates and deeper organic soils. It is likely that the floristic association was formerly more widespread in temperate grassland in the ACT, but has been reduced in extent due to extensive habitat modification at these wetter sites (Sharp 1997).

Danthonia Grassland

Total area in ACT - 691.4 hectares; number of sites - 25

Danthonia grasslands are largely restricted to the northern parts of the Monaro region, particularly the Canberra, Queanbeyan, Bungendore and Lake George districts. These areas are generally of lower elevation and subject to higher temperatures compared with other parts of the region. (Benson 1994).

In the ACT, *Danthonia* grasslands typically occur at lower altitude sites on gentle slopes, ridges or other flat areas where the substrate is shallow to skeletal. The sites are rapidly draining, and have a high clay content, particularly sandy clay loams and clay loams (Sharp 1997).

Dry *Themeda* Grassland

Total area in ACT - 73.6 hectares; number of sites - 14

Dry *Themeda* grasslands, as noted above, are widespread in the Monaro region. Dry *Themeda* grasslands are found at a range of altitudes, at lower to mid slope sites in the ACT. The sites are moderately rapidly draining and include substrates of shallow to moderately deep loams and silty or sandy clay loams (Sharp 1997). Some secondary grasslands may also be dominated by the Dry *Themeda* floristic association.

Stipa Grassland

Total area in ACT - 637.3 hectares; number of sites - 17

Stipa grasslands are found throughout the Monaro (Benson 1994) and in the ACT (Rauhala *et al.* 1995). It is thought that the association may occur at sites originally dominated by *T. triandra* but which have been subject to moderate to heavy disturbance, causing loss of those species that are sensitive to disturbance (Benson 1994, Sharp 1997). *Stipa* dominated grasslands typically occur on upper ridge slopes and ridges. In the ACT, the sites are well drained and include substrates of shallow to moderately deep sandy or loamy clay soils.

Table 2. Botanical significance

Botanical Significance for Natural Temperate Grassland					
	Rating 1	**Rating 2**	**Rating 3**	**Rating 4**	**Rating 5**
Conser-vation value	**Very high**	**High**	Moderate	**Low**	**Minimal**
Native species diversity	Very high	High	Medium	Lower	Low
Exotic species diversity	Very low	Low	Moderate	High	Very high
Uncommon species	Several to many	Several	Few	None	None
Disturbance	Minimal	Some change	Moderate alteration	Much alteration	Largely altered

Conservation Status

NATURAL TEMPERATE GRASSLAND

Natural Temperate Grassland is recognised as a threatened ecological community in the following sources:

Australian Capital Territory

Endangered. - Section 21 of the *Nature Conservation Act 1980,* Determination No. 89 of 1997 (formerly Determination No. 29 of 1996).

New South Wales

Natural temperate grassland currently has no formal conservation status as an ecological community under NSW legislation. However, there is provision for protection via Management Plans for various specified natural grassland regions under the amendments to State Environment Planning Policy 46. Natural temperate grassland regions that have been specified under SEPP46 include: Hay Plains, Liverpool Plains, The Monaro, Moree Plains, and Walgett-Brewarrina.

Victoria

Threatened. Schedule 2 of the *Flora and Fauna Guarantee Act 1988*. Natural temperate grasslands listed under Schedule 2 include: Western (Basalt) Plains Grassland Community, Northern Plains Grassland Community, Plains Grassland (South Gippsland) Community and Central Gippsland Plains Grassland Community.

RELATED GRASSY WOODLAND COMMUNITIES

Natural temperate grasslands intergrade on slopes with grassy woodland. The following related grassy woodland communities are also recognised as threatened ecological communities in the following sources:

Australian Capital Territory

Yellow Box/Red Gum Grassy Woodland - Endangered Ecological Community. Section 21 of the *Nature Conservation Act 1980*, Determination No. 89 of 1997.

New South Wales

Cumberland Plain Woodland - Endangered Ecological Community. Part 3, Schedule 1 of the *Threatened Species Conservation Act 1995.*

Victoria

Forest Redgum Grassy Woodland Community (Gippsland) - Threatened. Schedule 2 of the *Flora and Fauna Guarantee Act 1988*.

Threats

Generally speaking, the following threatening processes have been identified as the cause of significant degradation and loss of natural temperate grassland in the ACT and surrounding region:

- Loss and fragmentation through clearing for urban, industrial and infrastructure development and for agricultural purposes.
- Modification and degradation through incompatible and inadequate land management practices.

In making its expert assessment, the ACT Flora and Fauna Committee recognised that there has been a significant alteration in structure and species composition in grasslands, with remaining areas threatened by urban expansion, over-grazing, tree planting, altered burning patterns, weed invasion and nutrient enrichment.

LOSS AND FRAGMENTATION, EFFECTS OF URBANISATION

The clearing and fragmentation of native vegetation due to agricultural land use and urban development constitute major threats to natural temperate grassland in the ACT. Clearing results in complete loss of the ecological community. Reduction in size of remnants results in increased edge effects, including increased disturbance due to fire and human interference, and increased vulnerability to invasion by introduced species of plants and animals. Fragmentation may restrict or prevent movement of species of native flora and fauna between natural grassland sites. These factors are likely to have serious and deleterious effects on populations of native species, quality of habitats and integrity of ecosystem processes in natural grasslands.

Loss and fragmentation of natural temperate grassland has been continuous from the time of earliest settlement of the region, and has increased in this century, particularly due to the establishment of the city of Canberra, and associated with the development of areas for domestic, civic and industrial use and for infrastructure such as roads, utilities, lakes and other recreation areas. The focus of much of this development has been in the valleys and low-lying areas where natural temperate grassland habitat occurred.

The threatening processes of agricultural clearing and urban development have been major factors leading to an estimated 95% loss of natural temperate grassland in the ACT, and to severe fragmentation of the remaining 5% (Office of the Commissioner for the Environment 1995).

These threatening processes continue to affect natural temperate grassland in the ACT. For example, 40 natural and secondary grassland sites were described by Chan (1980) and National Capital Development Commission (1984). During the period 1980 to 1996 the following changes have occurred to these sites:

- seven sites have been totally lost (17.5%)
- five sites have been degraded and also been reduced by loss to development or modified agricultural practices;
- three sites have been partially reduced;
- 15 sites have been modified or severely degraded as a result of urban and agricultural land use; and
- ten sites remain at a similar size and without significant degradation.

MODIFICATION AND DEGRADATION

Modification and degradation of grassland areas due to incompatible and inadequate land management practices also constitutes a major threat to natural temperate grasslands in the ACT. Modification and degradation of grassland communities are associated with depletion or loss of populations of native species, loss of habitat quality, changes in ecosystem processes, reduced size of areas dominated by native species, and invasion by exotic species, particularly weeds.

Land management practices that have deleterious effects on natural grassland species and ecosystems include: intensive urban and recreational land use, over-grazing, soil disturbance, tree planting, changes to fire regimes, roadside plantings, weed invasion and changed moisture and nutrient levels due to altered patterns of drainage and runoff (McDougall and Kirkpatrick 1993). Small sites are particularly vulnerable to disturbance events and could even be eliminated if the occurrence is of sufficient magnitude. Even light recreation may be deleterious, for instance, through the development of tracks leading to soil compaction, loss of species and weed spread.

Inadequate or incompatible land management practices have resulted in extensive modification and degradation of natural temperate grassland remnants in the ACT and surrounding region. Degradation associated with recent weed invasion of grassland sites in the ACT has been documented by Hogg (1990) and Frawley (1991).

Modification and degradation of natural temperate grassland in the ACT and surrounding region has also contributed to loss of some species of plants and animals from the ecological community, and to serious reduction in population sizes of other species, which may have deleterious effects on genetic variability.

Two species of grassy ecosystem plants, Purple Pea (*Swainsona recta*) and Button Wrinklewort (*Rutidosis leptorrhynchoides*), were declared **Endangered** under the *Nature Conservation Act 1980*, in April 1996. *Swainsona recta* and *Rutidosis leptorrhynchoides* are also listed as endangered under national legislation, together with another ACT grassy ecosystem species, Toadflax (*Thesium australe*), which is listed as nationally vulnerable. Other plant species such as the purple peas (*Swainsona sericea* and *S. monticola*), Yam Daisy (*Microseris lanceolata*), and Emu Foot (*Psoralea tenax*) are considered uncommon in the ACT (Sharp and Shorthouse 1996).

Animal species of conservation significance in natural temperate grassland in the ACT include the Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*) and the Golden Sun Moth (*Synemon plana*) which were declared **Endangered**, and the Striped Legless Lizard (*Delma impar*) and the Perunga Grasshopper (*Perunga ochracea*) which were declared **Vulnerable** under the *Nature Conservation Act 1980*. A third lizard species, the Pink-tailed Worm Lizard (*Aprasia parapulchella*), is listed as nationally endangered (Osborne *et al*. 1995).

Major Conservation Objective

The major conservation objective of this Action Plan is to:

- **maintain natural temperate grassland as a viable and well represented ecological community in the ACT in perpetuity**.

Supporting objectives are to:

- **conserve all remaining natural grassland sites that are of high conservation value** (based on botanical significance, habitat diversity, presence of species of conservation significance and site size), and have the potential to remain viable over the long term;
- **establish a system of reserves or areas with equivalent protection that is:**
    1. **comprehensive** - it will include the full range of the five floristic associations identified for ACT natural temperate grassland;
    2. **adequate** - it will replicate ecologically viable natural grassland communities, species and populations; and
    3. **representative** - it will reasonably reflect the biological diversity of the ecological community.
- **maintain the viability of all populations of listed threatened grassland species** that occur within conserved areas;
- **integrate the conservation of viable remnants of natural temperate grassland wherever possible within the matrix of other land uses in the ACT** through appropriate planning, and by sensitive and compatible land-use management; and
- **promote a greater awareness amongst all relevant agencies, landholders and stakeholders of the major conservation objective of this Action Plan** and its place in meeting regional, national and international objectives and obligations for conservation of biodiversity and the environment.

The following **conservation strategy** will be used to achieve the objectives of this Action Plan:

1. Apply protection measures, including reservation, off-reserve management and lease arrangements.

2. Undertake research into the management responses of the five floristic associations, and grassland species including invertebrates.
3. Implement appropriate management for grassland conservation including site-specific requirements for maintaining grassland community and threatened species values.
4. Monitor the impacts of management actions on natural grassland values and species.
5. Apply adaptive management strategies and actions to maintain and enhance grassland conservation.
6. Undertake education programs concerning protection and conservation of grassland values.
7. Maintain appropriate liaison links with stakeholders to ensure a coordinated grassland conservation effort.

Conservation Issues and Intended Management Actions

THE RECOVERY PROCESS

Implementation of a four year Recovery Plan for natural temperate grassland in the ACT commenced in 1993 (Wildlife Research Unit 1991, 1992). The primary goal of the Recovery Plan was to reduce the threat to the ecological community. Achievements of the recovery program include the mapping and surveying of the floristics of the ACT grasslands; ecological research of grassland floristics and some threatened species; impacts of herbicides on selected native grasses; development of a management plan; establishment of a long-term monitoring program; compilation of a data base; and provision of seminars and educational materials (Sharp and Shorthouse 1996). The achievements of the Recovery Plan provide an important basis for attaining the major conservation objective of this Action Plan.

- Outputs from the Recovery Plan will be used as the basis for implementing future recovery actions for natural temperate grassland in the ACT.
- Funding received in 1997 from Environment Australia's Threatened Species and Communities Program, will be used to assist with implementation of the recovery process for all ACT grasslands, including Commonwealth-occupied land.

REGIONAL CONSERVATION

A regional approach is essential to achieving effective and efficient conservation of natural temperate grassland in the ACT. The appropriate regional context includes the ACT and adjacent parts of NSW to the south, east and north of the Territory that provide suitable habitat for natural temperate grassland. The focus of this regional approach must be on ecological rather than political boundaries.

- Regional conservation of natural temperate grassland will be pursued through liaison and collaboration with State, Commonwealth and Local Governments, conservation and other land management agencies, landholders and special interest groups.
- Regional conservation will include developing, implementing and promoting collaborative or joint approaches to the protection and maintenance of the ecological community.

COMMONWEALTH LAND

Significant areas of natural temperate grassland in the ACT also occur on Commonwealth-owned or -occupied land. Generally, land managers are aware of the importance of managing native grassland for its conservation values. It is essential that natural temperate grassland with high conservation values on Commonwealth land be included in any ACT-wide conservation strategy. Commonwealth agencies must also continue to be involved in the conservation planning and management of these grassland values.

- Environment ACT will liaise and collaborate as appropriate with agencies that have responsibility for Commonwealth-owned or -occupied land with natural grassland values in the ACT.
- Assistance will be sought from relevant agencies to enable research, planning and management to be undertaken for the conservation of natural temperate grassland values on Commonwealth land.

THREATENED SPECIES

Threatened species are those that are formally listed as vulnerable or endangered under the *Nature Conservation Act 1980*. Other species, although not listed under legislation, are also of conservation concern; these include: Key's Matchstick (*Keyacris scurra*) and the Canberra Raspy Cricket (*Coorabookorama canberrae*).

Threatened species are particularly vulnerable to deleterious impacts of land uses and land

management practices. The conservation of these species is a critical element in achieving the conservation goal for the ecological community.

General issues and actions relevant to species listed as threatened under the *Nature Conservation Act 1980* have been included in this Action Plan. However, Action Plans are required for each listed species that occurs in natural temperate grassland in the ACT. These will be progressively released for public comment.

- Issues, research needs and management actions set out in Action Plans for particular species will be coordinated with the actions identified in this Plan.

FRAGMENTATION

Fragmentation is one of the major threatening processes affecting natural temperate grassland in the ACT (see under Threats above). Fragmentation associated with development and other land uses has had a major impact on the distribution and viability of natural temperate grassland in the Territory. It still constitutes a major threat to the ecological community.

- Planning mechanisms and management practices will be used wherever possible to:
  1. avoid further fragmentation of natural temperate grassland sites;
  2. maintain habitat linkages between grassland sites, and between natural grassland and grassy woodland communities; and
  3. re-establish habitat or habitat linkages in areas where viability of natural grassland remnants is threatened by fragmentation.

DEGRADATION

Degradation due to incompatible land uses and management practices, disturbances, weed invasion and other factors is identified as a major threatening process affecting natural temperate grasslands in the ACT (see section on Threats).

- Planning strategies and land management practices will be developed and implemented to reduce or eliminate processes causing degradation of natural grassland remnants. These will include programs for control of weeds and animal pests.

ENHANCEMENT OF GRASSLAND VALUES

In some situations, long-term retention of a natural temperate grassland site may require the enhancement of natural grassland values.

- Where appropriate, management actions will be directed towards enhancement of natural grassland values by re-establishing species that are indigenous to the region, and characteristic of the floristic association. Regard will be given to maintaining genetic integrity.
- Replanting using native grassland species may be undertaken in special cases and on a limited scale, for example:
  1. at sites where weed removal or other management has caused extensive bare areas;
  2. in areas designated as buffer zones;
  3. at selected roadside sites; and
  4. at sites where there is an identified need to increase the population size of a particular species for conservation objectives.

SURVEY

Prior to 1990, knowledge of natural grassland remnants in the ACT was limited to a small number of incomplete surveys (eg Chan 1980). Research carried out under the Recovery Plan program during the period 1992 to 1996 included comprehensive surveys for ACT grassland sites, and has led to a major increase in available knowledge of the distribution and ecology of natural grassland remnants and component plant species in the Territory (Sharp and Shorthouse 1996).

Evaluation of the conservation significance of natural grassland must be done in a regional context. To provide this context, survey work must be targetted to areas in the region which are relatively poorly known. Additional survey work must therefore be strategically undertaken to fill critical gaps (for example, areas with potential habitat that are not yet surveyed). Surveys will also be necessary to provide additional management-oriented information about selected grassland species.

- Additional grassland surveys in the ACT will be undertaken where appropriate, including for:
  1. uncommon and threatened species (including species declared as Endangered, or Vulnerable, under the *Nature Conservation Act 1980*);
  2. grassland invertebrate species;
  3. additional grassland sites; and
  4. sites that require special protection.

- Where additional information becomes available, management and protection measures consistent with this Action Plan will be implemented.
- ACT Government agencies will liaise and collaborate with NSW Government agencies to promote strategic and efficient regional approaches to grassland survey.

MONITORING

Monitoring is vital to our understanding of trends in grassland communities, and is an essential component of a sound approach to conservation management of natural grassland. Long-term monitoring of the ecological community in the ACT has commenced under the Recovery Plan program (Sharp and Shorthouse 1996). Permanent monitoring sites have been established to include the main floristic associations and the range of land uses and management practices in the ACT.

Grasslands are destroyed as a result of clearing for urban development, planting of crops or trees and heavy fertilisation. Long-term impacts of other land uses and management practices on the natural temperate grassland ecological community and its component species are not well known. Particular land-uses and management practices may have slow but steady deleterious effects on grassland biodiversity and processes. Long term monitoring is designed to identify those slow, largely imperceptible changes.

- Long-term monitoring of natural temperate grassland at permanent sites in the ACT will be maintained. In order to provide data that can be used to assist with management decisions, the monitoring program needs to continue over several decades.
- The impacts of management practices on natural grassland values (including species of conservation significance, and invertebrates) will be monitored regularly. The impacts of changes to management practices will also be monitored.
- A program of periodic review of the results of all monitoring will be implemented. Reviews will take place five yearly intervals. The review program will provide a mechanism for adjustment and modification of management practices to achieve conservation goals.

RESEARCH

The emphasis of ACT grassland research to date has been to improve knowledge of the distribution and some aspects of the ecological requirements of the ecological community and selected species. For implementation of the Action Plan, emphasis needs to be placed on management-oriented research, particularly the dynamic response of the ecological community to management activities. There is also a need for additional research on the basic ecological requirements of selected grassland species, including threatened species, species that may be declining and therefore potentially threatened, and other species of conservation significance.

- Future research priorities and activities will address management-related issues, requirements and constraints. In particular, research will be undertaken to provide an understanding of the:
    1. dynamic response of the ecological community and its constituent species to management practices, including burning, grazing, mowing, and soil disturbance;
    2. impacts of management within reserves; and
    3. impacts of grassland management on threatened species, as set out in the respective Action Plans for declared species, and on selected invertebrate groups.

Additional floristic analysis is required to ascertain regional differences in grassland types. Both subtle and profound differences exist between grasslands of the ACT and the region. Understanding of these differences will serve to highlight the special significance of grasslands within any particular locality.

- Future research will address regional differences in the ecological communities, to provide an understanding of the significance of particular localities.

MANAGEMENT

Management activities in grassland sites require a long-term strategic approach based on clear objectives that are developed from scientific principles. These principles are identified from scientific studies of the ecology of the grassland community and of component species undertaken in the ACT and elsewhere in Australia. Development of a strategy and objectives is based on the identification of the dominant grassland and weed species, information about any species of conservation concern, and an understanding of drainage, soil patterns and past management of the site.

However, knowledge about long-term outcomes of management practices on grassland biodiversity is not available.

Conservation management of natural temperate grassland must recognise that:

1. in order to retain the significant conservation values of a grassland site it is essential to maintain native plant diversity through control of biomass and weeds (eg by mowing) to enable native plants to flower, set seed and for seedlings to establish;
2. vegetation and habitat diversity are assumed to reflect total biodiversity; and
3. in order to prevent soil compaction and disturbance, reduction in plant cover and erosion caused by increased water run-off, it is necessary to ensure that grassland sites are not subjected to prolonged intense levels of use.

Conservation management of natural temperate grasslands in the ACT is based on the following objectives:

1. to retain or enhance the diversity and structure of the ecological community;
2. to control destructive disturbance;
3. to control burning; and
4. to control weeds.

- Investigation of the impacts of management practices on the biodiversity and dynamics of grasslands will be undertaken using an experimental approach.
- By default, previous management practices will be continued at a site until alternative practices are deemed to better fulfil objectives. Current management options include grazing by domestic stock, mowing or slashing, and burning and control of weeds through herbicide treatment.

A Management Plan for natural temperate grassland was prepared in 1994, as part of the implementation of the Recovery Plan. The Management Plan included recommendations for the management and protection of each recorded natural grassland site in the ACT (Wildlife Research Unit 1994).

- Research results and other relevant information obtained since 1994 will be used to develop and refine the 1994 Management Plan, and to update the recommendations for management and protection of each site.
- Management guidelines will incorporate principles and objectives based on scientific study; regional conservation requirements; and site specific prescriptions that take into account the component biodiversity, habitat diversity, historical land management and processes occurring in each site.
- The updated management guidelines for ACT natural grassland sites will be implemented on a site-specific basis in cooperation with relevant landholders.

Conservation management of natural grassland remnants must be able to adjust to new knowledge and to cope with changing land-use requirements while continuing to pursue conservation goals. Management must also provide for the long-term co-existence of viable natural grassland remnants with other land uses wherever possible.

- An adaptive approach to management of natural grassland values will be developed. The approach will ensure that new knowledge, including results from research and monitoring studies, is used to adjust or modify management practices where necessary to achieve conservation outcomes.

Natural grassland sites may have other values in addition to the natural values associated with the ecological community. Examples of other values include Aboriginal and European cultural values. Management of other values may require separate protection or joint management arrangements.

- Site-based conservation objectives and management practices will be developed and implemented for those places where values other than grassland conservation also exist.
- The approach used will avoid compromising the conservation of grassland, while seeking to:
    1. meet common objectives; and
    2. optimise solutions where conflicts arise.

EDUCATION AND LIAISON

Education and liaison between grassland conservation managers and governments, landholders and stakeholders are critically important to maintain a high level of community awareness of the conservation needs of natural temperate grassland.

- Ongoing liaison will be promoted amongst stakeholders including government agencies, planners, developers, utility companies, landholders, researchers, special interest and community groups.

- Educational activities will be developed and implemented to promote the value of natural temperate grassland to government and community organisations, landholders, stakeholders, school children and the general public.
- Information materials suitable for community and government use will be provided, including material for a proposed regional field guide for natural temperate grasslands.
- Management guidelines and advice for the conservation of natural temperate grassland remnants will be revised periodically and provided to land managers, leaseholders, special interest groups and the general community.

GRASSLAND INFORMATION

Databases that are accessible and user-friendly, and include comprehensive, geo-coded information for grassland sites, will greatly assist future conservation and management of natural temperate grassland. Databases of ACT grassland information have already been established and include floristic associations, species, weeds and pests, management practices, past and present land uses and impacts, and research outcomes (Wildlife Research Unit 1994, Wellington and Larwill 1995).

- Databases of site, species, research and management information related to natural temperate grassland sites in the ACT will be maintained, and updated where necessary.
- New information collected as part of survey, monitoring, research and management will be standardised as appropriate for inclusion in the ACT grassland databases and other regional databases.

Where possible, grassland databases and grassland information for the ACT and NSW should be fully compatible to provide the option of a larger regional grassland database. The databases should also have the potential to link with Geographic Information Systems used by the relevant conservation and land management agencies.

- Liaison will be undertaken with NSW and other relevant conservation agencies concerning the establishment of a regional database platform, and the development of standardised formats and protocols for data collection and capture.
- A strategy will be developed and implemented to encourage land managers, landholders, researchers and other users of grassland-related information to use the grassland databases and, where possible, to contribute additional relevant information to the database.

Protection

An approach to conservation planning for natural grassland areas in Gungahlin outlined by Williams *et al*. (1995) has been applied to grassland sites throughout the ACT to achieve conservation goals while maximising planning flexibility in that part of the ACT. The approach is based on the application of a set of operational principles for conservation planning which seek to ensure that the environmental costs and benefits of different planning options are clearly articulated and are based on scientific assessment wherever possible.

The operational conservation planning principles include:

- areas that have the highest conservation values should be protected (including all areas with botanical significance ratings of 1 or 2);
- consideration of size (viability), diversity, representativeness, distinctiveness (rarity) and naturalness is required;
- replication of conservation areas in fragmented habitats is necessary as a hedge against catastrophic and/or unpredictable local extinction;
- integration of smaller systems within broader conservation systems increases their conservation value; and
- regional conservation planning based on remnants must consider the constraints and opportunities provided by the present and future land use patterns.

MEASURES FOR PROTECTION

Adequate protection of conservation values at selected natural temperate grassland sites in the ACT is critical to attaining the major conservation objective of this Action Plan.

Sites with remnant natural grassland in the ACT occur on land under a variety of tenures, including urban open space, rural leasehold Territory land, unleased Territory land and Commonwealth-owned and managed land (National Land). Grassland remnants are often small in size, and may be isolated from one another by areas used for urban, agricultural or other land purposes. In some sites, the combination of small size, isolation

and the impacts of adjacent land uses may preclude or severely limit prospects for long-term viability of their grassland values, irrespective of protection or other conservation measures. Other sites may have good prospects for long-term viability, but be unavailable for formal inclusion in a reserve system.

IDENTIFYING PROTECTION MEASURES

Measures for effective protection of natural grassland values are identified through an assessment of the conservation values and needs of each site. These include a site's natural values and diversity, its long-term viability, its contribution to management or protection of adjacent sites (for example as a buffer), together with any constraints to viability, protection and conservation management (for example, due to small size, designated future use).

Protection of sites on Territory land containing natural temperate grassland will be achieved through the provisions of the *Land (Planning and Environment) Act 1991* and the Territory Plan.

Environment ACT will work with Planning and Land Management, Department of Urban Services, and the National Capital Authority to ensure that land uses in areas adjacent to grassland areas are compatible with conservation objectives and to minimise any adverse impacts.

- A core set of sites that have the highest priority for conservation and are Territory Land will be protected in nature reserves.
- National Land, under Commonwealth control, which has high conservation value, will be protected by Memoranda of Understanding between the relevant Commonwealth agency and ACT Government.
- For sites of lower conservation value, measures that may maintain their conservation values over the long term are identified as a means of supplementing the core sites.

The recommended status for each recorded natural grassland site in the ACT is summarised below.

Core Sites with High Conservation Value

Sites that form the core areas required to maintain natural temperate grassland as a viable and well represented ecological community in the ACT in perpetuity (major conservation objective) will be afforded the highest degree of protection. This will enable the reserve system to be comprehensive, adequate and representative (refer to Major Conservation Objectives for further explanation).

The core sites that warrant the highest degree of protection are the Majura Field Firing Range (GAP 28), the Belconnen Naval Station (GAP 20), "Woden" property (GAP 36), West Belconnen (GAP 3) and St Marks, Barton (GAP 33). Their importance is based on their botanical significance, representativeness, habitat diversity, size, and the presence of threatened species.

Two measures are recommended for protection of sites for conservation values in the long term. These are provisions under the Territory Plan and Memoranda of Understanding with the Commonwealth.

(i) Reservation - Hills, Ridges and Buffer Areas with Public Land Overlay for Nature Reserve

Reservation is generally recognised as providing the primary mechanism for ensuring that sites of high conservation value are not eventually converted to a land use incompatible with their natural values (Caughley and Gunn 1996). Reservation is therefore an important mechanism for the protection of natural temperate grassland. Reservation does not exclude the option of management through controlled grazing to achieve conservation objectives through appropriate arrangements with local rural landholders.

The Campbell Park grasslands (GAP 27) that is Commonwealth-owned, is recommended for transfer to ACT Government for reservation. Belconnen Naval Station, which has been identified as an area to be transferred to the ACT Government on vacation of the site by the Navy, is recommended for partial protection as a reserve.

Areas already set aside, together with those to be considered as Nature Reserve, are listed in Table 3 (page 19).

(ii) Memoranda of Understanding

Memoranda of Understanding (MOU) between ACT Governments and landholders, particularly the Commonwealth Government, provide another means of ensuring that sites with high conservation value will be managed so as to maintain their conservation value in perpetuity while enabling other compatible land uses, as identified in each MOU, to occur. An MOU with the Commonwealth does not preclude the possibility of the land being

reserved in the future under Commonwealth legislation.

MOU's are appropriate also for land where long-term land uses will not compromise the conservation values (for example, land used for communication facilities). Areas for which an MOU will be negotiated, are listed in Table 4 (page 19).

In order to achieve protection at the highest level for the core sites, the following actions are recommended:

- Sites selected will have highest conservation values and long-term viability so that a comprehensive, adequate and representative reserve system will be achieved. Sites will:

(a) have a botanical significance rating of 1, 2 or 3;

(b) have a combination of site factors that will promote conservation goals;

(c) contribute to representation of all floristic associations and grassland biodiversity; and

(d) have tenure, land uses and planning objectives which are compatible with conservation goals (including existing reserves).

- Memoranda of Understanding will be negotiated with relevant landholders, including the Commonwealth Government, to protect sites of high conservation value that are otherwise unavailable for reservation.
- Interim management agreements will be established between land managers and Environment ACT until reservation or Memoranda of Understanding are achieved for core areas.

Unshaded areas in Table 3 require boundaries to be clarified when the land use policy is modified. These areas contain significant populations of threatened species which are the subject of separate Action Plans.

If the proposed reservation and MOU proposals are achieved, samples of the five floristic associations will have been protected as indicated below:

Floristic associations	Number of sites	Area (hectares)	Botanical Significance
Wet *Themeda*	6	39.0	2-5
Poa	2	3	3-4
Danthonia	10	399.9	1-3
Dry *Themeda*	3	13.9	1-3
Stipa	4	222.3	2-5

Under these forms of protection, Dry *Themeda* and Wet *Themeda* floristic associations are not adequately represented. Although the area of the *Poa* association protected is very small, no other site in the ACT is available.

Sites with Moderate Conservation Value

Public Land categories of the Territory Plan (other than nature reserves) include Urban Open Space and Special Purpose Reserves. Activities permitted in these land use categories can be compatible with conservation of native grassland values, provided that appropriate conservation management is in place. In these cases maintenance of the conservation values of the site is the responsibility of the relevant ACT Government agency. Other similar land uses include road reserves and powerline easements.

There are already several small grassland sites with a range of conservation values that are located within these Public Land categories. Appropriate management is required to ensure conservation values are not compromised by other activities.

Sites that readily can be included in this category (Table 5 - page 19) generally have a lower botanical significance than reserved areas (rating 3 to 5), and long-term viability in some sites may be limited by their small size and higher perimeter to area ratio and/or impacts from surrounding land uses.

- Natural temperate grassland sites will be included where feasible in appropriate Public Land categories under the Territory Plan.
- To ensure that the conservation values of these areas are protected, management agreements that incorporate conservation objectives will be developed for implementation by the relevant agency.

The current management of the property, "Mugga Mugga" as a rural lease is adequate for the present, but a change to public land is foreseen, and a management plan will need to address conservation requirements.

If the proposed Public Land categories (other than nature reserve) are implemented, additional samples of the five floristic associations will have been protected as indicated below:

Floristic associations	Number of sites	Area (hectares)	Botanical Significance
Wet *Themeda*	2	11.2	
Danthonia	7	12.0	3-4

Dry *Themeda*	6	14.8	3-5

Under this form of protection, representation of Dry and Wet *Themeda* grassland will be increased and several small areas of *Danthonia* grassland of low to moderate conservation value that contain populations of the Golden Sun Moth (*Synemon plana*) and a further small population of the Button Wrinklewort (*Rutidosis leptorrhynchoides*) will be managed for conservation.

Sites with Low Conservation Value

Where Territory Land includes grassland sites with low conservation values, these values will be retained and appropriately managed, wherever possible, within the development context by consideration at the appropriate stages of the outline planning and development approval processes. Such measures provide a means whereby the primary land use continues while accommodating the conservation values of natural grassland on the site, but without the additional protection mechanism of creating public land. Such arrangements include planning and management agreements with non-government landholders, property management agreements with rural lessees and protection of sites within the urban fabric.

These grassland sites occur on rural leases and small urban leases and are typically small, fragmented and/or of lower conservation value or within blocks of land scheduled for development. While not of sufficient importance to form part of the core reserve system, these sites may still contribute to grassland biodiversity. Such sites also have values as buffers to higher value sites (such as the Gungahlin Reserves, or where they border woodland areas), as landscape features within the natural fabric of the city, or provide opportunities for education or rehabilitation research. Additionally, failure to maintain these areas for their conservation values within the matrix of land uses compromises community asset management options of future generations.

(i) Rural Leases

Land of moderate to low conservation value located outside the existing urban area can be appropriately managed through property management agreements applying to rural leases (Table 6 - page 20). Property Management Agreements are required for rural leases when leases are renewed. This provides an opportunity to identify conservation values within the lease and to determine appropriate conservation management of that land, and where necessary, apply constraints on some practices such as ploughing and fertilisation. Such provisions will be developed in consultation with relevant stakeholders, including lessees.

(ii) Urban Leases

Where small sites occur within urban areas advice can be provided to assist landholders maintain conservation values. This advice may be given as site management guidelines and plans. Similar guidelines are relevant for sites which are currently under rural agistment pending development of areas, such as in the Gungahlin Town Centre. This enables protection and management of areas occurring as road reserves, easements and urban parks, since they can be maintained as landscape features, research resources or buffers. When incorporating these sites into the urban fabric, the entire site may not be retained. In such instances, boundaries of the areas to be incorporated require clarification.

These planning and site management measures do not preclude future land use changes, but are intended to retain the conservation values of the sites until future land use decisions are made. Relevant issues considered in future land use decisions may include the success in establishing grassland reserves in the ACT and region and the socio-economic factors at the time.

Where future planning has been conducted, mechanisms to retain part of the sites within the urban fabric have already been identified. These are indicated in Table 7 (page 20). In the other sites, the protection of conservation values will be considered in the course of outline planning, by selecting grassland sites as far as possible for areas such as roadside reserves and urban parks.

- Planning and site management mechanisms will be applied as required to sites of low conservation value, so that wherever possible, the natural grassland values are conserved in the context of the primary land use.
- Where rural sites occur in blocks of land scheduled for development, or where sites have been identified as requiring reservation, Property Management Agreements will be developed to conserve the ecological values of the grassland until such time as changes occur to the land tenure and use.

Protection of Other Grassland Sites Containing Listed Threatened Species

Where specific measures are required for the protection of sites containing listed threatened species, these may also provide protection for some elements of the grassland community. These areas, however, typically have lower botanical significance (3 to 5) and reduced viability as a grassland community (Table 8 - page 20). Therefore they do not form part of the core reserve system for natural temperate grassland. The actual protection measures are considered in the relevant Action Plan for each species.

- Areas protected because they contain one or more listed threatened species but having a lower botanical significance for the grassland community will be managed primarily for the conservation of the listed species.

The following floristic associations may be conserved through measures designed to protect the listed threatened species:

Floristic associations	Number of sites	Area (hectares)	Botanical Significance
Danthonia	5	214.3	3-4
Stipa	4	312.5	4-5

OTHER ACTIONS FOR PROTECTION

Additional actions that will be implemented to protect natural temperate grassland sites in the ACT are outlined below:

- Development will only be permitted on any of the listed sites currently supporting natural temperate grassland once a reserve system that is comprehensive, adequate and representative (as outlined above) in its coverage of the five grassland floristic associations has been established.
- Reserves or other conservation areas established primarily for natural temperate grassland conservation will be managed so as to protect and maintain the ecological community.
- Natural grassland sites of high conservation value, including highly significant sites outside the reserve system, will be nominated to the ACT Heritage Council for possible inclusion on the ACT Heritage Places Register.

These sites include:

(a) West Belconnen (GAP 3);

(b) Gungahlin Grassland Reserves (GAPs 6, 9, 13);

(c) Belconnen Naval Station (GAP 20);

(d) Yarramundi Reach (GAP 24)

(e) Campbell Park Offices & paddocks (GAP 27);

(f) Majura Valley East (Field Firing Range, Airport (GAP 28);

(g) St Marks, Barton (GAP 33);

(h) Jerrabomberra East (GAP 36);

(i) Jerrabomberra West (GAP 37).

The Royal Australian Naval Transmitting Station site (Belconnen Naval Station) has been listed on the Register of the National Estate, on the basis of the conservation value of the natural temperate grassland on the site.

- The powers of the Conservator of Flora and Fauna, as specified under Parts V and VI of the *Nature Conservation Act 1980*, will be applied to ensure that landholders implement appropriate management practices for conservation of natural temperate grassland.
- Landholders will be advised to maintain dominant management practices used over the last ten years in areas of land known to support natural temperate grassland until each situation is evaluated and, where appropriate, alternative practices are identified and appropriate advice provided.

Complementary protection of natural temperate grassland in the Southern Tablelands of NSW will be promoted in appropriate forums involving NSW authorities.

This Action Plan, along with the Draft Canberra Nature Park Management Plan and updated management guidelines for ACT natural grassland sites will provide further support for the conservation management of this endangered ecological community.

Table 3. Hills, Ridges and Buffer Areas: Public Land - Nature Reserve

Location and Site	GAP No.	Floristic Association	Area (ha)	Botanical Significance	Significant Species
Gungaderra					
(Site A)	9	*Stipa*	14.8	3	Di
- (Site B)	9	Wet *Themeda*	12.8	3(5)	Di
(Site C)	9	*Poa*	2.0	3	Di, Ks
Mulanggary					
(Site A)	6	*Danthonia*	3.3	3	#
(Site B)	6	Wet *Themeda*	6.1	3	Di, #
(Site C)	6	*Stipa*	82.8	3(5)	Di, Sp, #
Crace Hill					
(Site A)	13	*Stipa*	44.7	4	Di
(Site B)	13	*Danthonia*	8.7	3	Di
West Belconnen					
(Site A, Dunlop)	3	Wet *Themeda*	10.8	2	#
(Site B)	3	*Stipa*	20	3	Sp, #
Reservation to be considered as part of further evaluation of planning and conservation issues					
Jerrabomberra West (Site A "Woden")	36	*Danthonia*	72.4	2	Tlp, Ap, Sp, #
Belconnen Naval Station (Site A)	20	*Danthonia*	106.5	2	Sp, #
Campbell Park					
Offices	27	*Danthonia*	**3.3**	3	Rl, Tlp, Sp, #
Paddocks	27	*Danthonia*	**9.0**	3	

Shaded areas indicate sites that are Public Land - Nature Reserve.

Table 4. Memorandum of Understanding to achieve protection equivalent to reservation

Location and Site	GAP No.	Floristic Association	Area (ha)	Botanical Significance	Significant Species
Majura Valley East					
(Site A, Firing Range)	28	*Danthonia*	142.2	1(3)	Di, Tlp, Sp, Rl, #
(Site B, FAC Beacon)	28	Wet *Themeda*	5.6	3(2)	Di, #
(Site C, FAC Beacon)	28	*Danthonia*	7.0	2	Di, Tlp, #
(Site D, Airport)	28	*Danthonia*	47.1	2	Tlp, Sp, #
York Park, Barton	34	*Danthonia*	0.4	3	Sp
Yarramundi Reach					
(Site A)	24	Dry *Themeda*	8.0	3	
(Site B)	24	Wet *Themeda*	4.1	4	Di
(Site C)	24	*Poa*	1.0	4	
St Mark's Barton	33	Dry *Themeda*	**3.1**	1	Rl, #
CSIRO Limestone Avenue	25	Dry *Themeda*	2.8	3	Sp
Caswell Drive Road (Site A)	22	Wet *Themeda*	1.4	3	#

Table 5. Public Land - Urban Open Space

Location and site	GAP No.	Floristic Association.	Area (ha)	Botanical Significance	Significant Species
Glenloch Interchange	23	Dry *Themeda*	1.5	3	
Lady Denman Drive	29	*Danthonia*	2.5	3	Sp, #
Lake Isabella, Monash	38	Dry *Themeda*	1.2	3	
Black Street, Yarralumla	32	*Danthonia*	4.1	3	Sp
Lake Ginninderra,					
(Site A)	19	*Danthonia*	0.1	3	Sp
(Site B)	19	*Danthonia*	1.6	4	
(Site C)	19	*Danthonia*	0.4	4	
Jerrabomberra East(Tharwa Rd)	37	Dry *Themeda*	2.0	3(4)	Rl
Mugga Mugga	39	Danthonia	3.0	3(4)	
Evatt Powerlines	18	Dry *Themeda*	2.3	4	
Novar St, Yarralumla.	31	*Danthonia*	0.3	4	
Umbagong Park, North	16	Dry *Themeda*	5.0	5	
Umbagong Park, South	17	Dry *Themeda*	2.8	3	
Dudley St, Yarralumla	30	Wet *Themeda*	0.9	3	Sp
Horse Park Entr. (Site A)	1	Wet *Themeda*	10.3	3	#

Dark shaded areas indicate sites that are already Public Land.

Key to Significant Species
Ap = *Aprasia parapulchella*, Di = *Delma impar*, *Ks* = *Keyacris scurra*, Rl = *Rutidosis leptorrhynchoides*,
Sp = *Synemon plana*, Tlp = *Tympanocryptis lineata pinguicolla*, # = uncommon or declining species.

Table 6. Property Management Agreements (Rural Leases)

Location and Site	GAP No.	Floristic Association	Area (ha)	Botanical Significance	Significant Species
Kooringal property	2	Dry *Themeda*	18.8	3(4)	
Belconnen Naval Stn.					
(Site B)	20	*Stipa*	53.7	3	
(Site C)	20	Dry *Themeda*	12.4	4	
(Site D)	20	*Stipa*	6.3	4	
Kaleen east paddocks	21	*Danthonia*	28.6	3	
Caswell Drive Paddock	22	Wet *Themeda*	5.4	4	
Jarramlee property	15	*Stipa*	53.8	5(4)	

Table 7. Protection of sites within the urban fabric

Location and Site	GAP No.	Floristic Association	Area (ha)	Botanical Significance	Significant Species	Identified Protection
Constitution Avenue	26	Dry *Themeda*	3.0	3	Sp, #	Open space
North Mitchell						
(Site A)	10	*Danthonia*	14.8	3	#	Road reserve
(Site B)	10	Dry *Themeda*	1.9	3		
Palmerston						
Area A	7	Dry *Themeda*	1.2	3	Di	Urban park
Area B	7	*Stipa*	13.1	4	Di	
Racecourse	14	*Stipa*	1.5	4	Di	
Horse Park Entrance B	1	*Danthonia*	21.8	4	#	
Kenny North	11	*Stipa*	11.4	4		
Harrison	5	*Stipa*	8.7	4		Linear park
"Stray Leaf"	4	*Stipa*	4.8	4		Road reserve
Gundaroo Rd south	8	*Stipa*	4.2	4		Open space

Table 8. Additional sites containing listed threatened species

Location and Site	GAP No.	Floristic Association	Area (ha)	Botanical Significance	Significant Species	Recommended Protection
Jerrabomberra West (Site B)	36	*Stipa*	53.7	4	Tlp	Reserve
(Site C)	36	*Stipa*	85.8	5	Tlp	PMA
(Site D)	36	*Danthonia*	53.5	4	Tlp	PMA
AMTECH, Fyshwick	35	*Danthonia*	24.2	4(3)	Tlp	Further investigation
Jerrabomberra East					Tlp, Di	
(Site A, Harman)	37	*Stipa*	171.3	5(4)		MOU
(Site B, Mike's Hill)	37	*Danthonia*	43.8	3	Tlp, Di	Reserve
(Site C, East Woden)	37	*Danthonia*	20.1	3(4)	Tlp	Reserve
Majura Valley East	28				Tlp, Sp	
(Site E, Airport)		*Danthonia*	72.7	3		MOU
Kenny	11	*Stipa*	1.7	4	Di	Planning

Key to Protection
PMA: Property Management Agreement; MOU: Memorandum of Understanding.
Recommended protection (see species Action Plans)

Key to Significant Species
Ap = *Aprasia parapulchella*, Di = *Delma impar*, *Ks* = *Keyacris scurra*, Rl = *Rutidosis leptorrhynchoides*, Sp = *Synemon plana*, Tlp = *Tympanocryptis lineata pinguicolla*, # = uncommon or declining species.

Socio-economic Issues

The main social benefits of conserving representative communities of natural temperate grassland are:

- meeting community concerns that further loss or extinction of significant ecological communities, together with their component native species, be prevented;
- the amenity and recreation associated with the grassland reserves; and
- the tourism potential of a successful program to protect an endangered community and component threatened species.

The potential for economic utilisation of natural temperate grassland sites is relevant for those sites where current management or land uses are deemed to be compatible with the retention of conservation values.

There are four main aspects of planning in Canberra that will be affected by the implementation of this Action Plan. These are:

1. Future Urban Areas

Proposals for future urban areas, as identified in either the National Capital Plan or the Territory Plan, and provided for in the Residential Land Release Program, may for some areas have their viability affected by the size and location of possible future grassland reserves.

2. Transport Facilities

The provision and/or upgrading of the following transport facilities may be affected:

- John Dedman Parkway
- Glenloch Interchange
- Majura Parkway - southern section and connections
- William Slim Drive - possible extension (Lawson)
- Very High Speed Train (VHST) corridor (Majura and Jerrabomberra valleys).

In the case of the VHST proposal, Environment ACT is actively involved in the evaluation of planning options.

3. Industrial Areas

The planning for future industrial areas, in particular, a possible extension to the Hume industrial area and a possible industrial complex associated with the Airport in the Majura Valley.

4. Rural Leasing Aspects

Some of the core sites of high conservation value, including those in the Jerrabomberra Valley, are within rural leases. Preliminary investigations indicate that these leases currently contain withdrawal clauses allowing for the use of land for public purposes. The Rural Policy Taskforce has recently reviewed all aspects of rural leases including the recommendation of appropriate lease terms. Two recommendations of the Taskforce that will affect the Action Plans are that:

- the lease term for the Jerrabomberra Valley be to the year 2020; and
- there be no withdrawal clauses over any part of a rural lease unless it has been clearly defined for an imminent public work, such as a road, stormwater or other infrastructure.

This will mean that the Territory would have to withdraw any area of land having conservation significance at the time of an application for a new lease, or acquire it subsequently under the provisions of the *Land Acquisition Act 1994*.

It is expected that it will be early in 1998 before rural lessees are able to take up a new lease as proposed by the Taskforce. In the meantime, Environment ACT will need to identify areas requiring special conservation measures before applications for extended lease terms are received. In the event that large areas of a lease are to be withdrawn for conservation purposes, consideration must be given to the viability of the remainder of the lease. Grazing may be undertaken where it is considered that it will be consistent with the maintenance of the natural temperate grassland conservation values.

Rural properties in the Belconnen and Symonston areas are impacted by recommendations in the Rural Taskforce report.

In addition to the issues outlined above, there are some site specific issues which need to be addressed in order to implement the protection measures specified in this Action Plan. These are:

- Belconnen Naval Station, Lawson (GAP 20): This area potentially has high value as residential land. A decision on conservation will be complex given that the land is currently owned by the Commonwealth and may be transferred to the Territory in the near future.

- Horse Park entrance region, Forde (GAP 1): This area has yet to have detailed outline planning conducted.

Grassland conservation will be considered in the urban structure review of Forde and Horse Park, and lease boundaries and land use policies will be determined at that stage. This will be undertaken during the urban structure review process.

- Harrison Site 2 (GAP 5): Part of the area to the north of the Mulanggary Grassland Reserve will be partly conserved within the urban fabric as a linear park. Development will be managed to reduce the impact on this site.
- Kenny (GAP 12): This suburb has yet to have outline planning conducted, however during this process, some conservation values in the area will be protected by retaining habitat in areas such as roadside and urban parks.
- Kosciusko Avenue, Palmerston (GAP 7): While preservation of the entire area is not proposed, there is scope to incorporate portions of this area into small parks, as part of the development of the area, for example, at the top of the knoll.

Legislative Provisions

The following ACT legislation applies to the conservation of flora and fauna in the ACT:

Nature Conservation Act 1980

The *Nature Conservation Act 1980* provides authority for the Conservator to manage Public Land reserved for conservation of the natural environment. Activities that are inconsistent with management objectives for nature conservation are controlled. Special measures for conservation of a species or community of concern can be introduced in a reserved area, including restriction of access to important habitat.

Section 47 of the Act allows the Conservator to give the occupier of land directions for protection or conservation of native plants and animals. This provision is relevant to the management of threats to the conservation requirements of a species or community of concern that occurs on leased land.

Provisions in the *Nature Conservation Act 1980* are applicable to Commonwealth land.

Land (Planning and Environment) Act 1991

The *Land (Planning and Environment) Act 1991* is the primary authority for land planning and administration. It establishes the Territory Plan and several of its provisions are relevant to the protection of flora and fauna.

- **Public Land** is reserved via the Territory Plan. Land reserved as wilderness area, national park or nature reserve has conservation of the natural environment as a paramount management objective. The Conservator of Flora and Fauna must prepare a **plan of management** setting out how management objectives are to be implemented or promoted.
- **Places of natural heritage significance**, including important habitat for native species, may be entered in the Heritage Places Register, with conservation requirements specified.
- **Environmental Assessments and Inquiries** may be initiated as part of the approvals process for defined land use and development decisions or activities prescribed as controlled. Assessments are required to address potential environmental impact, including threats to a species of flora and fauna, an ecological community or an area.

COMMONWEALTH

Australian Heritage Commission Act 1975

The Australian Heritage Commission Act requires a Commonwealth agency to avoid taking an action that has an adverse effect on any part of a place listed on the Register of the National Estate, unless there is no feasible or prudent alternative. Should a Commonwealth agency find that it must take such an action, then that agency must take all reasonable measures to minimise the adverse effect. The agency is required to advise the Australian Heritage Commission and provide a reasonable opportunity for the Commission to consider and comment on the proposal. The listing of a place on the Register applies only to the Commonwealth Government. It does not provide any legal constraints or controls over the actions of State, Territory or local government, or of private owners.

Consultation and Community Participation

Community participation with activities assisting the conservation of native grasslands will be encouraged through groups such as the Herpetological Association, Friends of Grasslands and Park Care Groups operating in or near grassland areas. The formation of new grassland landcare groups will be actively encouraged and assisted to ensure best practice management. Information on the Conservation of the Natural Temperate Grassland will be incorporated into community education programs conducted by Environment ACT.

Implementation and Review

RESPONSIBILITY FOR IMPLEMENTATION

Environment ACT (Wildlife Research and Monitoring) will have responsibility for coordinating implementation of this Action Plan, subject to the availability of Government resources. Primary responsibility for conservation and management of the grassland community on Territory Land will rest with the ACT Parks and Conservation Service whilst relevant Commonwealth agencies will have responsibility for National Land, however, provisions in the *Nature Conservation Act 1980* (ACT) are still applicable.

- The ACT Government will seek the cooperation of the Commonwealth Government in setting in place coordinated and complementary action to protect natural temperate grassland in the ACT.

EVALUATION

Implementation of this Action Plan will be a collaborative exercise between government agencies, landholders and the community generally. Commonwealth and NSW participation will be critical in some cases. The Action Plan will be reviewed after three years. The review will comprise an assesssment of progress using the following performance indicators:

- completion of commitments that can reasonably be expected to be finalised within the review timeframe (e.g. introduction of a statutory protection measure for a species; development of a management plan);
- completion of a stage in a process with a time line that exceeds the review period (e.g. design or commencement of a research program);
- commencement of a particular commitment that is of a continuing nature (e.g. design or commencement of a monitoring program for population abundance); and
- expert assessment of achievement of conservation objectives of the Action Plan.

The review will be reported to the ACT Flora and Fauna Committee. This will provide an opportunity for Environment ACT and the Flora and Fauna Committee to assess progress, take account of developments in nature conservation knowledge, policy and administration and review directions and priorities for future conservation action.

The following conservation actions will be given priority attention:

- implemention of recommended protection measures;
- development of management plans; and
- implemention of management plans.

Acknowledgements

This Action Plan draws on unpublished research work, particularly work undertaken by the ACT Grasslands Project Officer, Sarah Sharp and funded under the Commonwealth Endangered Species Program, and includes unpublished results obtained during post-graduate studies.

Expert advice concerning the conservation status of natural temperate grassland for NSW was provided by Mr Rainer Rehwinkel, NSW National Parks and Wildlife Service, and for Victoria by Mr James Ross, Victorian National Parks Association.

The Action Plan is based upon a draft prepared for Environment ACT by
Dr A.B. Wellington (Freelance Ecology).

References

Baker-Gabb, D.J., Benshemesh, J. & Maher, P.N., 1990. A revision of the distribution, status and management of the plains-wanderer (*Pedionomus torquatus)*. *Emu* 90: 161-168.

Benson, J.S., 1994. The native grasslands of the Monaro region: Southern Tablelands of NSW. *Cunninghamia* 3(3): 609-650.

Benson, J. & Wyse Jackson, M., 1993. The Monaro region. In McDougall, K. & Kirkpatrick, J.B., (eds.) *Conservation of lowland native grasslands in south-eastern Australia,* pp. 13-43. Report to the World Wide Fund for Nature, Australia.

Caughley, G. & Gunn, A., 1996. *Conservation biology in theory and practice*. Blackwell Science, Carlton.

Chan, C., 1980. *Natural grasslands in Canberra: Their distribution, phenology and effects of mowing*. MSc thesis, Australian National University.

Costin, A.B., 1954. *A study of the ecosystems of the Monaro region of New South Wales*. NSW Government Printer, Sydney.

Department of Conservation and Natural Resources (Vic), 1994. *Action Statement No. 53: Western (Basalt) Plains Grassland Community*. Department of Conservation and Natural Resources, Melbourne.

Driscoll, D., 1994. *Invertebrates of lowland native grasslands in the Australian Capital Territory: Conservation and research strategies for a recovery plan*. Technical Report No. 9. ACT Parks and Conservation Service, Canberra.

Frawley, K.F., 1991. *The conservation of remnant woodland and native grassland in the ACT.* Report to the National Parks Association (ACT) Inc., Canberra.

Greenslade, P., 1997. Are *Colleombola* useful as indicators of the conservation value of natine grasslands? *Pedobiologia* 41: 215-220.

Groves, R.H. & Williams, O.B., 1981. Natural grasslands. In Groves, R.H., (ed.) *Australian Vegetation,* pp. 293-316. Cambridge University Press, Melbourne.

Hogg, D. McC., 1990. *The ecological resources of the ACT: A review of recent information.* Unpublished report to the National Capital Planning Authority, Canberra.

Kirkpatrick, J.B., 1993. Methods. In McDougall, K. & Kirkpatrick, J.B., (eds) *Conservation of lowland native grasslands in south-eastern Australia,* p. 3. Report to the World Wide Fund for Nature, Australia.

McDougall, K. & Kirkpatrick, J.B., (eds), 1993. *Conservation of lowland native grasslands in south-eastern Australia*. Report to the World Wide Fund for Nature, Australia.

McIntyre, S., 1994. Integrating agricultural land-use and management for conservation of a native grassland flora in a variegated landscape. *Pacific Conservation Biology* 1: 236-244.

Melbourne, B.A., Gullan, P.J. & Su, Y.N., 1997. Interpreting data from pitfall-trap surveys: crickets and slugs in exotic and native grasslands of the Australian Capital Territory*. Memoirs of the Museum of Victoria* 56(2): 361-367.

Moore, C.W.E., 1964. Distribution of grasslands. In Barnard, C., (ed.) *Grasses and grasslands,* pp. 182-205. Macmillan, London.

National Capital Development Commission, 1984. *The ecological resources of the ACT*. National Capital Development Commission, Canberra.

Office of the Commissioner for the Environment ACT, 1995. *Australian Capital Territory state of the environment report: ACTSER '95*. Office of the Commissioner for the Environment ACT and ACT Government, Canberra.

Osborne, W., Kukolic, K. & Jones, S., 1995. Management of threatened vertebrates in native grasslands: A case of grasping at straws? In Sharp, S. & Rehwinkel, R., (eds) *Management of relict grasslands: Proceedings of a workshop and public seminar, September 24 and 25 1993,* pp. 89-96. Conservation Series No. 8, ACT Parks and Conservation Service, Canberra.

Pryor L.D., 1938. The botany, forestry and zoology of the Australian Capital Territory on an ecological basis. In Burns K., (ed.) *Handbook for Canberra,* pp. 1-31. ANZAAS Meeting, Canberra January 1939. Commonwealth Government Printer, Canberra.

Rauhala, M.A., Shorthouse, D.J. & Ingwersen, F., 1995. *The Striped Legless Lizard* (Delma impar) *in the Gungahlin, Majura and Jerrabomberra Valleys*. Internal Report 95/2. ACT Parks and Conservation Service, Canberra.

Rehwinkel, R., 1997. *Grassy ecosystems of the South Eastern Highlands*. Technical report - Stage 1: Joint regional biodiversity survey of grassy ecosystems of the South Eastern Highlands project. Report to ACT Parks and Conservation Service, ACT Planning Authority, Housing Industry Association, National Capital Authority, NSW National Parks & Wildlife Service, Queanbeyan City Council, Yarrowlumla Shire Council and Yass Shire Council.

Ride, W.D.L. & Wilson, G.R., 1982. The conservation status of Australian animals.

In Groves, R.H. & Ride, W.D.L., (eds) *Species at risk: Research in Australia,* pp. 27-44. Australian Academy of Sciences, Canberra.

Sharp, S.B., 1995. Distribution of grasslands and floral diversity in lowland native grasslands in the ACT. In Sharp, S. & Rehwinkel, R., (eds) *Management of relict grasslands: Proceedings of a workshop and public seminar, September 24 and 25 1993*, pp. 80-88. Conservation Series No. 8, ACT Parks and Conservation Service, Canberra.

Sharp, S.B., 1997. *Diversity, patterns and processes of vegetation and invertebrate orders in natural temperate grassland in the Australian Capital Territory*. MAppSc thesis, Faculty of Applied Science, University of Canberra.

Sharp, S.B. & Shorthouse, D.J., 1996. Native grasslands and threatened species in the Australian Capital Territory: Steps towards protection and recovery. In Stephens, S. & Maxwell, S., (eds) *Back from the brink: Refining the threatened species recovery process,* pp. 138-149. Surrey Beatty & Sons, Chipping Norton.

Story, R., 1969. Vegetation of the Queanbeyan-Shoalhaven area*. CSIRO Aust. Land Res. Er.* No. 24: 113-133. CSIRO, Australia.

Stuwe, J., 1986. *An assessment of the conservation status of native grasslands on the Western Plains, Victoria and sites of botanical significance*. Arthur Rylah Institute for Environmental Research Technical Report Series No. 48. Department of Conservation, Forests and Lands, Melbourne.

Walker, J. & Hopkins, M.S., 1984. Vegetation. In McDonald, R.C., Isbell, R.F., Speight, J.G., Walker, J. & Hopkins, M.S., (eds) *Australian soil and land survey field handbook,* pp. 44-67. 1st Edition. Inkata Press, Melbourne.

Wellington, A.B. & Larwill, S.A., 1995. *Grassland information 1995: ACT and adjacent NSW*. Unpublished report to the ACT Parks and Conservation Service, Canberra.

Wildlife Research Unit, 1991. *Recovery plan for lowland native grasslands in the Australian Capital Territory*. Unpublished report to the Australian National Parks and Wildlife Service. ACT Parks and Conservation Service, Canberra.

Wildlife Research Unit, 1992. *Lowland native grassland ecosystems in the Australian Capital Territory*. Unpublished report to the Australian National Parks and Wildlife Service. ACT Parks and Conservation Service, Canberra.

Wildlife Research Unit, 1994. *Management plan for ACT lowland native grasslands*. Unpublished report to the Australian Nature Conservation Agency. ACT Parks and Conservation Service, Canberra.

Wildlife Research Unit, 1996. *Lowland native grasslands in the Australian Capital Territory recovery plan: Project No. 179*. Unpublished report to the Australian Nature Conservation Agency. ACT Parks and Conservation Service, Canberra.

Williams, D.G., Osborne, W., Georges, A. & Holloway, S., 1995. *Principles and strategic options for the conservation of native grasslands and their threatened fauna in Gungahlin, Australian Capital Territory*. Unpublished report to the ACT Planning Authority. Applied Ecology Research Group, University of Canberra.

List of Action Plans - December 1997

In accordance with Section 23 of the *Nature Conservation Act 1980,* the following Action Plans have been prepared by the Conservator of Flora and Fauna:

No. 1: Natural Temperate Grassland - an endangered ecological community.

No. 2: Striped Legless Lizard (*Delma impar*) - a vulnerable species.

No. 3: Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*) - an endangered species.

No. 4: A leek orchid (*Prasophyllum petilum*) - an endangered species.

No. 5: A subalpine herb (*Gentiana baeuerlenii*) - an endangered species.

No. 6: Corroboree Frog (*Pseudophryne corroboree*) - a vulnerable species.

FURTHER INFORMATION

Further information on this Action Plan or other threatened species and ecological communities can be obtained from:

Environment ACT
(Wildlife Research and Monitoring)
Phone: (02) 6207 2126
Fax: (02) 6207 2122

This document should be cited as:

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

Appendix 1. Specific and Common Names of Species in the Action Plan

NATIVE GRASSES

Bothriochloa macra	Red Grass
Chloris truncata	Windmill Grass
Danthonia spp.	Wallaby Grasses
D. caespitosa	Ringed Wallaby Grass
D. carphoides	Short Wallaby Grass
D. laevis	Wallaby Grass
Elymus scaber	Common Wheat Grass
Enneapogon nigricans	Niggerheads
Poa spp.	Tussock Grasses
Poa labillardieri	Tussock Grass
P. sieberiana ssp. *sieberiana*	Tussock Grass
Panicum effusum	Hairy Panic
Stipa spp.	Spear grasses
S. scabra ssp *falcata*	Spear grass
S. bigeniculata	Spear grass
Themeda triandra	Kangaroo Grass

NATIVE FORBS

Asperula conferta	Common Woodruff
Bulbine bulbosa	Golden Lily
Carex appressa	Sedge
C. inversa	Common Sedge
Chrysocephalum apiculatum	Common Everlasting
Goodenia pinnatifida	Scrambled Eggs
Haloragis heterophylla	Perennial Raspweed
Hydrocotyle laxiflora	Stinking Pennywort
Juncus spp.	Rushes
Leptorhynchos squamatus	Scaly Buttons
Microseris lanceolata	Yam Daisy
Oxalis perennans	Wood Sorrel
Plantago varia sens. lat.	Variable Plantain
Psoralea tenax	Emu Foot
Rutidosis leptorrhynchoides	Button Wrinklewort
Solenogyne dominii	Solenogyne
Stackhousia monogyna	Creamy Candles
Swainsona monticola	Purple Pea
S. sericea	Purple Pea
S. recta	Purple Pea
Thesium australe	Toadflax
Triptilodiscus pygmaeus	Common Sunray
Vittadinia muelleri	Narrow-leaf New Holland Daisy
Wahlenbergia spp.	Native bluebells
Wurmbia dioica	Early Nancy

EXOTIC GRASSES

**Aira caryophyllea*	Silvery Hairgrass
**Aira elegantissima*	Delicate Hairgrass
**Avena* spp.	Wild Oats
**Bromus hordaceous*	Brome
**Dactylis glomerata*	Cocksfoot
**Holcus lanatus*	Yorkshire Fog
**Phalaris aquatica*	Phalaris
**Poa pratensis*	Kentucky Bluegrass
**Vulpia myuros*	Rat's Tail Fescue

EXOTIC FORBS

**Arctotheca calendula*	Cape Weed
**Carthamus lanatus*	Saffron Thistle
**Centaurium erythraea*	Common Centaury
**Cerastium glomeratum*	Chick weed
**Cirsium vulgare*	Spear Thistle
**Hypochaeris glabra*	Smooth Catsear
**Hypochaeris radicata*	Flatweed
**Paronchyia brasiliana*	Chilean Whitlow
**Rumex crispus*	Curled Dock
**Tolpis umbellata*	Tolpis
**Tragopogon porrifolius*	Salsify
**Tragopogon dubius*	Salsify
Trifolium spp.	Clovers
**T. arvense*	Haresfoot Clover
**T. campestre*	Hop Clover
**T. dubium*	Yellow Suckling Clover
T. glomeratum	Clover
**T. repens*	White Clover

INVERTEBRATES

Cooraboorama canberrae	Canberra Raspy Cricket
Keyacris scurra	Key's Matchstick
Perunga ochracea	Perunga Grasshopper
Synemon plana	Golden Sun Moth

REPTILES

Aprasia parapulchella	Pink-tailed Worm Lizard
Delma impar	Striped Legless Lizard
Lampropholis delicata	Delicate Skink
Tympanocryptis lineata pinguicolla	Eastern Lined Earless Dragon

AMPHIBIANS

Lymnodynastes dumerilii	Eastern Banjo Frog
Neobatrachus sudelli	Spotted Burrowing Frog
Uperoleia laevigata	Orange-groined Toadlet

BIRDS

Ardeotis australis	Australian Bustard
Coturnix australis	Brown Quail
Coturnix novaezeelandiae	Stubble Quail
Ephthianura albifrons	White-fronted Chat
Gallinago hardwickii	Latham's Snipe
Gymnorhina tibicen	Australian Magpie
Pedionomus torquatus	Plains Wanderer
Rhipidura leucophrys	Willy Wagtail

Appendix 2. Site Locations with Floristic Associations

Location and Site	Grassland Action Plan Location No. (GAP)	Floristic Association	Area (ha)	Botanical Significance 1=high; 5=low	Species of Conservation Significance
"Horse Park" entrance, Gungahlin (Site A)	1	Wet Themeda	10.3	3	#
"Horse Park" entrance, Gungahlin (Site B)	1	Danthonia	21.8	4	Sp, #
"Kooringal" property	2	Dry Themeda	18.8	3(4)	
West Belconnen (Site A, Dunlop)	3	Wet Themeda	10.8	2	#
West Belconnen (Site B)	3	Stipa	20.0	3	Sp, #
"Stray Leaf" property, Gungahlin	4	Stipa	4.8	4	
Harrison, Gungahlin	5	Stipa	8.7	4	
Mulanggary Grassland Reserve (Site A)	6	Danthonia	3.3	3	#
Mulanggary Grassland Reserve (Site B)	6	Wet Themeda	6.1	3	Di, #
Mulanggary Grassland Reserve (Site C)	6	Stipa	82.8	3(5)	Di, Sp, #
Kosciusko Avenue, Palmerston (Site A)	7	Dry Themeda	1.2	3	Di
Kosciusko Avenue, Palmerston (Site B)	7	Stipa	13.1	4	Di
Gundaroo Rd sth, Gungahlin	8	Stipa	4.2	4	
Gungaderra Grassland Reserve (Site A)	9	Stipa	14.8	3	Di
Gungaderra Grassland Reserve (Site B)	9	Wet Themeda	12.8	3(5)	Di, #
Gungaderra Nature Reserve (Site C)	9	Poa	2.0	3	Di
North Mitchell (Site A)	10	Danthonia	14.8	3	
North Mitchell (Site B)	10	Dry Themeda	1.9	3	Di
Kenny North, Gungahlin	11	Stipa	11.4	4	
Kenny, Gungahlin	12	Stipa	1.7	4	Di
Crace Hill Grassland Reserve (Site A)	13	Stipa	44.7	4	Di
Crace Hill Grassland Reserve (Site B)	13	Danthonia	8.7	3	Di
Racecourse, Gungahlin	14	Stipa	1.5	4	
Jarramlee	15	Stipa	53.8	5(4)	
Umbagong Park North, Florey	16	Dry Themeda	5.0	5	
Umbagong Park South, Florey	17	Dry Themeda	2.8	3	
Evatt powerlines	18	Dry Themeda	2.3	4	
Lake Ginninderra (Site A)	19	Danthonia	0.1	3	Sp
Lake Ginninderra (Site B)	19	Danthonia	1.6	4	
Lake Ginninderra (Site C)	19	Danthonia	0.4	4	
Belconnen Naval Station (Site A)	20	Danthonia	106.5	2	Sp, #
Belconnen Naval Stn (Site B, paddocks)	20	Stipa	53.7	3	
Belconnen Naval Stn (Site C, paddocks)	20	Dry Themeda	12.4	4	
Belconnen Naval Stn (Site D, paddocks)	20	Stipa	6.3	4	
Kaleen east paddocks	21	Danthonia	28.6	3	
Caswell Drive, Roadside (Site A)	22	Wet Themeda	1.4	3	#
Caswell Drive, Paddock (Site B)	22	Wet Themeda	5.4	4	
Glenloch Interchange	23	Dry Themeda	1.5	3	
Yarramundi Reach (Site A)	24	Dry Themeda	8.0	3	
Yarramundi Reach (Site B)	24	Wet Themeda	4.1	4	Di
Yarramundi Reach (Site C)	24	Poa	1.0	4	Sp
CSIRO Limestone Avenue, Campbell	25	Dry Themeda	2.8	3	Sp
Constitution Avenue, Reid	26	Dry Themeda	3.0	3	Sp, #
Campbell Park Offices	27	Danthonia	3.3	3	Rl, Tlp, Sp, #
Campbell Park paddocks	27	Danthonia	9.0	3	Rl, Tlp, Sp, #
Majura Valley East (Site A, Firing Ra.)	28	Danthonia	142.2	1(3)	Di, Tlp, Sp, Rl, #
Majura Valley East (Site B, FAC Beacon)	28	Wet Themeda	5.6	3(2)	#
Majura Valley East (Site C FAC Beacon)	28	Danthonia	7.0	2(3)	Di, Tlp, #
Majura Valley East (Site D, Airport,)	28	Danthonia	47.1	2	Tlp, Sp, #
Majura Valley East (Site E, Airport)	28	Danthonia	72.7	3	Tlp, #
Lady Denman Drive, Yarralumla	29	Danthonia	2.5	3	Sp, #
Dudley Street, Yarralumla	30	Wet Themeda	0.9	3	Sp
Novar Street, Yarralumla	31	Danthonia	0.3	4	
Black Street, Yarralumla	32	Danthonia	4.1	3	Sp
St Mark's, Barton	33	Dry Themeda	3.1	1	Rl, #
York Park, Barton	34	Danthonia	0.4	3	Sp
AMTECH, Fyshwick	35	Danthonia	24.2	4(3)	Tlp
Jerrabomberra West (Site A, "Woden")	36	Danthonia	72.4	2	Tlp, Ap, Sp, #
Jerrabomberra West (Site B, "Woden")	36	Stipa	53.7	4	Tlp
Jerrabomberra West (Site C Callum Brae)	36	Stipa	85.8	4	Tlp
Jerrabomberra West (Site D Callum Brae)	36	Danthonia	53.5	4	Tlp
Jerrabomberra East (Site A, HMAS Harman)	37	Stipa	171.3	5(4)	Di, Tlp
Jerrabomberra East (Site B, Mike's Hill)	37	Danthonia	43.8	3	Tlp
Jerrabomberra East (Site C, East Woden)	37	Danthonia	20.1	3(4)	Tlp
Jerrabomberra East (Site D, Tharwa Rd)	37	Dry Themeda	2.0	3(4)	Rl
Lake Isabella, Monash	38	Dry Themeda	1.2	3	
Mugga Mugga	39	Danthonia	3.0	3(4)	
Total of 68 sites at 39 locations			**1450.1**		

Shaded areas indicate sites that are Public Land - Nature Reserve

Ap = *Aprasia parapulchella*, Di = *Delma impar*, Rl = *Rutidosis leptorrhynchoides*, Sp = *Synemon plana*, Tlp = *Tympanocryptis lineata pinguicolla*, # = uncommon or declining species which are not formally listed.

GAP = Grassland Action Plan Number - this number is used as a site reference in this Action Plan (and Figure 1) and as a reference to grassland sites in other Action Plans.

Note: Some sites may be represented by more than one entry - this is because some locations include more than one floristic association or are subject to different land uses or are under separate leases.

Appendix 3. Botanical Significance Ratings used for Natural Temperate Grassland Sites.

These botanical significance rating is based on a qualitative assessment of the naturalness of the vegetation community in grassland sites. They have been modified by Environment ACT (Wildlife Research and Monitoring) from Stuwe (1986) in order to assist with the identification of conservation values of sites. The ratings are applied across the Monaro region.The ratings reflect the diversity of native and exotic plant species and the occurrence of species that are indicative of disturbance levels. Diversity is a measure of species richness measured over a specified area, such as species per hectare.

Although the botanical significance ratings are applied to an entire site, there may be some areas of higher (or lower) botanical significance, reflecting different disturbance levels or differences in natural site conditions of drainage, soil depth or nutrient levels. Such sites are indicated in the text with the botanical significance of the minor areas in brackets.

Botanical significance rating does not include other assessments of conservation value, which include the occurrence of threatened species, the occurrence of particular floristic associations, site size, threats from surrounding land uses and assessments of viability. These assessments, together with the botanical significance, are used to determine appropriate protection mechanisms and management requirements.

Botanical Significance Rating 1

Sites with a botanical significance rating of 1 have a very high conservation value. They contain a very high diversity of native plant species, especially native forbs and a very low diversity of exotic species. These sites also contain species indicative of minimal disturbance and generally include the most natural examples of the ecological community. They are amongst the best available sites of their type, and are often one of only a small number of sites with similar conservation values remaining in Australia.

Botanical Significance Rating 2

Sites with a botanical significance rating of 2 have a high conservation value. They have a high to very high diversity of native plants, but contain a moderate diversity of exotic species. They generally have fewer species indicative of minimal disturbance.

Botanical Significance Rating 3

This botanical significance rating is applied to sites with moderate conservation value. These sites have a moderate native species diversity and a moderate exotic species diversity. They have usually been moderately altered by disturbance or land uses, and contain few species indicative of low levels of disturbance.

Botanical Significance Rating 4

Sites with a botanical significance rating of 4 have only low conservation value. They contain a lower diversity of native species, particularly native forbs, but may contain a high cover of native grasses. They contain a high cover and diversity of exotic plants. They include no species which are indicative of low levels of disturbance. However, they may have utility for their fauna habitat values, for wildlife corridors or buffers to areas of higher conservation value, and as potential sites for rehabilitation.

Botanical Significance Rating 5

Sites given a botanical significance rating of 5 have only minimal conservation value. They contain few native forbs, and include only those native species indicative of high levels of disturbance. Exotic species cover and diversity is very high. However, they may have utility for their fauna habitat values, for wildlife corridors or buffers to areas of higher conservation value, and as potential sites for rehabilitation.

ACTION PLAN No. 2

In accordance with section 21 of the *Nature Conservation Act 1980*, the **Striped Legless Lizard (*Delma impar*)** was declared a **vulnerable** species on 15 April 1996 (formerly Determination No. 29 of 1996 and currently Determination No. 89 of 1997). Section 23 of the Act requires the Conservator of Flora and Fauna to prepare an Action Plan in response to each declaration. This is the Action Plan for the:

Striped Legless Lizard
Delma impar

Preamble

The *Nature Conservation Act 1980* establishes the ACT Flora and Fauna Committee with responsibilities for assessing the conservation status of the ACT's flora and fauna and the ecological significance of potentially threatening processes. Where the Committee believes that a species or ecological community is threatened with extinction or a process is an ecological threat, it is required to advise the Minister for the Environment, Land and Planning and recommend that a declaration be made accordingly.

Flora and Fauna Committee assessments are made on nature conservation grounds only and are guided by specified criteria as set out in its publication *"Threatened Species and Communities in the ACT*, July 1995".

In making its assessment of the Striped Legless Lizard, the Committee concluded that it satisfied the criteria indicated in the adjacent table.

An Action Plan is required in response to each declaration. It must include proposals for the identification, protection and survival of a threatened species or ecological community, or, in the case of a threatening process, proposals to minimise its effect.

While the legal authority of this Action Plan is confined to the Australian Capital Territory, management considerations are addressed in a regional context.

Criteria Satisfied

2.1 The species is known to occur in the ACT region and is already recognised as vulnerable in an authoritative international or national listing.

2.2 Species is observed, estimated, inferred or suspected to be at risk of premature extinction in the ACT region in the medium-term future, as demonstrated by the following:

2.2.1 Current serious decline in population or distribution from evidence based on :

2.2.1.3 serious decline in quality and quantity of habitat;

2.2.1.4 high actual or potential levels of exploitation or persecution; and

2.2.1.5 serious threats from herbivores, predators, parasites, pathogens or competitors.

2.2.2 Imminent risk of serious decline in population or distribution from evidence based on 2.2.1.3 to 2.2.1.5 (above).

2.2.4 Seriously fragmented distribution for a species currently occurring over a moderately small range or having a moderately small area of occupancy within its range.

Links with other Action Plans

This Action Plan interrelates with the Action Plan for Natural Temperate Grassland and other component threatened species, such as

the Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*). Action Plans are listed at the end of this document.

Species Description and Distribution

DESCRIPTION

The Striped Legless Lizard *Delma impar* (Fischer 1882) (Figure 1) is a reptile of the family Pygopodidae. The average snout-vent length of adults is 90 mm (Cogger 1992), with a maximum total length of about 300 mm and an average body weight of 4.1 grams (Coulson 1990). Sexes are externally similar.

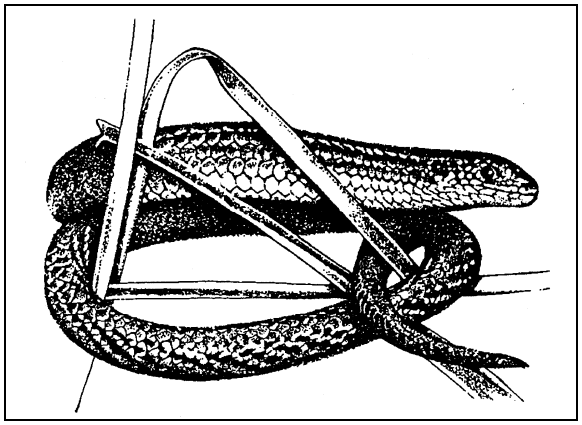

Figure 1: Illustration of the Striped Legless Lizard, *Delma impar*. Scale: Natural size.

The species is variable in colour but is most commonly grey-brown above, with a series of dark brown or blackish longitudinal stripes along the length of the body and tail, commencing at the neck (Cogger 1992). A large amount of variation exists between individuals in colour and intensity of the striping, and in some animals (particularly in the young), striping is indistinct or absent. The colour of the head is darker than that of the body, being dark brown to dark slate grey in adults and black in young individuals. The ventral surface has been described as whitish (Cogger 1992), however some individuals have salmon-pink coloration on the flanks that may extend to the undersurface. Most individuals have yellow coloration on the infralabial and adjacent gular scales, extending back to the tympanum (Coulson 1990).
The Striped Legless Lizard can usually be distinguished from the inornate legless lizard *Delma inornata*, a closely related species which also occurs in the ACT region, by the presence of stripes.

Legless lizards superficially resemble small snakes, however, they can be readily distinguished from snakes by having a visible ear opening, fleshy broad tongue, the presence of remnant hindlimbs (which are reduced to two scaly flaps near the vent) and a tail that is longer than the body, which can be voluntarily shed.

HABITAT

The Striped Legless Lizard is found primarily in lowland native grasslands (Coulson 1990, Osborne *et al.* 1993). This habitat type occurs on flat or gently undulating plains (Coulson 1990, Hadden 1995), and is dominated by perennial, tussock-forming grasses such as Kangaroo Grass *Themeda triandra*, Speargrass *Stipa* spp. and Wallaby Grass *Danthonia* spp. (Coulson 1990, Hadden 1995). The species is also found in some areas dominated by exotic grasses (Coulson 1990, Williams and Kukolic 1991, Kukolic *et. al.* 1994, Rauhala *et. al.* 1995, Hadden 1995). A tussock structure in grassland appears to be an important habitat characteristic (Wildlife Research Unit 1992, Hadden 1995), although little is known about the way in which the vegetation is utilised. Some evidence exists to suggest that lizards over-winter at the base of grass tussocks or just below the soil surface (Wildlife Research Unit 1994).

A recent review of sites in Victoria and the ACT, where the species is known to occur (Hadden 1995), has determined that habitat is characterised by a vegetative cover dominated by native tussock grasses, and that soils generally have a moderate to high clay content which often produce cracks in summer. In Victoria, most sites supporting the species have a cover of lightly embedded rocks, although this is not a feature of the species' habitat in the ACT.

Although the Striped Legless Lizard is found in both primary and secondary grasslands, Dorrough (1995) found it to inhabit secondary grasslands but only where this was within two kilometres of primary grasslands.

Most areas where the species persists, are thought to have had low to moderate levels of agricultural disturbance in the past (Coulson 1990, Hadden 1995, Dorrough 1995). It has been suggested (Coulson 1990, Dorrough 1995) that ploughing may be a practice that is particularly incompatible with the survival of the species in an area.

BEHAVIOUR AND BIOLOGY

The Striped Legless Lizard is known to feed on a variety of insects and arthropods including spiders, crickets, cockroaches and caterpillars

(Coulson 1990, Wainer 1992, Nunan 1995). Some evidence is available to suggest that the species displays some selectivity in its diet, with *Lepidoptera* larvae (caterpillars) being implicated as a particularly important food resource (Nunan 1995).

The species is diurnal and surface active from late spring to early autumn, with a peak in activity in November and December (Kukolic 1994). Gravid individuals are commonly caught in these months, with two eggs being laid in December. Some evidence is available to suggest that communal oviposition occurs and that at least sometimes, eggs may be laid under rocks or other substrate (Mills 1992, Rauhala 1996). Incubation periods of between 35 and 60 days have been observed in captivity under ideal conditions, however, the incubation period is likely to be longer in the field.

The longevity of the species is not known but a maximum of ten years has been estimated (Webster *et al.* 1991, Dorrough 1995).

DISTRIBUTION - ACT

In the ACT, the potential range of the species prior to European settlement is likely to have been within the more or less continuous area of treeless plains which extended over 20 000 hectares. However, most of this area has been developed for urban and related purposes and the current distribution of the Striped Legless Lizard in the ACT is a fragmented one, with four disjunct populations recognised (Figure 2): Gungahlin, Yarramundi Reach, Majura Valley and the Jerrabomberra Valley (Rauhala *et al.* 1995). These sites are separated from one another by unsuitable habitat, roads and urban development.

Gungahlin

The Gungahlin area can be further divided into several parts, most of which are separated from each other by roads. These are:

- Mulanggary, Gungaderra and Crace: - are separated from each other by roads and form the grassland reserves system in the Gungahlin area.
- Kenny: - an area to the south-east of Gungahlin which is separated from Mulanggary by marginal habitat.

Other relatively small and isolated patches of habitat known to support *D. impar* in the Gungahlin area are:

- Kosciusko Avenue: - Surrounded by roads and the suburb of Palmerston.
- Barton Highway, Kaleen: - Bounded on one side by the suburb of Kaleen and on the other by the Barton Highway, which separates this site from the Crace and Gungaderra grassland reserve units.
- Ginninderra Creek/Gundaroo Road: - located between Ginninderra Creek and Gundaroo Road toward the south-western end of the road.
- Corner Gundaroo Road and Gungahlin Drive: - bordered on two sides by roads and located adjacent to the Gungahlin Town Centre development.

The evidence available to date suggests that areas of Gungahlin are the stronghold for the species in the ACT region, although nearby areas of New South Wales and areas of potentially suitable habitat beyond the ACT border are yet to be thoroughly investigated.

Yarramundi Reach

A small area of grassland on the shores of Lake Burley Griffin. The habitat at this site is separated into two portions by a bicycle path. The survey conducted at this site in 1993 (Kukolic 1994) indicated that the species was scattered across the site and that its densities were low in relation to other sites surveyed during that year.

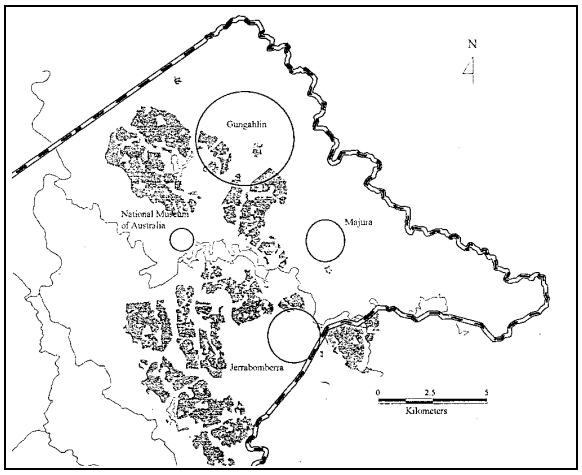

Figure 2: Four areas known to support *Delma impar* in the ACT.

Majura Valley

This is a large area comprising two main parts separated by the Majura Road. To the east of the Majura Road is an extensive area of habitat made up of part of the Majura Field Firing Range and the Airservice Australia navigational beacon enclosure. The other area lies to the west of the Majura Road and although the extent of the species in this area has not been fully investigated, it possibly extends from the road, west to the grasslands near the Campbell Park Offices where there has been an unconfirmed report of the

species. The surveys conducted in the Majura Valley indicate that the species is present in moderate densities. In late February 1997, the Majura Field Firing Range site was subjected to an extensive fire. The impact of this event on the *Delma impar* population at the Range will not be known for some time.

Jerrabomberra Valley

The species is currently known only in the grassland to the east of Jerrabomberra Avenue on the Woden, Bonshaw and Wendover properties, as well as on HMAS Harman. The only site west of this road known to have supported the species was developed in 1996 for the new headquaters for the Australian Geological Survey Organisation. In the Jerrabomberra Valley, *Delma impar* has been found in relatively low densities and is more scattered in distribution compared with the Gungahlin area.

DISTRIBUTION - ELSEWHERE

The total geographic range of the species is confined to south-eastern Australia. It is currently known to occur at scattered locations in several regions of Victoria, mainly on the basalt plains to the north and west of Melbourne and in the western district of the state (Department of Conservation and Environment 1992). In NSW, the most recent isolated records are from near the Federal Highway (Eaglehawk Hill) in 1996, Yass (Dobbin Drive) in 1997, and Goulburn (Gundary) in 1997 A survey for the species was undertaken in 1996 at Bungendore, Queanbeyan and Gundaroo (Gunninah Environmental Consultants 1997). This survey failed to find *D. impar* at these locations. Other records are from Cooma in 1995 (BHP/Westcoast Energy 1995), Goulburn in 1992 (Husband 1995) and Batlow in 1977 (Cogger *et al.* 1993). The species has also been recorded from South Australia, in the extreme south-eastern corner of the state, however, the most recent records from this area are in 1969, and the area now appears unlikely to support a population of the species (Coulson 1990, Hadden 1995).

Throughout its range in south-eastern Australia, the Striped Legless Lizard is considered to have suffered a substantial contraction in its distribution since European settlement. An investigation by Coulson (1990) indicated that there were few recent records of the species from areas of western Victoria where it had previously been recorded. Subsequent work by Hadden (1995) estimated that of the 125 sites from which the species has been recorded historically, it now occurs in as few as 40 of those sites.

It is believed that a combination of factors, including clearing of grasslands for urban development, some agricultural practices (prolonged heavy grazing by stock, pasture improvement, crop production), habitat fragmentation, weed invasion and inappropriate fire regimes have contributed to the decline of the species (Cogger *et al.* 1993).

Conservation Status

D. impar is recognised as a threatened species in the following sources:

International

Vulnerable. - IUCN (1994).

National

Vulnerable. - ANZECC (1991).

Vulnerable. - Schedule 1, Part 2 of the *Endangered Species Protection Act* 1992 (Commonwealth).

Australian Capital Territory

Special Protection Status Species. - Schedule 6 of *the Nature Conservation Act* 1980.

Vulnerable. - Section 21 of the *Nature Conservation Act 1980,* Determination No. 89 of 1997 (formerly Determination No. 29 of 1996).

New South Wales

Vulnerable. - Schedule 2 of the *Threatened Species Conservation Act* 1995.

Victoria

Threatened taxon. - Schedule 2 of the *Flora and Fauna Guarantee Act* 1988.
The species is also the subject of Action Statement No. 17, prepared by the Victorian Department of Conservation and Environment.

Threats

The major perceived threats to the continued survival of the Striped Legless Lizard are:

- loss and fragmentation of habitat through clearing of grasslands for urban, industrial and infrastructure development and for agricultural purposes;
- modification and degradation of grassland habitat through incompatible and

inadequate land management practices; and

- other potential effects of urbanisation, including increased incidence of predation and frequency of fires.

Major Conservation Objective

The major conservation objective of this Action Plan is to maintain in the long term, viable, wild populations of *Delma impar* as a component of the indigenous biological resources of the ACT and as a contribution to regional and national conservation of the species (ACT Government 1994). This is interpreted to include the maintenance of the species' potential for evolutionary development in the wild.

This objective is to be achieved by:

- improving understanding of the biology and ecology of the species as the basis for managing its habitat in reserves, other managed complementary areas and other sites where it persists; and
- protecting several viable populations *in situ*, in a cluster of sites in native grassland across the geographic range of the species in the ACT.

Conservation Issues and Intended Management Actions

The current pattern of distribution of the Striped Legless Lizard in the ACT is largely the result of loss and fragmentation of habitat caused by urban and associated developments. Habitat loss or fragmentation in any areas where viable populations of the species are to be conserved in the long term is undesirable.

- Where possible, further fragmentation of populations will be minimised and habitat linkages will be maintained through planning and sensitive implementation of essential construction activities.

The threatened status of natural temperate grassland communities and several grassland species presents the opportunity to identify areas for conservation and implement management strategies which will not only serve to protect *D. impar* but also its natural grassland habitat and other component species. Protection of *D. impar* will therefore allow for significant and complementary conservation actions.

Whilst understanding of the habitat requirements of the species remains incomplete, there should be no drastic alteration of an existing management regime, in an area where the species is known to occur. However, minor modifications may be appropriate and the effect of any changes on the species requires monitoring and evaluation.

- An adaptive management approach will be adopted to accommodate the conservation requirements of the taxon as they are clarified through new research.
- However, where there is possible conflict in conservation objectives with other threatened species, the differing requirements will be resolved in the context of documented management arrangements for each location.

Other potential threats associated with urbanisation include the increased incidence of fire and predation.

- The reality and magnitude of these potential threats needs further investigation, however, in the short-term a public awareness campaign will be developed to inform residents who live closest or adjacent to *Delma impar* habitats, of ways in which these potential threats can be reduced.

A number of small isolated sub-populations are known to exist in various sites in the ACT. The long-term viability of these groups is unknown, and some are in areas planned for development.

- The salvage of individuals from such areas will only be attempted where specific research projects using these animals have been developed and can be commenced within a short time frame.

Any management conflicts between those for the species and other threatened species will be resolved through site specific management plans, based on scientific principles.

SURVEY

Distributional surveys for *Delma impar* have been conducted in the ACT annually since 1989. Although there are no substantial areas of potentially suitable grassland habitat that have not yet been investigated in the ACT, some areas, such as Majura Valley (west), may require further assessment to determine the extent of the species' distribution in the area. Adjacent areas of NSW with potentially

suitable grassland habitat are largely unsurveyed.

- The need to establish the regional distribution of the species is an essential prerequisite to placing the ACT information into a proper biogeographical context. This will enable the relative significance of different areas in the region to be assessed for their importance for this species and will assist regional planning for both development and conservation purposes.
- Environment ACT will continue to liaise with NSW National Parks and Wildlife Service to ensure a co-ordinated approach to surveys in the region.

MONITORING

Monitoring is essential to determine the long-term status of the Striped Legless Lizard in the ACT (Coulson 1995), and the success of conservation measures implemented.

- A program will be maintained to monitor sites across the geographical range of the species in the ACT. Where possible this will include monitoring of isolated small populations.
- The monitoring program will be designed to obtain information on population fluctuations over time, and more specifically on how populations respond to changes in their grassland habitat, specific management practices and pressures associated with urbanisation.
- Records will be maintained on the electronic data base system maintained by Environment ACT (Wildlife Research and Monitoring (WR&M)), for analysis of population trends.

RESEARCH

Many aspects of the basic ecology of the Striped Legless Lizard require investigation in order to understand how the species responds to management practices being implemented for grasslands.

- A small captive colony of the species is held at Tidbinbilla Nature Reserve. These animals will be available for research into aspects of the species' biology or behaviour directly relevant to its conservation in the wild.
- Implementing a research program will be dependent on the availability of resources and the cooperation of researchers in tertiary institutions. Research priorities will be coordinated with other research on the species being carried out in Victoria and New South Wales through the Striped Legless Lizard National Recovery Team

Priorities for research include:

1. Population dynamics

- Population viability assessment and required habitat size
- Longevity and age at sexual maturity
- Causes of mortality
- Movements and mobility, and identifying what constitutes a barrier to movement
- Microhabitat selection
- Oviposition and over-wintering requirements
- Absolute population size and how this relates to the indices of abundance obtained during trapping.

2. Capture techniques

- Evaluate the efficiency of the current pitfall trapping configuration with alternative trapping arrays, including grid-based designs.
- Investigate innovative trapping techniques which provide an alternative to conventional pitfall trapping.

3. Marking techniques

- Investigate the effectiveness and reliability of alternative marking techniques for the species.

4. Habitat requirements

Although some information is available regarding the habitat requirements of the species, the fundamental question of what limits its distribution and abundance remains largely unanswered.

- Research and where possible, future surveys, should address specific habitat requirements of the species. Information gained will assist in identifying and managing the species' habitat, and can also be used to develop a program for rehabilitating degraded grassland habitat.

5. Population genetics

Genetic data from the Jerrabomberra Valley population requires analysis to determine whether it is divergent from populations in other areas of the ACT. This is particularly important only in the event of any attempts to move lizards to other locations.

6. Habitat management

The management of grasslands should incorporate where possible measures to

maintain and enhance community structure and diversity. The specific habitat requirements of the Striped Legless Lizard, as outlined above, are not well understood at present. Research into habitat management needs to focus on the following:

- The effect of grazing by stock on the habitat of the species, including different levels of intensity, duration and season, as well as the potential use of conservation grazing as a management tool.
- The effect of fires, including wildfire and controlled burns. The appropriate season of burn and frequency are particularly important factors related to the use of fire in the habitat of this species.
- The most appropriate season of mowing, mowing height and the effect of cut grass removal or retention on site.
- The effect of weed invasion, as well as the use of some weeds as habitat, requires examination. Large scale removal of some weeds may adversely affect populations in the short-term where alternative native habitat is not available. The staging of weed control activities in some circumstances appears warranted.

EDUCATION AND LIAISON

As with any vulnerable species, the importance of information transfer to the community and people responsible for managing their habitat is substantial. Environment ACT will:

- compile and distribute management guidelines and maintain contact with land managers responsible for areas on which populations presently occur;
- prepare and distribute to appropriate target audiences (eg. school children, tourists, building industry personnel) information about the species and its conservation; and
- consider the use of salvaged animals as a basis for community education and captive display programs, in addition to their use for research.

Protection

Conservation effort in the ACT for this species will be focused on protecting viable populations, in functional native grassland habitat in a cluster of sites across the geographic range of the species in the ACT. These sites will be located at Gungahlin, Yarramundi Reach and the Majura and Jerrabomberra valleys.

In the Majura and Jerrabomberra valleys, it may be possible to achieve protection of this species coincidentally with that of grasslands and other threatened species including the endangered Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla)*.

The known *D. impar* populations occur on land under a variety of tenures including Territory Land - Nature Reserve managed by Environment ACT, rural leasehold land, and Commonwealth owned and managed land (National Land).

In Gungahlin, three Nature Reserves have already been established to protect the species. However, there is no formal protection for any part of the other three known disjunct populations. Consideration therefore needs to be given to the survival of the species at Yarramundi Reach, and the Majura and Jerrabomberra valleys.

Protection of main *D. impar* Populations

Protection of *Delma impar* in natural temperate grassland habitat will be achieved through the provisions of *the Land (Planning and Environment) Act 1991,* the Territory Plan and Memoranda of Understanding with the Commonwealth.

(i) Territory Plan - Hills, Ridges and Buffers with Public Land Overlay of Type Nature Reserve

Reservation is generally recognised as the mechanism for ensuring that sites of high conservation value are not eventually converted to a land use incompatible with their natural values (Caughley and Gunn 1996). Reservation is therefore an important mechanism for the protection of *Delma impar* and its habitat. Reservation does not exclude the option of managing controlled grazing to achieve conservation objectives through agistment arrangements with rural lessees. The reserved natural temperate grassland areas in Gungahlin supporting *D. impar* are listed in Table 1.

Table 1. Hills, Ridges and Buffers: Public Land - Nature Reserve.

Location and site	GAP No.	Area (ha)	Current Status
Gungahlin:			
Mulanggary	6	115	Reserve
Gungaderra	9	272	Reserve
Crace	13	150	Reserve

Note: GAP No. = Grassland Action Plan Number. This number is used as a site reference in the Natural Temperate Grassland Action Plan. Its use in Action Plans for component species, such as *D. impar* indicates that the

habitat of the species in question more or less coincides with the natural temperate grassland site referred to.

(ii) Memoranda of Understanding

Memoranda of Understanding (MOU) provide another means of ensuring that sites with high conservation value will be managed so as to maintain their conservation value in perpetuity while enabling other compatible land uses, as identified in the MOU, to occur. An MOU with the Commonwealth does not preclude the possibility of the land being reserved in the future under Commonwealth legislation.

MOU's are appropriate for Commonwealth owned or -occupied land, or other land where long-term land uses will not compromise conservation values (for example, land used for Defence purposes or communication facilities). Areas of National Land supporting *D. impar*, for which an MOU will be negotiated with the Commonwealth, are listed in Table 2 below.

Table 2. Memorandum of Understanding to achieve protection equivalent to reservation.

Location and site	GAP No.	Area (ha)	Current Status
Majura Valley (East) Field Firing Range (parts) and the navigation beacon	28	155	National Land
Yarramundi Reach	24	13	National Land
Jerrabomberra: HMAS Harman-parts	37	159	National Land

Once MOU's have been agreed, there will be populations of *D. impar* protected in each of the four disjunct areas of the ACT where the species occurs in its native grassland habitat.

Other Areas Supporting *D. impar*

There are several areas of varying sizes with modified grassland habitat which support *Delma impar*. These are not proposed to be protected either as nature reserves under the Territory Plan or through an MOU with the Commonwealth. However, parts of these areas may be appropriately managed to retain their conservation values. Such arrangements include planning and management agreements with non government landholders, property management agreements with rural lessees and protection of sites within the urban fabric.

- Sites will be included where feasible in appropriate Public Land categories under the Territory Plan.
- To ensure that the conservation values of these areas are protected, management agreements that incorporate conservation objectives will be developed for implementation by the relevant agency.

Information on the regional distribution of the species, which will become available through survey work in NSW, is likely to influence the requirements for protection of the species in these areas of the ACT.

(i) Public Land (Urban Open Space)

Most land included in Hills, Ridges and Buffer Areas is identified as Public Land and can therefore be assigned a category under the Territory Plan. This would include (other than nature reserves), Urban Open Space and Special Purpose Reserves. Activities permitted in these land use categories can be compatible with conservation values, provided that appropriate conservation management is in place. In these cases, maintenance of the conservation values of the site is the responsibility of the relevant ACT Government agency. Other similar land uses include road reserves and powerline easements. Areas of Public Land (other than nature reserves) supporting *D. impar* are listed below in Table 3.

Table 3. Public Land - Urban Open Space

Location and site	GAP No.	Area (ha)	Current Status
Gungahlin: Gundaroo Rd S'th	N/A	17	HRB
Kaleen	N/A	58	HRB

Note: HRB = Hills, Ridges and Buffer areas.
N/A = Not applicable

(ii) Other Land Categories under the Territory Plan

Where Territory Land includes other sites of populations of *D. impar*, these may be retained and appropriately managed, within the development context, by consideration at the appropriate stages of the concept planning and development approval process. Such measures provide a means of enabling the primary land use to continue while accommodating the conservation needs of *D impar* habitat on the site, but without the additional protection mechanism of being public land.

Non Urban / Rural Leases

Land located outside the existing urban area can be appropriately managed through property management agreements (PMAs)

applying to rural leases. PMAs are required for rural leases when leases are renewed. This provides an opportunity to identify conservation values within the lease and to determine appropriate conservation management of that land, and where necessary, apply constraints on some practices such as ploughing and fertilisation. Such provisions will be developed in consultation with relevant landholders. Areas of Territory Land classified as non-urban which support *D. impar*, for which a site management agreement is the appropriate mechanism for protection, are listed in Table 4 below.

- Where rural sites occur in blocks of land scheduled for development, or where sites have been identified as requiring reservation, property management agreements will be developed to conserve the habitat values until such time as changes occur to the land tenure and use.

In respect to the Gungahlin Cemetery, the Conservator of Flora and Fauna will liaise with the ACT Cemeteries Trust on management and use to protect the conservation values of the site.

Table 4. Planning and Site Management Agreements (outside urban areas)

Location and site	GAP No.	Area (ha)	Current Status
Jerrabomberra:			
"Bonshaw"	N/A	19	Rural lease
"Woden"	36	72	Rural lease
Gungahlin Cemetery	N/A	5	Broadacre

Urban Leases

Where small sites occur within urban areas, advice can be provided to assist landholders maintain conservation values. This advice may be given as site management guidelines and plans. Similar guidelines are relevant for sites which are currently under rural agistment pending development of areas, such as in the Gungahlin Town. This enables protection and management of areas occurring as road reserves, easements and urban parks, since they can be maintained as landscape features, research resources or buffers. When incorporating these sites into the urban fabric, the entire site may not be retained. In these instances, boundaries of the areas to be incorporated require clarification.

These planning and site management measures do not preclude future land use changes, but are intended to retain the conservation values of the sites until future land use decisions are made. Urban leases supporting *D. impar*, for which negotiation of site management guidelines are appropriate, are listed in Table 5 below.

- Planning and site management mechanisms will be applied as required to both urban and non-urban sites so that, where possible, the natural grassland values of the *D. impar* habitat are conserved in the context of the primary land use.

Table 5. Sites within the urban fabric

Location and site	GAP No.	Area (ha)	Current Status
Gungahlin:			
Kenny	12	198*	Rural lease
North Mitchell	10	2	Industrial

* This area includes extensive *D. impar* habitat which has been significantly modified to the extent that it no longer retains native grassland community values. Small areas may be protected along roadsides and urban parks.

***D. impar* Areas Requiring Further Investigation**

The extent of the *D. impar* presence in the area to the west of the Majura Road (Table 6) is still to be fully investigated, although it possibly extends from the road to the grasslands near the Campbell Park Offices. Further study is required before it is possible to fully assess the conservation significance of the Striped Legless Lizard population at this site. In the meantime, the precautionary principle will be applied to the area and it will be excluded from any development until its significance can be determined. It will be managed through a property management agreement.

Table 6. Site where further assessment is required

Location and site	GAP No.	Area (ha)	Current Status
Majura (West)	N/A	38	Rural lease

Displaced Animals

In situations where urban and other developments preclude protection of the species in viable habitat, it will be necessary to evaluate options for managing and handling displaced animals which will not be protected in reserves or similar areas. Such options include incorporating the species and its

grassland habitat in open space within future urban development areas, removal of animals which can be used for research and educational purposes, and destruction without salvage.

- In places where the species is known to exist but long-term protection is not proposed, options for management of displaced animals will be evaluated in the context of available resources and conservation needs of the species at the time development of the habitat is proposed.

Further Supporting Mechanisms

This Action Plan, together with the Draft Canberra Nature Park Management Plan and the Action Plan for Natural Temperate Grassland, provides the conservation management of this species and its habitat.

Environment ACT will work with Planning and Land Management to ensure that land uses in areas adjacent to sites supporting *D. impar* are compatible with conservation objectives and to minimise any adverse impacts.

Socio-economic Issues

The main social benefits of conserving representative sites of natural temperate grassland in which *Delma impar* occurs are:

- meeting community concerns that further loss or extinction of significant ecological communities, together with their component native species, be prevented;
- the amenity and recreation associated with the grasslands reserves, in which the species occurs; and
- the tourism potential of a successful program to protect a threatened species along with its endangered habitat.

The potential for economic utilisation of native grassland habitat sites is relevant for those sites where current management or land uses are deemed to be compatible with the retention of conservation values.

There are four main aspects of planning in Canberra that will be affected by the implementation of this Action Plan. These are:

1. Future Urban Areas

Proposals for the Jerrabomberra Valley, as identified in either the National Capital Plan or the Territory Plan, and provided for in the Residential Land Release Program, may have their viability affected by the size and location of possible future grassland reserves.

2. Transport Facilities

The provision and/or upgrading of the following transport facilities may be affected:

- John Dedman Parkway - this may impact on the Kaleen sites but will be subject to environmental impact assessment in which conservation issues will be considered in terms of road alignment, road construction and verge management.
- Majura Parkway - southern section and connections.
- Very High Speed Train (VHST) corridor (Majura and Jerrabomberra valleys).

In the case of the VHST proposal, Environment ACT is actively involved in in the evaluation of planning options.

3. Industrial Areas

The planning for future industrial areas, in particular, a possible industrial complex associated with the Airport in the Majura Valley. Some habitat adjacent to the Mitchell Industrial Area may also be affected.

4. Rural Leasing Aspects

Some sites in the Jerrabomberra Valley are within rural leases. Preliminary investigations indicate that these leases currently contain withdrawal clauses allowing for the use of land for public purposes. The Rural Policy Taskforce has recently reviewed all aspects of rural leases including the recommendation of appropriate lease terms. Two recommendations of the Taskforce that will affect the Action Plans are that:

- the lease term for the Jerrabomberra Valley be to the year 2020; and
- there be no withdrawal clauses over any part of a rural lease unless it has been clearly defined for an imminent public work, such as a road, stormwater or other infrastructure.

This will mean that the Territory would have to withdraw any area of land having conservation significance at the time of an application for a new lease, or acquire it subsequently under the provisions of the *Land Acquisition Act 1994*.

It is expected that it will be early in 1998 before rural lessees are able to take up a new lease as proposed by the Taskforce. In the meantime, Environment ACT will need to identify areas requiring special conservation measures before applications for extended

lease terms are received. In the event that large areas of a lease will be withdrawn for conservation purposes, consideration will be given to the viability of the remainder of the lease. Grazing may be undertaken where it is considered that it will be consistent with the maintenance of the natural temperate grassland conservation values.

In addition to the issues outlined above, there are some site-specific issues which need to be addressed in order to implement the protection measures specified in this Action Plan. These are:

- Kenny: This suburb has yet to have outline planning conducted, however during this process, some *D. impar* habitat in the area will be protected by retaining habitat in areas such as roadside and urban parks.
- Kosciusko Avenue, Palmerston: While preservation of the entire area is not proposed, there is scope to incorporate portions of this area into small parks as part of the development of the area, for example, at the top of the knoll.

Legislative Provisions

The following ACT legislation applies to the conservation of flora and fauna in the ACT:

Nature Conservation Act 1980

The Nature Conservation Act protects native plants and animals. Activities affecting native plants and animals require a licence which may specify conditions to apply to the activity.

- A person may not kill, take, keep, sell, import, export or interfere with the "nest" of a native animal without a licence.

Native plants and animals may be declared as *protected* or having *special protection status* in recognition of a particular conservation concern that warrants additional protection. Increased controls apply to declared species and licensing constraints are specified.

Licence Conditions (SPS)

The Striped Legless Lizard is listed as a Special Protection Status (SPS) species under the Act. This is the highest level of statutory protection available and is conferred on species which are either threatened with extinction or are a migratory animal subject to an international agreement for their protection. Conservation requirements are a paramount consideration and only activities related to conservation of the species or serving a special purpose are permissible.

The Conservator of Flora and Fauna may only grant a licence for activities affecting a species with SPS where satisfied that the act specified in the licence:

- is required to be done for scientific, educational, propagative or other similar purposes;
- is required to be done for the purpose of protecting persons or property and will be conducted in a way that will, so far as is practicable, keep to a minimum any impact on the species concerned;
- is merely incidental to other acts, and will not appreciably reduce the chances of survival or recovery in the wild of the species concerned;
- is of particular significance to Aboriginal tradition and will not appreciably reduce the chances of survival or recovery in the wild of the species concerned.

Other Relevant Provisions

The Nature Conservation Act provides authority for the Conservator to manage Public Land reserved for conservation of the natural environment. Activities that are inconsistent with management objectives for nature conservation are controlled. Special measures for conservation of a species or community of concern can be introduced in a reserved area, including restriction of access to important habitat.

Section 47 of the Act allows the Conservator to give the occupier of land directions for protection or conservation of native plants and animals. This provision is relevant to the management of threats to the conservation requirements of a species or community of concern that occurs on leased land.

Natural Temperate Grasslands, which provide habitat for *D. impar* in many areas, has been declared as an endangered community by the ACT Minister for the Environment, Land and Planning, and as such requires the preparation of an Action Plan for its conservation.

Land (Planning and Environment) Act 1991

The Land (Planning and Environment) Act is the primary authority for land planning and administration. It establishes the Territory Plan and several of its provisions are relevant to the protection of flora and fauna.

- **Public Land** is reserved via the Territory Plan. Land reserved as wilderness area, national park or nature reserve has conservation of the natural environment as

a paramount management objective. The Conservator of Flora and Fauna must prepare a **plan of management** setting out how management objectives are to be implemented or promoted.

- **Places of natural heritage significance**, including important habitat for native species, may be entered in the Heritage Places Register, with conservation requirements specified.
- **Environmental Assessments and Inquiries** may be initiated as part of the approvals process for defined land use and development decisions or activities prescribed as controlled. Assessments are required to address potential environmental impact, including threats to a species of flora and fauna, an ecological community or an area.

COMMONWEALTH

Endangered Species Protection Act 1992

Under this legislation, *Delma impar* has been declared a **vulnerable** species. This places an obligation on the Commonwealth to prepare and implement recovery plans for the species as it occurs in Commonwealth areas. The Commonwealth is also required to cooperate with both the ACT and NSW authorities in protecting the species, and joint preparation and implementation of a recovery plan across State and Territory boundaries is encouraged (ANCA, 1994). This is being achieved through joint membership on the National Recovery Team, which will be preparing a national recovery plan for the species.

Consultation and Community Participation

Environment ACT (WR&M) is a member of the regional Striped Legless Lizard Working Group (SLLWG), which also comprises representatives from the New South Wales National Parks and Wildlife Service, the Australian National University, University of Canberra and the ACT Herpetological Association. This group coordinates survey, research and the regional conservation of the species. The regional SLLWG group is represented on the National Recovery Team, set up in 1995 to direct and facilitate appropriate research and management of the species and to prepare a National Recovery Plan. The membership of the National Recovery Team also includes representatives from the Victorian Striped Legless Lizard Working Group, South Australia and the Commonwealth.

Community participation with activities assisting the conservation of native grasslands and the Striped Legless Lizard will be encouraged through groups such as the Herpetological Association, Friends of Grasslands and Park Care Groups operating near grassland areas supporting the species. Information on the conservation of the Striped Legless Lizard will be incorporated into community education programs conducted by Environment ACT.

Implementation and Review

RESPONSIBILITY FOR IMPLEMENTATION

Environment ACT (WR&M) will have responsibility for coordinating the implementation of this Action Plan, subject to the availability of Government resources. Primary responsibility for conservation and management of the species on Territory Land will rest with the ACT Parks and Conservation Service, whilst relevant Commonwealth agencies will have responsibility on National Land, however, provisions in the *Nature Conservation Act 1980* (ACT) are still applicable. In addition, the Commonwealth has its own statutory obligations to protect the species under the *Commonwealth Endangered Species Protection Act 1992.*

EVALUATION

Implementation of this Action Plan will be a collaborative exercise between government agencies, landholders and the community generally. Commonwealth and NSW participation will be critical in some cases. The Action Plan will be reviewed after three years. The review will comprise an assesssment of progress using the following performance indicators:

- completion of commitments that can reasonably be expected to be finalised within the review timeframe (e.g. introduction of a statutory protection measure for a species; development of a management plan);
- completion of a stage in a process with a time line that exceeds the review period (e.g. design or commencement of a research program);

- commencement of a particular commitment that is of a continuing nature (e.g. design or commencement of a monitoring program for population abundance); and
- expert assessment of achievement of conservation objectives of the Action Plan.

The review will be reported to the ACT Flora and Fauna Committee. This will provide an opportunity for Environment ACT and the Flora and Fauna Committee to assess progress, take account of developments in nature conservation knowledge, policy and administration and review directions and priorities for future conservation action.

The following conservation actions will be given priority attention:

- completion of surveys in native grassland sites yet to be fully assessed, where the species is known to occur;
- establishment of a monitoring program to provide information on how populations respond to management practices and environmental pressures;
- commencement of the research program, especially on priority research topics;
- putting in place protection measures; and
- establishing liaison mechanisms with NSW authorities and determining the regional distribution and conservation status of the species.

This plan will also be reviewed in the context of a National Recovery Plan for the species when it is developed.

Acknowledgements

The illustration of the species (Figure 1) was prepared for Environment ACT by Marjorie Crosby-Fairall.

References

ACT Government Working Party, 1994. *Draft conservation strategy for the Striped Legless Lizard* (Delma impar*) in the Australian Capital Territory*. Unpublished report prepared by a working party convened by the Minister for the Environment, Land and Planning. ACT Parks and Conservation Service, Canberra.

ANCA, 1994. Endangered Species Protection Act 1992*: An outline*. Australian Nature Conservation Agency, Canberra.

ANZECC, 1991. *List of Australian Endangered Vertebrate Fauna.* Australian and New Zealand Environment and Conservation Council, Canberra.

Biosis Research Pty Ltd, 1995*. Eastern gas pipeline project: Flora, fauna and ecology studies*. Consultant report for BHP Petroleum and Westcoast Energy.

Caughley, G. & Gunn, A., 1996. *Conservation biology in theory and practice.* Blackwell Science, Carlton.

Cogger H.G., Cameron, E.E., Sadlier, R.A. & Eggler, P., 1993. *The action plan for Australian reptiles*. Australian Nature Conservation Agency, Canberra.

Cogger, H.G., 1992. *Reptiles and amphibians of Australia*. Reed Books, Chatswood.

Coulson, G., 1990. *Conservation biology of the Striped Legless Lizard* (Delma impar)*: An initial investigation*. Arthur Rylah Institute for Environmental Research Technical Report Series No. 106. Department of Conservation and Environment, Melbourne.

Coulson, G., 1995. *Management directions for the Striped Legless Lizard* (Delma impar) *in the Australian Capital Territory.* Technical Report No. 12. ACT Parks and Conservation Service, Canberra.

Department of Conservation and Environment (Vic), 1992. *Action Statement No 17: Striped Legless Lizard* (Delma impar). Department of Conservation and Environment, Melbourne.

Dorrough, J., 1995. *Past and present habitat of the Striped Legless Lizard* (Delma impar, *Pygopodidae) in the Australian Capital Territory.* BSc (Hons) thesis, Department of Botany and Zoology, Australian National University.

Gunninah Environmental Consultant, 1997. *Status of Striped Legless Lizard.* Report to the Road Transport Authority and the National Parks & Wildlife Service, NSW.

Hadden, S., 1995*. Distribution, population habitat estimates and habitat requirements of the Striped Legless Lizard* (Delma impar) *(Fischer).* Unpublished final report to the Australian Nature Conservation Agency. Department of Conservation and Natural Resources, Heidelberg.

Husband, G., 1995. A new northern limit for the Striped Legless Lizard (*Delma impar)*. *Herpetofauna* 25: 44-45.

IUCN, 1993. *1994 IUCN Red List of Threatened Animals*. IUCN - The World Conservation Union, Gland.

Kukolic, K., 1994. *Survey for the Striped Legless Lizard* (Delma impar) *during 1993 at the National Museum of Australia site,*

Yarramundi Reach, ACT. Unpublished report to the National Capital Planning Authority. ACT Parks and Conservation Service, Canberra.

Kukolic, K., McElhinney, N. & Osborne, W.S., 1994. *Survey for the Striped Legless Lizard* (Delma impar) *during 1993 in the proposed development area E1 comprising sites for the Gungahlin Town Centre and the suburb of Franklin*. Internal Report 94/3. ACT Parks and Conservation Service, Canberra.

Mills, D., 1992. *Report of* Delma impar *trapping survey conducted at Werribee, Jan-Feb 1992*. Report to the Striped Legless Lizard Working Group. Deakin University, Geelong.

Nunan, D., 1995*. Diet and feeding ecology of the Striped Legless Lizard* (Delma impar) *(Fischer, 1882) within the Australian Capital Territory*. BAppSc (Hons) thesis, Faculty of Applied Science, University of Canberra.

Osborne, W.S., Kukolic, K. & Williams, K.D., 1993. Conservation of reptiles in lowland native grasslands in the Southern Tablelands of New South Wales and the Australian Capital Territory. In Lunney, D. & Ayers, D., (eds) *Herpetology in Australia: A diverse discipline,* pp. 151-158. Transactions of the Royal Zoological Society of New South Wales.

Rauhala, M.A., 1996. *1995 survey and monitoring program for the Striped Legless Lizard* (Delma impar). Internal Report 96/1. ACT Parks and Conservation Service, Canberra.

Rauhala, M.A., Shorthouse, D.J. & Ingwersen, F., 1995. *The Striped Legless Lizard* (Delma impar) *in the Gungahlin, Majura and Jerrabomberra Valleys.* Internal Report 95/2. ACT Parks and Conservation Service, Canberra.

Wainer, J.W., 1992*. Diet of the Striped Legless Lizard* (Delma impar) *at the Derrimut Grassland Reserve, to the west of Melbourne*. Unpublished report to the Striped Legless Lizard Working Group. Department of Conservation and Environment, Melbourne.

Webster, A., Smith, S., Robertson, P. & Banks, C., 1991. *Striped Legless Lizard* (Delma impar) *population viability assessment: A preliminary examination.* Unpublished report prepared for Department of Conservation and Environment, Victoria.

Wildlife Research Unit, 1994. *Management plan for ACT lowland native grasslands.* Unpublished report to the Australian Nature Conservation Agency. ACT Parks and Conservation Service, Canberra.

Williams, D.G., Osborne, W., Georges, A. & Holloway, S., 1995. *Principles and strategic options for the conservation of native grasslands and their threatened fauna in Gungahlin, Australian Capital Territory*. Unpublished report to the ACT Planning Authority. Applied Ecology Research Group, University of Canberra.

Williams, K.D. & Kukolic, K., 1991. Fauna of the ACT's native grasslands. In Falconer, R., (ed.) *The ACT's native grasslands: Proceedings of a workshop,* pp.11-19. Conservation Council of the South-east Region and Canberra, Canberra.

List of Action Plans - December 1997

In accordance with Section 23 of the *Nature Conservation Act 1980,* the following Action Plans have been prepared by the Conservator of Flora and Fauna:

No. 1: Natural Temperate Grassland - an endangered ecological community.

No. 2: Striped Legless Lizard (*Delma impar*) - a vulnerable species.

No. 3: Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*) - an endangered species.

No. 4: A leek orchid (*Prasophyllum petilum*) - an endangered species.

No. 5: A subalpine herb (*Gentiana baeuerlenii*) - an endangered species.

No. 6: Corroboree Frog (*Pseudophryne corroboree*) - a vulnerable species.

FURTHER INFORMATION

Further information on this Action Plan or other threatened species and ecological communities can be obtained from:

Environment ACT
(Wildlife Research and Monitoring)
Phone: (02) 6207 2126
Fax: (02) 6207 2122

This document should be cited as:

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

ACTION PLAN No. 3

In accordance with section 21 of the *Nature Conservation Act 1980*, the **Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*)** was declared an **endangered** species on 15 April 1996 (formerly Determination No. 29 of 1996 and currently Determination No. 89 of 1997). Section 23 of the Act requires the Conservator of Flora and Fauna to prepare an Action Plan in response to each declaration. This is the Action Plan for the:

Eastern Lined Earless Dragon
Tympanocryptis lineata pinguicolla

Preamble

The *Nature Conservation Act 1980* establishes the ACT Flora and Fauna Committee with responsibilities for assessing the conservation status of the ACT's flora and fauna and the ecological significance of potentially threatening processes. Where the Committee believes that a species or ecological community is threatened with extinction or a process is an ecological threat, it is required to advise the Minister for the Environment, Land and Planning, and recommend that a declaration be made accordingly.

Flora and Fauna Committee assessments are made on nature conservation grounds only and are guided by specified criteria as set out in its publication *"Threatened Species and Communities in the ACT*, July 1995".

In making its assessment of the Eastern Lined Earless Dragon, the Committee concluded that it satisfied the criteria indicated in the adjacent table.

An Action Plan is required in response to each declaration. It must include proposals for the identification, protection and survival of a threatened species or ecological community, or, in the case of a threatening process, proposals to minimise its effect.
While the legal authority of this Action Plan is confined to the Australian Capital Territory, management considerations are addressed in a regional context.

Criteria Satisfied

1.2 Species is observed, estimated, inferred or suspected to be at risk of premature extinction in the ACT region in the near future, as demonstrated by:

1.2.1 Current severe decline in population or distribution from evidence based on :

1.2.1.3 severe decline in quality or quantity of habitat; and

1.2.1.5 severe threats from herbivores, predators, parasites, pathogens or competitors.

1.2.4 Severely fragmented distribution for a species currently occurring over a small range or having a small area of occupancy within its range.

1.2.6 Extremely small population.

Links with other Action Plans

ENVIRONMENT ACT

Unauthorised version prepared by ACT Parliamentary Counsel's Office
Authorised by the ACT Parliamentary Counsel—also accessible at www.legislation.act.gov.au

This Action Plan interrelates with the Action Plan for Natural Temperate Grassland and other component threatened species.

Species Description

The Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla)* (Mitchell 1948) is a member of the family Agamidae, the dragon lizards. Most members of the genus *Tympanocryptis,* including *T. l. pinguicolla,* lack an external ear opening (Greer 1989) and a functional tympanum (ear drum) (Witten 1993).

T. l. pinguicolla is a small lizard with a stout body and short robust limbs (Mitchell 1948) (Figure 1). Total adult body length is between 180 and 210 mm (Smith 1994). These lizards have three longitudinal light stripes on the dorsal surface and the ventral surface is either intricately patterned with dark brown or grey markings or immaculate white or cream. They are diurnal and are cryptic in their grassland habitat. When captured individuals can be identified from distinct grey and dark brown dorsal surface markings (Howe *et al.* in prep., Nelson *et al.* 1996) which usually form thick irregular transverse bars across the body and down the tail. Many individuals exhibit yellow or orange flushing of the throat which sometimes extends to the sides of the head and down the dorsal stripes and flanks (Smith 1994) and differentiation of these markings occurs between sexes and age classes (Langston 1996). Specimens usually have a narrow pale bar on their head between the anterior corners of the eyes (Cogger 1992).

T. l. pinguicolla is distinguished from other members of its species by its greater number of mid body dorsal scales and greater number of scattered dorsal spinous scales which are also higher than their basal width (Mitchell 1948, Smith 1994). Work by Smith (1994) provides strong support for the subspecies being a distinct species within the genus. A paper upgrading *T. l. pinguicolla* to species status (*T. pinguicolla*) is being prepared (Smith *et al*., in prep.) and the common name is likely to be "Grassland Earless Dragon".

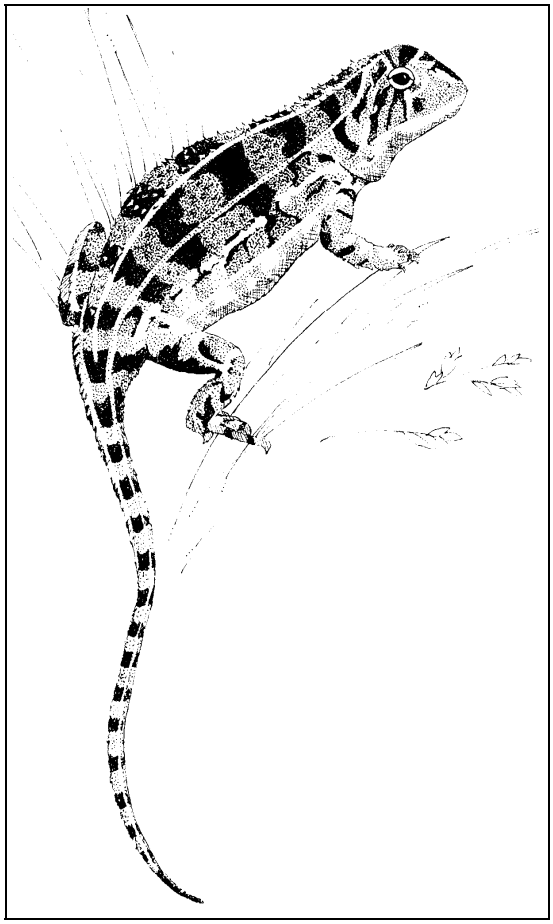

Figure 1: *Tympanocryptis lineata pinguicolla* in natural habitat. Scale: actual adult size.

HABITAT

Until recently little work had been conducted (Robson 1968) on the habitat requirements of *T. l. pinguicolla* as the subspecies had declined in all areas where it occurred in Victoria, its distribution in NSW was poorly known and within the ACT, it was previously known only from North Canberra (Osborne *et al.* 1993*a*). *T. l. pinguicolla* was rediscovered near Canberra in 1991 (Osborne *et al.* 1993*a*) and near Cooma in 1993 (Osborne *et al.* 1993*b*). Capture sites have been documented as well-drained natural temperate grasslands which are relatively undisturbed with minimal pasture improvement (Osborne *et al.* 1993*a*). In the Canberra-Monaro region, *T. l. pinguicolla* appears to be associated with natural temperate grasslands dominated by wallaby grasses (*Danthonia* spp.), spear grasses (*Stipa* spp.) and Kangaroo Grass (*Themeda triandra*) (Osborne *et al.* 1993*a,* Langston

1996). The patchy distribution of *T. l. pinguicolla* within these grassland areas suggests that animals prefer more open sections where vegetation is sparser or shorter with taller tussocks adjacent (Osborne *et al.* 1993*a,* Smith 1994). However, Langston (1996) suggests that the lizard is associated with a patchy habitat and utilises both open and more dense areas. Although some specimens have been hand captured from under rocks (Osborne *et al.* 1993*a*, Osborne *et al.* 1993*b*), shelter provided by rocks does not appear to be an essential component of the habitat in the ACT (Langston 1996).

Nevertheless, sites from where the lizard has been recorded in Victoria in the past are characterised by embedded rocks and a similar vegetation structure to habitat in the Canberra-Monaro region (Beardsell in Brereton and Backhouse 1993).

Although the *T. lineata* group has been recorded in savanna woodlands (Jenkins and Bartell 1980), McCoy (1889) reported that *T. l. pinguicolla* never ascended trees or bushes. It is not known whether this subspecies uses woodland habitat. Similarly its precise microhabitat requirements are not understood and are likely to be more subtle than is indicated by vegetation structure alone (Smith 1994).

BEHAVIOUR AND BIOLOGY

The biology and ecology of *T. l. pinguicolla* is the subject of ongoing research and most of what is known is derived from very recent university research and project work (Smith, 1994 & Langston, 1996) and survey work by the ACT Parks and Conservation Service (ACTP&CS; Fletcher *et al.*, 1995 & Nelson *et al.*, 1996). Field observation is difficult because *T. l. pinguicolla* avoids detection by remaining still and uses its cryptic coloration to blend in with its grassland environment (Smith 1994).

Capture data is characterised by a dominance of young animals and low recaptures of previous-year adults (Smith 1994, Langston 1996, Nelson *et al.* 1996) suggesting a predominantly annual turnover of adults. This turnover suggests that females breed once and gravid females have been recorded in the field from September to January (Langston 1996). However, some females survive to their second year and they may produce a second clutch (Langston 1996). *T. l. pinguicolla* is oviparous (Witten 1993) and the only two known records of egg laying occurred in late November and early December (Langston 1996.). Both records comprised a clutch of five eggs, one in a shallow scrape which was covered with soil and small stones to disguise its presence, and the other was unintentionally disturbed with the eggs successfully incubated in the laboratory. Field incubation time has been recorded at 11 weeks and two days (Langston 1996).

Hatching occurs from January to March and hatchlings show rapid growth (mean 0.3 mm/day) approaching adult size by the end of March (Smith 1994). Adult growth rates are much slower with a mean of 0.08 mm/day (Langston 1996).

Fat storage in the neck, body and tail is thought to be an adaptation to a cooler climate (Mitchell 1948). Animals in the *T. lineata* group have been found during winter in a torpid state under rocks (Jenkins and Bartell 1980) and in arthropod burrows (Langston 1996). The use of arthropod burrows by *T. l. pinguicolla* at other times of the year is well-established (McCoy 1889, Young 1992, Osborne *et al*. 1993*a,* Langston 1996).

Although the size of home ranges of *T. l. pinguicolla* are unknown, individuals are highly mobile. Records of movements of more than 230m between yearly trapping seasons have been made with one record of this magnitude occurring in less than a week (Smith, pers. comm.). Fluoro-dye tracking has shown that daily movements of 40m are common (Langston 1996).

Occasionally during handling animals have been observed to vocalise using a soft hiss. This is thought to be a threat response (Smith 1994, Nelson pers. obs.). Animals display aggressive behaviour if placed together in captivity and there seems to be a dominance hierarchy based on the size of individuals (Smith 1994).

T. l. pinguicolla feeds on a variety of insects, banana and apple in captivity (Robson 1968, Smith 1994). In the field animals have been observed consuming spiders and insects, however precise field dietary requirements are yet to be determined.

Species Distribution

FORMER DISTRIBUTION

In 1938 Pryor described the species as more common than the Brown Snake (*Pseudonaja textilis*) in the ACT, and animals were captured adjacent to Northbourne Avenue in the 1950's (Young 1992).

NSW records show that the taxon occurred near Cooma in the Southern Tablelands (Mitchell 1948) and at Bathurst (Osborne *et al.* 1993*a*).

Most former records of *T. l. pinguicolla* in Victoria are from the basalt plains in the south of the state (Brereton and Backhouse 1993). The taxon was not uncommon at Essendon and the plains near Sunbury to the north of Melbourne late last century (McCoy 1889). There are also records from Maryborough and Rutherglen in central Victoria (Lucas and Frost 1894).

PRESENT KNOWN DISTRIBUTION

In the ACT region, *T. l. pinguicolla* is found only in a small number of sites with suitable native grassland habitat located in the Majura and Jerrabomberra valleys and one adjacent location near Queanbeyan in NSW (Figure 2). The lizards have also been recorded at several sites near Cooma (Osborne *et al.* 1993b, Biosis Research Pty Ltd 1995). *T. l. pinguicolla* has shown a dramatic decrease in both its local and geographical range. Surveys to determine the presence and absence of the subspecies at selected sites in the ACT commenced as recently as 1992 (Osborne *et al. 1993a,* Fletcher *et al.* 1995, Rauhala 1996, Langston 1996 & Nelson *et al.* 1996). Additional survey work is required in the ACT to establish whether the lizard occurs in potential habitat at other locations and also to determine the extent and relative densities of populations at each location. Langston (1996) also surveyed for this subspecies in the Gundaroo, Bungendore and Hoskingtown areas. No NSW specimens were recorded in this survey.

This reduction in range makes the known populations in NSW and the ACT particularly important as the taxon is known to survive in only three broad locations throughout its geographical range: Majura Valley, Jerrabomberra Valley and near Cooma. More survey work is required urgently to locate any other extant populations in the region and to determine the extent and relative abundance of each.

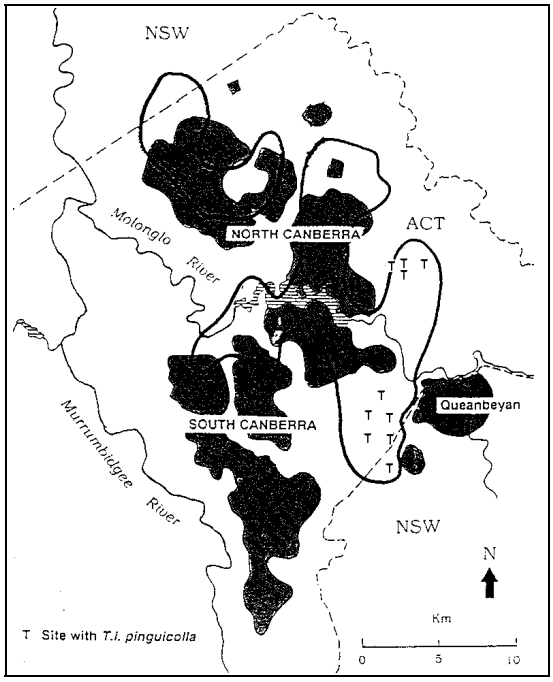

Figure 2: Present known distribution (Â) of *Tympanocryptis lineata pinguicolla* in the ACT and adjacent region. They are all within the former extent of the natural temperate grassland, which is outlined.

Conservation Status

T. l. pinguicolla is recognised as a threatened subspecies in the following sources:

International

Vulnerable. - IUCN (1994).

National

No formal listing under the *Endangered Species Protection Act 1992* (C'th) although a nomination for Endangered is expected to be considered by the Scientific Sub Committee in the near future.

The Action Plan for Australian Reptiles (Cogger *et al.* 1993) recognises *T. l. pinguicolla* as Vulnerable.

Australian Capital Territory

Endangered. - Section 21 of the *Nature Conservation Act 1980,* Determination No. 89 of 1997 (formerly Determination No. 29 of 1996).

Special Protection Status Species - Schedule 6 of the *Nature Conservation Act 1980,* Determination No. 77 of 1996.

New South Wales

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

Victoria

Endangered. - Flora and Fauna Guarantee Act 1988.

The species is also the subject of Action Statement No. 35, prepared by the Victorian Department of Conservation and Environment.

Threats

Generally speaking, the main threats to the continued survival of *T. l. pinguicolla* have been loss and fragmentation of suitable habitat, changed fire regimes, weed invasion and the impact of predators, domestic and feral animals.
In making its expert assessment of the taxon, the ACT Flora and Fauna Committee recognised that:

- there has been a serious decline in the quality and quantity of habitat of this species throughout its range including the ACT and known populations are now fragmented in distribution; and
- the grassland habitat of this species has been, and continues to be, exploited for agricultural use, along with urban and industrial development. The remaining areas are vulnerable to further fragmentation associated with urban infrastructure and transport, and there is little likelihood of the creation of any ecological links between remaining disjunct areas.

Whilst the potential impact of introduced predators including foxes and domestic cats has not been assessed, it should not be overlooked, especially in relation to urban expansion.

Major Conservation Objective

The major conservation objective of this Action Plan is to protect in perpetuity several viable populations of *T. l. pinguicolla in situ* in secure native grassland habitat across the species' geographical range in the ACT and maintain its evolutionary development in the wild.

This objective is to be achieved by:

- improving understanding of the biology and ecology of the species as the basis for managing the species and its habitat in reserves, other managed complementary areas and other sites where it persists; and
- formally protecting a cluster of sites known to support viable populations of the species in each geographical area in the ACT (noting that:

  - at present there is insufficient known about what constitutes a viable population of *T. l. pinguicolla;* and

  - half of the known areas where *T. l. pinguicolla* occur are on National Land, under Commonwealth control. The long term status and management of such areas is being addressed in the National Recovery Plan, which is being drafted by the National Recovery Team in anticipation of *T. l. pinguicolla* being recognised as a

separate species and listed as nationally endangered).

Conservation Issues and Intended Management Actions

Effective treatment for an endangered species requires accurate diagnosis on whatever is limiting the population/s (Caughley and Gunn 1995).

Prior to 1993, negligible work had been conducted on the taxon. Intensive studies over the last two years by university students and the ACTP&CS has focused on identifying habitat characteristics and use (Osborne *et al.* 1993*a,* Langston 1996), clarifying its taxonomy (Smith 1994), improving survey efficiency (Fletcher *et al.* in prep., Nelson *et al.* 1996) and population dynamics (Langston 1996).

- More research is required to improve understanding of the biology, ecology, physiology and precise micro-habitat requirements of the lizard so that informed management decisions can be made.
- An adaptive management approach will be adopted to accommodate the conservation requirements of the taxon as they are clarified through new research.

The threatened status of natural temperate grassland communities and many grassland species presents the opportunity to identify areas for conservation and implement management strategies which will serve more than one conservation objective.

- The protection of endangered natural temperate grasslands and other threatened species within this community will allow for significant and complementary conservation actions.
- Where there is possible conflict in conservation objectives with other endangered species, for example, the Golden Sun Moth (*Synemon plana)* (notably at the "Woden" sites), the differing requirements will be resolved in the context of documented management arrangements for each location, based on scientific principles.

The limited known habitat available for the species (Langston 1996) highlights the need for protection of existing habitat and prevention of further fragmentation of areas where *T. l. pinguicolla* is known to occur.

- Protection *in situ* is by far the preferred option and opportunities to conserve the subspecies in its native grassland habitat will be advocated by Environment ACT.
- Salvage, involving the removal of animals from the wild, will be considered only as an absolute last resort, and exclusively in cases where the site is considered non-viable and an approved research project with identified facilities and other appropriate research resources are available.

SURVEY

The distribution of *T. l. pinguicolla* in the ACT and NSW is poorly known and potential habitat areas remain to be evaluated in both jurisdictions. The following actions are designed to address this problem:

- Continued survey effort to ensure all extant populations are identified, their area of occupancy determined and this habitat quarantined from development until appropriate clusters of viable populations are identified, and their habitat secured and managed for conservation objectives. Similar action by NSW and Commonwealth authorities will be encouraged.
- The survey program will be structured to allow surveys to be undertaken first in areas where the subspecies is thought to occur, then in adjacent areas and next in areas where the subspecies may occur.
- Evaluation of the potential use of an optic fibre scope to examine arthropod burrows during autumn, winter and spring as an alternative survey method for the lizards.

Catch rates from survey work conducted during the last few years has been variable (Environment ACT (Wildlife Research and Monitoring {WR&M}) records, Langston, 1996). Unseasonal weather, refinement of survey techniques, and a survey focus on presence/absence have contributed to this variation. Therefore, a confident

assessment of where the most extensive and abundant populations occur will require further work.

MONITORING

Monitoring the impact of changes in management practices including grazing, weed control, mowing and fire will be an important component of the adaptive management strategy required for this subspecies.

- A monitoring program across *T. l. pinguicolla*'s geographical range in the ACT will be developed and implemented, and records will be maintained on the electronic data base system maintained by Environment ACT (WR&M) for analysis of trends.
- The Vertebrate Atlas of the ACT will be maintained and checked to monitor new records of the taxon.

RESEARCH

Cooperative work undertaken by government agencies, universities and other research institutions is an important way of increasing our knowledge of the conservation biology of the species. However, it will be essential to coordinate research activities, particularly in the field, to ensure minimal impact on a population.

A list of topics requiring further research in the order of priorities for undertaking this work follows. In noting this list, it should be recognised that implementation of priority work will be dependent on available resources, the opportunities for coordination with other research being conducted on the subspecies, and the appropriateness for university research and student project work.

1. *Radio-tracking to determine movement patterns will provide information on:*

- movement and temporal use within the microhabitat,
- area of home range,
- interaction between individuals,
- seasonality of habitat use based on sex and age,
- refuge areas including nocturnal retreats, over-wintering sites and the implications for management,
- dispersal, and
- spatial requirements of individuals.

2. *Identification of precise habitat requirements will require work to assess:*

- presence or absence in woodland,
- sensitivity to weeds within habitat,
- the impact of mowing including preferred height of mown vegetation, pattern, season and frequency,
- impact of different grazing regimes including species grazed (kangaroos, sheep, cattle, goats, rabbits) and effects of season and density of grazers,
- sensitivity of habitat to trampling or other potential damage by multiple use, and
- oviposition site requirements.

3. *Fire management studies will assist in determining:*

- susceptibility to fires and seasonality effects,
- optimum fire regimes,
- characteristics and use of fire refugia, and
- the value and use of fire breaks.

4. *Long term population studies are necessary to determine:*

- seasonal impacts on population structure,
- reproductive rates,
- survivorship, and
- minimum viable population size.

5. *Dietary and energetics work is required to ascertain:*

- preferred foods and their availability,
- dietary differences between age classes, and
- seasonal energy requirements.

6. *The relative impacts of predation undertaken through experimentation involving:*

- native raptors, and
- introduced predators such as foxes and cats.

7. *Further understanding of the subspecies provided through behavioural studies on:*

- territoriality,
- dominance, and
- reproduction.

From a management perspective, one of the most pressing research issues is to identify habitat parameters which can be manipulated for the benefit of *T. l. pinguicolla.* This will include the identification of the preferred mowing, grazing and/or fire regimes for the lizard and in doing so identify the potential for appropriate conservation grazing, mowing and burning protocols.

EDUCATION AND LIAISON

As with any endangered species, the importance of information transfer to the community and people responsible for managing their habitat is critical. Environment ACT will:

- compile and distribute management guidelines and maintain contact with land managers responsible for areas on which populations presently occur, and
- prepare and distribute to appropriate target audiences (eg. school children, tourists, building personnel) information about *T. l. pinguicolla* and its conservation; and
- consider the use of salvaged animals as a basis for community education and captive display programs, in addition to their use for research.

Protection

At present no known population of *T. l. pinguicolla* occurs on reserved land in any part of its range. In the ACT, apart from the Majura Field Firing Range, Canberra Airport and the proposed AMTECH technology estate, the areas where the lizard presently occurs are grazed under rural lease or agistment arrangements. All but one of the ACT sites (HMAS Harman) are the subject of development proposals including an airport taxiway extension, the Very High Speed Train route, a major road, a new technology park and urban development.

The known extant populations occur on land under a variety of tenures including rural leasehold Territory Land, Commonwealth owned and managed land (National Land), and unleased Territory Land. These sites are separated from one another by unsuitable habitat, roads and urban development. In late February 1997, the Majura Field Firing Range site was subjected to an extensive fire, which was believed to have been started by an arsonist. The impact of this event on the *T. l. pinguicolla* population at the Range will not be known for some time.

Conservation effort in the ACT for this species will be focussed on protecting viable populations in functional native grassland habitat within two clusters of sites across its geographical range. One cluster occurs within the Majura Valley and the other in the Jerrabomberra Valley.

In the Majura and Jerrabomberra valleys, there are opportunities to achieve protection of this species coincidentally with that of grasslands and other threatened species including the vulnerable Striped Legless Lizard (*Delma impar*). In the case of the Field Firing Range in the Majura Valley, protection measures may also serve to protect a sizeable population of the endangered Button Wrinklewort*, Rutidosis leptorrhynchoides*.
The majority of possible *T. l. pinguicolla* sites in the Majura and Jerrabomberra valleys have not been fully assessed to determine their conservation significance and value. Therefore, in the meantime, the precautionary principle will be applied to these areas and they will be excluded from any development until their significance can be determined.

- Environment ACT (WR&M) will assess the conservation significance of these sites as soon as practicable.

For land under the Territory's control, an appropriate arrangement of protected areas will be established within the two clusters of sites currently supporting *T. l. pinguicolla*, before development of other sites is permitted.

IDENTIFYING PROTECTION MEASURES

Protection of *T. l. pinguicolla* in natural temperate grassland habitat will be achieved primarily through the provisions of the *Land (Planning and Environment) Act 1991* and Memoranda of Understanding (MOUs) with the Commonwealth. The mechanisms available to the Territory are reservation under the Territory Plan and Property Management Agreements (PMAs). The Conservator of Flora and Fauna also has powers under the Nature Conservation Act to protect threatened flora and fauna.

(i) Reservation

Reservation provides the primary mechanism for ensuring that sites of high conservation value are not eventually converted to a land use incompatible with their natural values (Caughley and Gunn 1996). Reservation is therefore an important mechanism for the protection of *T. l. pinguicolla* and its habitat. Reservation does not exclude the option of management controlled grazing to achieve conservation objectives through agistment arrangements with rural lessees.

- Wherever possible reserved areas will be selected, developed and managed to minimise perimeter to area ratio.
- Reservation is to be considered as part of further evaluation of planning and conservation issues.

(ii) Memoranda of Understanding

Memoranda of Understanding (MOU's) provide another means of ensuring that sites with high conservation value will be managed to maintain their conservation value in perpetuity while enabling other compatible land uses, as identified in each MOU, to occur. An MOU with the Commonwealth does not preclude the possibility of the land being reserved in the future under Commonwealth legislation.

MOU's are appropriate for Commonwealth-owned or -occupied land, or other land where long-term land uses will not compromise the conservation values (for example, land used for Defence purposes or communication facilities).

(iii) Property Management Agreements (PMAs)

Land located outside the existing urban area can be appropriately managed through PMAs applying to rural leases. PMA's are required when leases are renewed. This can be an interim measure to allow protection whilst further work is conducted on the species at a site to determine the conservation significance of the site for the lizard's survival, reproduction, dispersal and relationship, or potential relationship, with other areas known to support the subspecies. On the basis of this work, areas managed through PMAs may be identified for a different level of protection, eg. elevated to reserve status.

(iv) Conservator's Powers

Section 47 of the *Nature Conservation Act 1980* provides for the Conservator of Flora and Fauna to give directions to lessees for protection of native plants and animals. This provision can be used for areas where threatened species or communities occur and urgent action is needed to ensure their conservation. Given that significant populations occur on rural leases, this provision would serve as a valuable interim measure pending the implementation of PMA's.

Areas considered to be of critical significance for the survival of the subspecies in the ACT, where conservation values should not be compromised, are at Majura Valley East (GAP No. 28)* and Jerrabomberra West ("Woden" property - GAP No. 36)*.

* For reference to GAP Nos, refer to the Table under "Reservation" below.

RECOMMENDED PROTECTION FOR KNOWN SITES

On the basis of known information on relative catch rates, habitat quality and evidence of recruitment, the following sites are considered to have significant

conservation value and are recommended for protection.

(i) Reservation

The table below sets out the areas that are proposed for reserve status:

Location & site	GAP No.	Area (Ha)	Current status
Jerrabomberra Valley:			
"Woden" property(west).	36	126	Rural lease
"Woden" property(east) incl. Mike's Hill.	37	93	Rural lease

Note: GAP No. = Grassland Action Plan Number. This number is used as a site reference in the Natural Temperate Grassland Action Plan. Its use in Action Plans for component species, such as *T. l. pinguicolla* indicates that the habitat of the species in question more or less coincides with the natural temperate grassland site referred to.

Until the lease expires for the rural leases included in the above Table, an interim option is to maintain the current leasing arrangements with appropriate conservation management directions from the Conservator of Flora and Fauna.

(ii) Memoranda of Understanding

The table below sets out the areas that are proposed for a Memorandum of Understanding to achieve protection equivalent to reservation.

Location & site	GAP No.	Area (Ha)	Current status
Majura Valley:			
Majura Field Firing Range and navigational beacon enclosure	28	167	National Land
Canberra Airport	28	25	National Land

(iii) Property Management Agreements (PMAs)

The table below sets out the areas that are proposed for a PMA to achieve an interim protection measure until further work is conducted on the site to determine the conservation significance for the subspecies.

Location & site	GAP No.	Area (Ha)	Current status
Jerrabomberra Valley:			
"Callum Brae"	36	151	Rural Lease

Note: PMAs may be required as the interim protection measure for rural leases in the Jerrabomberra Valley.

SITES WHERE FURTHER ASSESSMENT IS REQUIRED

Further study is required before it is possible to fully assess the conservation significance of the Eastern Lined Earless Dragon populations at these sites. The potential role of the site in facilitating the continued survival and evolution of the subspecies will be evaluated in terms of the results of future surveys, implementation of other protection measures elsewhere, and research requirements.

The table below sets out the areas with sites where further assessment is required:

Location & site	GAP No.	App. Area (Ha)	Current status
Majura Valley:			
East of Campbell Park Offices	27	44-192	National Land
Jerrabomberra Valley:			
HMAS Harman and "Bonshaw"	37	160-777	National Land
AMTECH	35	16	Unleased Territory Land

Only those sites on Territory Land are able to be reserved in the future by the ACT. In the meantime the Conservator of Flora and Fauna will negotiate for current management practices to be maintained on such land.

OTHER ACTIONS FOR PROTECTION

Additional actions that will be implemented to protect known sites where *T. l. pinguicolla* occurs are outlined below:

- Further fragmentation of sites will be avoided. Planning mechanisms will be used to maintain habitat linkages where they currently exist.
- Complementary protection through reservation in NSW will be promoted in any forums involving NSW authorities.
- Any conservation area established primarily for this subspecies will be managed to maintain the grassland community as a functional unit of which *T. l. pinguicolla* is a component.
- Site management agreements may be appropriate at any sites on Territory Land where reservation is not warranted but the primary land use at the site can continue while accommodating the conservation values at the site.
- Landholders will be advised to maintain dominant management practices used over the last ten years in areas of land known to support the species until each situation is evaluated and, where appropriate, alternative techniques identified.
- Any changes to management practices will require appropriate monitoring before and after implementation to enable appropriate evaluation and documentation of the subspecies' response.
- When compatible land use activities are identified and incorporated into areas where the lizard survives, a monitoring program will be implemented to assess the need to modify management practices further.
- Options for managing animals in other areas not identified for protection will be evaluated. Such options could include: removal of animals for research and education, destruction without salvage, and planning for the integration of these sites into open space within future urban areas. However, without specific management for the subspecies, these populations may not persist.
- Natural Temperate Grassland, which provides habitat for *T. l. pinguicolla* in many areas, has been declared an endangered community and as such requires the preparation of an Action Plan for its conservation.

Environment ACT will work with the Planning and Land Management group of the Department of Urban Services to ensure that land uses in areas adjacent to sites supporting *T. l. pinguicolla* are compatible with conservation objectives and to minimise any adverse impacts.

Socio-economic Issues

The main social benefits of conserving representative sites of natural temperate grassland community in which *T. l. pinguicolla* occurs are:

- meeting community concerns that further loss or extinction of significant ecological communities, together with their component native species, be prevented;
- the amenity and recreation associated with the grasslands reserves, in which the species occurs; and
- the tourism potential of a successful program to protect a threatened species along with its endangered habitat.

The potential for economic utilisation of native grassland habitat sites is relevant for those sites where current management or land uses are deemed to be compatible with the retention of conservation values.

On the basis of current information, there are four main aspects of planning in Canberra that will be affected by the implementation of this Action Plan. These are:

1. Future Urban Areas

Proposals for future urban areas, as identified in either the National Capital Plan or the Territory Plan, and provided for in the Residential Land Release Program - may for some areas have their viability affected by the size and location of possible future reserves.

2. Transport Facilities

The provision and/or upgrading of the following transport facilities may be affected:

- Majura Parkway - southern section and connections
- Very High Speed Train (VHST) corridor (Majura and Jerrabomberra valleys).

In the case of the VHST proposal, Environment ACT is actively involved in the evaluation of planning options.

3. Industrial Areas

The planning for future industrial areas, in particular, proposals for Hume and Symonston in the Jerrabomberra Valley and a possible industrial complex associated with the Airport in the Majura Valley.

4. Rural Leasing Aspects

Some of the core sites of high conservation value, including those in the Jerrabomberra Valley, are within rural leases. Preliminary investigations indicate that these leases currently contain withdrawal clauses allowing for the use of land for public purposes. The Rural Policy Taskforce has recently reviewed all aspects of rural leases including the recommendation of appropriate lease terms. Two recommendations of the Taskforce that will affect the Action Plans are that:

- the lease term for the Jerrabomberra Valley be to the year 2020; and
- there be no withdrawal clauses over any part of a rural lease unless it has been clearly defined for an imminent public work, such as a road, stormwater or other infrastructure.

This will mean that the Territory would have to withdraw any area of land having conservation significance at the time of an application for a new lease, or acquire it subsequently under the provisions of the *Land Acquisition Act 1994*.

It is expected that it will be early in 1998 before rural lessees are able to take up a new lease as proposed by the Taskforce. In the meantime, Environment ACT will need to identify areas requiring special conservation measures before applications for extended lease terms are received. In the event that large areas of a lease are to be withdrawn for conservation purposes, consideration must be given to the viability of the remainder of the lease. Grazing may be undertaken where it is considered that it will be consistent with the maintenance of the natural temperate grassland conservation values.

Legislative Provisions

AUSTRALIAN CAPITAL TERRITORY

The following legislation is relevant to conservation of flora and fauna in the ACT:

Nature Conservation Act 1980

The Nature Conservation Act protects native plants and animals. Activities affecting native plants and animals require a licence which may specify conditions to apply to the activity.

- A person may not kill, take, keep, sell, import, export or interfere with the “nest” of a native animal without a licence.

Native plants and animals may be declared as *protected* or *having special protection status* in recognition of a particular conservation concern that warrants additional protection. Increased controls apply to declared species and licensing constraints are specified.

Licence Conditions (SPS)

The endangered status of the Eastern Lined Earless Dragon requires its listing as a Special Protection Status (SPS) species. This is the highest level of statutory protection and is conferred on species which are either threatened with extinction or are a migratory animal subject to an international agreement for their protection. Conservation requirements are a paramount consideration and only activities related to conservation of the species or serving a special purpose are permissible.

The Conservator of Flora and Fauna may only grant a licence for activities affecting a species with SPS where satisfied that the act specified in the licence:

- is required to be done for scientific, educational, propagative or other similar purposes;
- is required to be done for the purpose of protecting persons or property and will be conducted in a way that will, so far as is practicable, keep to a minimum any impact on the species concerned;
- is merely incidental to other acts, and will not appreciably reduce the chances of survival or recovery in the wild of the species concerned; or
- is of particular significance to Aboriginal tradition and will not appreciably reduce the chances of survival or recovery in the wild of the species concerned.

Other Relevant Provisions

The Nature Conservation Act provides authority for the Conservator of Flora and Fauna to manage Public Land reserved for conservation of the natural environment. Activities that are inconsistent with management objectives for nature conservation are controlled. Special measures for conservation of a species or community of concern can be introduced in a reserved area, including restriction of access to important habitat.

Section 47 of the Act allows the Conservator to give the occupier of land directions for protection or conservation of native plants and animals. This provision is relevant to the management of threats to the conservation requirements of a species or community of concern that occurs on leased land.

Land (Planning and Environment) Act 1991

The Land (Planning and Environment) Act is the primary authority for land planning and administration. It establishes the Territory Plan and several of its provisions are relevant to the protection of flora and fauna.

- **Public Land** is reserved via the Territory Plan. Land reserved as wilderness area, national park or nature reserve has conservation of the natural environment as a paramount management objective. The Conservator of Flora and Fauna must prepare a **plan of management** setting out how management objectives are to be implemented or promoted. When grasslands containing *T. l. pinguicolla* habitat are declared Public Land, the management plans for these areas should contain management prescriptions specifically for the subspecies.
- **Places of natural heritage significance**, including important habitat for native species, may be entered in the Heritage Places Register, with conservation requirements specified.
- **Environmental Assessments and Inquiries** may be initiated as part of the approvals process for defined land use and development decisions or activities prescribed as controlled. Assessments are required to address potential environmental impact, including threats to a species of flora and fauna, an ecological community or an area.

NEW SOUTH WALES

Threatened Species Conservation Act 1995

The Act came into effect on 1 January 1996 and requires the preparation of recovery plans for endangered species (other than those presumed extinct), endangered populations, endangered ecological communities and vulnerable species. Threat abatement plans are required to manage key threatening processes with a view to their abatement, amelioration or elimination. A Species Impact Statement is required when a development application is made on land which contains areas declared to be critical habitat under Part 3 of the Act or which is likely to significantly effect threatened species, populations or ecological communities or their habitats.

The preparation of a Recovery Plan for *T. l. pinguicolla* is mandatory as the subspecies has been listed as Endangered.

COMMONWEALTH

At present no specific Commonwealth legislative protection exists for *T. l. pinguicolla.*

Formal listing of the subspecies as Endangered is expected in the near future by the Australian and New Zealand Environment and Conservation Council (ANZECC). Once listed by ANZECC its status will be considered by the Endangered Species Advisory Committee for recommendation as Endangered under the *Endangered Species Protection Act 1992* (Cmth). The preparation of a National Recovery Plan is progressing in anticipation of a national listing.

Consultation and Community Participation

Environment ACT (WR&M) is an active member of the *Tympanocryptis* Regional Working Group (TRWG), which includes representatives from the NSW National Parks and Wildlife Service, University of Canberra, ACT Herpetological Association, Friends of Grasslands, and the Australian National University. This group meets regularly to discuss a coordinated approach to survey, research and the regional conservation of the species. Regular liaison occurs between the TRWG, researchers in the ACT and Victoria and land managers. A National Recovery Team for *T. l. pinguicolla* has been established with the Chair being provided by the TRWG.

Representatives from Environment ACT (WR&M) also maintain regular contact with the managers of the Majura Field Firing Range, the Federal Airports Corporation, Air Services Australia, rural lessees, and officers from Environment ACT (Conservation and Land Management and the ACT Parks and Conservation Service), and Planning and Land Management in the Department of Urban Services to raise awareness of issues associated with *T. l. pinguicolla.*

Community groups including the ACT Herpetological Association, Friends of Grasslands and appropriate Park Care Groups will be encouraged to assist in the conservation of native grasslands and their component species including *T. l. pinguicolla.* General community awareness of grassland conservation issues, including those associated with endangered species, is raised during ranger guided activities conducted by Environment ACT (ACT Parks and Conservation Service).

Implementation and Review

RESPONSIBILITY FOR IMPLEMENTATION

Environment ACT (WR&M, the ACT Parks and Conservation Service and Conservation and Land Management) will have responsibility for coordinating implementation of this Action Plan. Specific actions on Territory Land will be subject to the availability of Government resources. Primary responsibility for conservation and management of the subspecies on Territory Land will rest with Environment ACT whilst relevant Commonwealth agencies will have responsibility on National Land, however, provisions in the *Nature Conservation Act 1980* (ACT) are still applicable.

EVALUATION

Implementation of this Action Plan will be a collaborative exercise between government agencies, landholders and the community generally. Commonwealth and NSW participation will be critical in some cases. The Action Plan will be reviewed after three years. The review will comprise an assesssment of progress using the following performance indicators:

- completion of commitments that can reasonably be expected to be finalised within the review timeframe (e.g. introduction of a statutory protection measure for a species; development of a management plan);
- completion of a stage in a process with a time line that exceeds the review period (e.g. design or commencement of a research program);
- commencement of a particular commitment that is of a continuing nature (e.g. design or commencement of a monitoring program for population abundance); and
- expert assessment of achievement of conservation objectives of the Action Plan.

The review will be reported to the ACT Flora and Fauna Committee. This will provide Environment ACT and the Flora and Fauna Committee an opportunity to assess progress, take account of developments in nature conservation knowledge, policy and administration and review directions and priorities for future conservation action.

The following conservation actions will be given priority attention:

- completion of surveys in all native grassland areas where the subspecies could occur;
- establishment of a monitoring program to allow for assessment of the relative importance of each site;
- commencement of the research program, especially on priority research topics; and
- putting protection measures in place.

This plan will be reviewed also in the context of a National Recovery Plan for the species when it is developed.

Acknowledgments

A considerable amount of unpublished material has been used in the preparation of this document and Don Fletcher, Art Langston, Peter Robertson, Sarah Sharp, and Warwick Smith are thanked for their input. Members of the TRWG and Peter Robertson provided useful comments on an earlier version of this draft Plan.

The illustration of the species (Figure 1) was prepared for Environment ACT by Liz Faul.

References

Biosis Research Pty Ltd, 1995. *Eastern gas pipeline project: Flora, fauna & ecology studies.* Background Paper No 5. Consultant report for BHP Petroleum and Westcoast Energy.

Caughley, G. & Gunn, A., 1996. *Conservation biology in theory and practice*. Blackwell Science, Carlton.

Cogger, H.G., Cameron, E.E., Sadlier, R.A. & Eggler, P., 1993. *The action plan for Australian reptiles*. Australian Nature Conservation Agency, Canberra.

Cogger, H.G., 1992. *Reptiles and amphibians of Australia.* Reed Books, Chatswood.

Department of Conservation and Natural Resources (Vic), 1993. *Action Statement No. 35: Southern Lined Earless Dragon* (Tympanocryptis lineata pinguicolla). Department of Conservation and Natural Resources, Melbourne.

Fletcher, D.B., Smith, W.J.S., Corrigan, T., & Rehwinkel, R. (in prep.). *Comparison of trap designs for studying the Eastern Lined Earless Dragon* (Tympanocryptis lineata pinguicolla).

Fletcher, D., Corrigan, T., Shorthouse, D., Smith, W., Sharp, S., & Dunford, M., 1995. *Survey of part Block 4 Section 102, Symonston for the presence of Lined Earless Dragons and Striped Legless Lizards*. Internal Report 95/1. ACT Parks and Conservation Service, Canberra.

Greer, A.E., 1989. *The biology and evolution of Australian lizards.* Surrey Beatty & Sons, Chipping Norton.

Howe, A., Smith, W.J.S., & Fletcher, D.B. (in prep.). *Identifying individual Eastern Lined Earless Dragons* (Tympanocryptis lineata pinguicolla) *(Agamidae) by dorsal colour patterns*.

IUCN, 1993. *1994 IUCN Red List of Threatened Animals*. IUCN - The World Conservation Union, Gland.

Jenkins, R. & Bartell, R., 1980. *Reptiles of the Australian high country*. Inkata Press, Melbourne.

Langston, A.C., 1996. *The ecology and distribution of* Tympanocryptis lineata pinguicolla *(Southern Lined Earless Dragon) in the Australian Capital Territory and adjacent sub-region*. BAppSc (Hons) thesis, Faculty of Applied Science, University of Canberra.

Lucas, A.H.S. & Frost, C., 1894. The lizards indigenous to Victoria. *Proc. Roy. Soc. Vic.* 6: 24-92.

McCoy, F., 1889. *Prodromus of the zoology of Victoria: Figures and descriptions of the living species of all classes of the Victorian indigenous animals.* In Natural History of Victoria. Volume II, Decade XI to XX. Government Printer, Melbourne.

Mitchell, F.J., 1948. A revision of the lacertilian genus *Tympanocryptis. Rec. South Aust. Mus.* 9: 57-86.

Nelson, L.S., Smith, W.J.S. & Goldie, R., 1996. *1996 survey program for the Eastern Lined Earless Dragon,* (Tympanocryptis lineata pinguicolla). Internal Report 96/2. ACT Parks and Conservation Service, Canberra.

Osborne, W.S., Kukolic, K., Davis, M.S. & Blackburn, R., 1993a. Recent records of the Earless Dragon (*Tympanocryptis lineata pinguicolla)* in the Canberra region and a description of its habitat. *Herpetofauna* 23(1): 16-25.

Osborne, W.S., Kukolic, K. & Williams, K.D., 1993b. Conservation of reptiles in lowland native grasslands in the Southern Tablelands of New South Wales and the Australian Capital Territory. In Lunney, D. & Ayers, D., (eds) *Herpetology in Australia: A diverse discipline,* pp. 151-158. Transactions of the Royal Zoological Society of New South Wales.

Pryor, L.D., 1938. The botany, forestry and zoology of the Australian Capital Territory on an ecological basis. In Burns, K., (ed.) *Handbook for Canberra,* pp. 1-31. ANZAAS Meeting, Canberra January 1939. Commonwealth Government Printer, Canberra.

Rauhala, M.A., 1996. *1995 survey and monitoring program for the Striped Legless Lizard* (Delma impar). Internal Report 96/1. ACT Parks and Conservation Service, Canberra.

Rehwinkel, R., 1997. *Grassy ecosystems of the South Eastern Highlands*. Technical report - Stage 1: Joint regional biodiversity survey of grassy ecosystems of the South Eastern Highlands project. Report to ACT Parks and Conservation Service, ACT Planning Authority, Housing Industry Association, National Capital Authority, NSW National Parks & Wildlife Service, Queanbeyan City Council, Yarrowlumla Shire Council and Yass Shire Council.

Robson, P., 1968. A rare agamid. *Wildlife in Australia* 5: 84.

Sharp, S., 1992. *Recovery plan: Lowland native grassland ecosystems in the Australian Capital Territory*. Unpublished report to the Australian National Parks and Wildlife Service, Act Parks and Conservation Service, Canberra.

Smith, W.J.S., 1994. *The ecology and taxonomy of the Southern Lined Earless Dragon* (Tympanocryptis lineata pinguicolla*).* BSc (Hons) thesis, Department of Botany and Zoology, Australian National University.

Smith, W.J.S., Donnellan, S., Osborne, W., & Cooper, P. (in prep.). *Taxonomic revision of two earless dragons* (Tympanocryptis tetraporophora) *and* (T. lineata pinguicolla) *(Agamidae) using allozyme electrophoresis and multivariate morphological techniques*.

Witten, G.J., 1993. *Fauna of Australia*. In Glasby, C.J., Ross, G.J.B. & Beesley, P.L., (eds), 1993. Vol. 2A Amphibia & Reptilia. AGPS, Canberra.

Young, G., 1992. *Herpy days of youth*. ACT Herpetological Association Newsletter, June-July: 4-6.

List of Action Plans - December 1997

In accordance with Section 23 of the *Nature Conservation Act 1980,* the following Action Plans have been prepared by the Conservator of Flora and Fauna:

No. 1: Natural Temperate Grassland - an endangered ecological community.

No. 2: Striped Legless Lizard (*Delma impar*) - a vulnerable species.

No. 3: Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*) - an endangered species.

No. 4: A leek orchid (*Prasophyllum petilum*) - an endangered species.

No. 5: A subalpine herb (*Gentiana baeuerlenii*) - an endangered species.

No. 6: Corroboree Frog (*Pseudophryne corroboree*) - a vulnerable species.

FURTHER INFORMATION

Further information on this Action Plan or other threatened species and ecological communities can be obtained from:

Environment ACT
(Wildlife Research and Monitoring)
Phone: (02) 6207 2126
Fax: (02) 6207 2122

This document should be cited as:

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

ACTION PLAN No. 5

In accordance with section 21 of the *Nature Conservation Act 1980*, the **subalpine herb *(Gentiana baeuerlenii)*** was declared an **endangered** species on 15 April 1996 (formerly Determination No. 29 of 1996 and currently Determination No. 89 of 1997). Section 23 of the Act requires the Conservator of Flora and Fauna to prepare an Action Plan in response to each declaration. This is the Action Plan for:

A subalpine herb
Gentiana baeuerlenii

Preamble

The *Nature Conservation Act 1980* establishes the ACT Flora and Fauna Committee with responsibilities for assessing the conservation status of the ACT's flora and fauna and the ecological significance of potentially threatening processes. Where the Committee believes that a species or ecological community is threatened with extinction or a process is an ecological threat, it is required to advise the Minister for the Environment, Land and Planning, and recommend that a declaration be made accordingly.

Flora and Fauna Committee assessments are made on nature conservation grounds only and are guided by specified criteria as set out in its publication "*Threatened Species and Communities in the ACT*, July 1995".

In making its assessment of this subalpine herb, the Committee concluded that it satisfied the criteria indicated in the adjacent table.

An Action Plan is required in response to each declaration. It must include proposals for the identification, protection and survival of a threatened species or ecological community, or, in the case of a threatening process, proposals to minimise its effect.

While the legal authority of this Action Plan is confined to the Australian Capital Territory, management considerations are addressed in a regional context.

Criteria Satisfied

1.1	The species is known or suspected to occur in the ACT region and is already recognised as endangered in an authoritative international or national listing.
1.2	The species is observed, estimated, inferred or suspected to be at risk of premature extinction in the ACT region in the medium-term future, as demonstrated by: 1.2.6 Extremely small population.

Species Description and Distribution

DESCRIPTION

Gentiana baeuerlenii is a small annual herb, standing 2-4 cm high. The flowers are borne singly at the ends of branching stems. Each is bell shaped, greenish outside and blue-white inside with five petals. The species occurs in the inter-tussock space of moist tussock grassland and sedgeland (*Poa labillardieri* and *Carex gaudichaudii*) associated with ground water, possibly a spring-fed area. The area is probably secondary grassland or a relict grassland opening once surrounded by open woodland. The site is on the lower slopes of a broad valley, above a river and lower valley floor.

ENVIRONMENT ACT

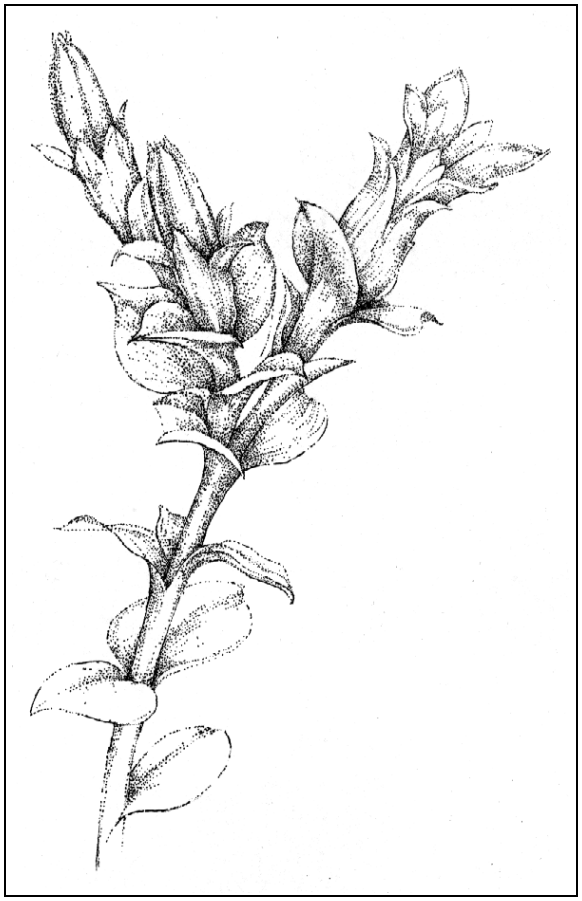

Figure 1: *Gentiana baeuerlenii*. Scale: shown approximately twice actual size.

DISTRIBUTION

The species is currently known only from one location, which was identified during a remarkable chance rediscovery in the Orroral Valley, Namadgi National Park (Figure 2) by Mr Laurie Adams of the Australian National Herbarium. It was believed to be extinct, having previously been described from the Quidong area near Bombala NSW, from specimens found there in 1887.

HABITAT

The orchid, *Spiranthes sinensis*, the herb, *Ranunculus pimpinellifolius* and the grass *Hemarthria uncinata* were found in association with the herb and this group of more widespread species may be indicators for other potential sites.

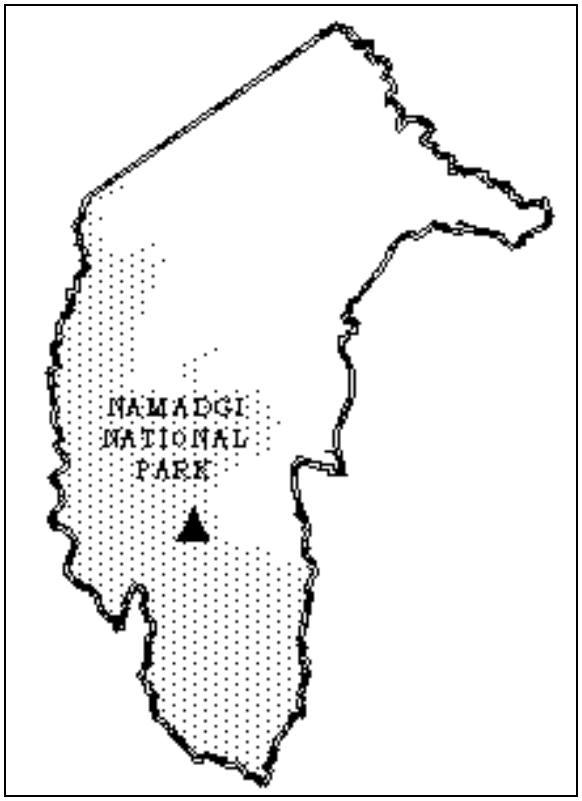

Figure 2: Map showing location (σ) of *G. baeuerlenii* within Namadgi National Park.

Conservation Status

G. baeuerlenii is recognised as a threatened species in the following sources:

National

Endangered. - ANZECC (1993).

Endangered. - Briggs & Leigh (1996).

Endangered. - Part 1, Schedule 1 of the *Endangered Species Protection Act 1992* (Commonwealth).

Australian Capital Territory

Endangered. - Section 21 of the *Nature Conservation Act 1980,* Determination No. 89 of 1997 (formerly Determination No. 29 of 1996).

Special Protection Status Species. - Schedule 6 of the *Nature Conservation Act 1980,* Determination No. 77 of 1996.

New South Wales

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

Threats

It is very likely that the species was once widespread but has become restricted through activities associated with land clearing and grazing, particularly in times of drought as the wet grassy areas in which it is found would have remained palatable well into the driest seasons. Although the species is likely to be unpalatable to stock because it contains certain chemicals known to render plants distasteful, it could have been grazed inadvertently, along with other herbage species. Its habitat may have been trampled, especially when adjoining areas dried out.

There are now only a few plants at the site, less than ten having been counted in 1994. At the time of discovery in 1992, 20 plants were observed.

The main threat to survival of this population and therefore the species is likely to be deliberate or unintended actions associated with park management activites in the local area. It is not clear whether grazing animals such as kangaroos may also pose a threat to survival of remaining plants, or whether such grazing may benefit the species by keeping competing grass tussocks and other plant growth short and open.

Major Conservation Objectives

The objectives of the Action Plan are to:

- preserve the existing ACT population as it is the *only known location* where the species survives;
- manage the habitat so that natural ecological processes continue to operate; and
- develop successful propagation techniques.

Conservation Issues and Intended Management Actions

SURVEY/MONITORING/RESEARCH

It is very unlikely that the species exists anywhere else in the ACT. Given this degree of rarity, surveys aimed at finding specimens beyond the immediate area are not economically justified. Survey opportunities will be found in other work by making field workers aware of the species and alerting interested naturalists and conservation groups. Contact will be maintained with the NSW National Parks & Wildlife Service on this matter.

- Environment ACT (Wildlife Research and Monitoring) will monitor the existing population on an annual basis.

REQUIRED MANAGEMENT ACTIONS

Due to the nature and small size of the site containing the species, management actions will be directed towards maintaining existing conditions and ensuring that activities located nearby do not adversely affect the site. To aid management and monitoring of the species the site has been unobtrusively marked.

- The site will kept open if necessary, by artificially trimming the tussock grass during the non-flowering season.- This will be done by careful use of a “whipper-snipper” and removing cut grass by raking to avoid continuous build up of decaying matter which smothers soil and small plants. Any spread of tea-tree will be monitored and appropriately controlled.
- Herbicides will not be used anywhere in the vicinity of the site, where there is any possibility of it adversely affecting the species.
- Activities, such as track development, which could alter the drainage of the site will not be allowed near the site.
- Feral pig control in the area needs to be maintained.
- Expert advice will be sought on the need and potential for *ex-situ* conservation measures to be taken for this species.
- Consideration will be given to burning adjacent areas of similar habitat subject to assessment of each area.

Protection

The small number of plants known to exist would so far not support adequate seed production but when the number available is greater, depending on the season, propagation must be undertaken. This is the only way to ensure biodiversity conservation as the habitat is fragile, is being grazed by macropods and could accidentally be burnt. Nothing is known of the species’ fire ecology but it appears to be an annual and dependent on seed

regeneration. Further research on this aspect is required.

There will be no track development near the site; thus, visitor access to the area where the species is located is not encouraged.

Socio- economic Issues

There are no foreseen activities or land uses which are likely to conflict with achievement of the conservation objective. Visitor access to the location will be discouraged.

The conservation and management of the subalpine herb is the responsibility of Environment ACT. Specific conservation measures, such as grass management, will be undertaken within funding provided to Environment ACT (ACT Parks and Conservation Service).

Legislative Provisions

The following legislation is relevant to conservation of flora and fauna in the ACT:

Nature Conservation Act 1980

The *Nature Conservation Act* protects native plants and animals. Activities affecting native plants and animals require a licence which may specify conditions to apply to the activity.

- A person may not take a **native plant** or fell **timber** on unleased land without a licence.

Native plants and animals may be declared as *protected* or *having special protection status* in recognition of a particular conservation concern that warrants additional protection. Increased controls apply to declared species and licensing constraints are specified.

Licence Conditions (SPS)

The endangered status of *G. baeuerlenii* requires its listing as a Special Protection Status (SPS) species. This is the highest level of statutory protection and is conferred on species which are either threatened with extinction or are a migratory animal subject to an international agreement for their protection. Conservation requirements are a paramount consideration and only activities related to conservation of the species or serving a special purpose are permissible.

The Conservator of Flora and Fauna may only grant a licence for activities affecting a species with SPS where satisfied that the act specified in the licence:

- is required to be done for scientific, educational, propagative or other similar purposes;
- is required to be done for the purpose of protecting persons or property and will be conducted in a way that will, so far as is practicable, keep to a minimum any impact on the species concerned;
- is merely incidental to other acts, and will not appreciably reduce the chances of survival or recovery in the wild of the species concerned; or
- is of particular significance to Aboriginal tradition and will not appreciably reduce the chances of survival or recovery in the wild of the species concerned.

Other Relevant Provisions

The *Nature Conservation Act* provides authority for the Conservator of Flora and Fauna to manage Public Land reserved for conservation of the natural environment. Activities that are inconsistent with management objectives for nature conservation objectives are controlled. Special measures for conservation of a species or community of concern can be introduced in a reserved area, including restriction of access to important habitat.

Land (Planning and Environment) Act 1991

The Land (Planning and Environment) Act is the primary authority for land planning and administration. It establishes the Territory Plan and several of its provisions are relevant to the protection of flora and fauna.

- **Public Land** is reserved via the Territory Plan. Land reserved as wilderness area, national park or nature reserve has conservation of the natural environment as a paramount management objective. The Conservator of Flora and Fauna must prepare a **plan of management** setting out how management objectives are to be implemented or promoted.
- **Places of natural heritage significance**, including important habitat for native species, may be entered in the Heritage Places Register, with conservation requirements specified.

- **Environmental Assessments and Inquiries** may be initiated as part of the approvals process for defined land use and development decisions or activities prescribed as controlled. Assessments are required to address potential environmental impact, including threats to a species of flora and fauna, an ecological community or an area.

Consultation and Community Participation

As the area is well within Namadgi National Park, there is likely to be little community involvement in the forseeable future.

Implementation, Evaluation and Review

RESPONSIBILITY FOR IMPLEMENTATION

Environment ACT will have responsibility for coordination of the implementation of this Action Plan, subject to the availability of Government resources. In Namadgi National Park, the conservation and management of the species is also the responsibility of Environment ACT.

EVALUATION

Implementation of this Action Plan will be a collaborative exercise between government agencies, landholders and the community generally. The Action Plan will be reviewed after three years. The review will comprise an assesssment of progress using the following performance indicators:

- completion of commitments that can reasonably be expected to be finalised within the review timeframe (e.g. introduction of a statutory protection measure for a species; development of a management plan);
- completion of a stage in a process with a time line that exceeds the review period (e.g. design or commencement of a research program);
- commencement of a particular commitment that is of a continuing nature (e.g. design or commencement of a monitoring program for population abundance); and
- expert assessment of achievement of conservation objectives of the Action Plan.

The review will be reported to the ACT Flora and Fauna Committee. This will provide Environment ACT and the Flora and Fauna Committee an opportunity to assess progress, take account of developments in nature conservation knowledge, policy and administration and review directions and priorities for future conservation action.

The following conservation actions will be given priority attention:

- assessment of *ex-situ* conservation measures; and
- putting protection measures in place.

Acknowledgements

The illustration of the species (Figure 1) was prepared for Environment ACT by John Pratt.

References

Adams, L.G., 1995. *Flora of Australia.* Volume 28, Gentianales. CSIRO Australia, Melbourne.

Adams, L.G. & Williams, J.B., 1988. *Gentiana* sect. *Chondrophyllae* (Gentianaceae) in Australia. *Telopea* 3(2): 167-176.

Further Reading

ANZECC, 1993. *List of Threatened Australian Flora*. Australian and New Zealand Environment and Conservation Council, Canberra.

Briggs, J.D. & Leigh, J.H., 1996. *Rare or threatened Australian plants*. 1995 Revised Edn. CSIRO Publishing, Collingwood.

List of Action Plans - December 1997

In accordance with Section 23 of the *Nature Conservation Act 1980,* the following Action Plans have been prepared by the Conservator of Flora and Fauna:

No. 1: Natural Temperate Grassland - an endangered ecological community.

No. 2: Striped Legless Lizard (*Delma impar*) - a vulnerable species.

No. 3: Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*) - an endangered species.

No. 4: A leek orchid (*Prasophyllum petilum*) - an endangered species.

No. 5: A subalpine herb (*Gentiana baeuerlenii*) - an endangered species.

No. 6: Corroboree Frog (*Pseudophryne corroboree*) - a vulnerable species.

FURTHER INFORMATION

Further information on this Action Plan or other threatened species and ecological communities can be obtained from:

Environment ACT
(Wildlife Research and Monitoring)
Phone: (02) 6207 2126
Fax: (02) 6207 2122

This document should be cited as:

ACT Government, 1997. *A subalpine herb* (Gentiana baeuerlenii): *An endangered species*. Action Plan No. 5. Environment ACT, Canberra.

ACTION PLAN No. 6

In accordance with section 21 of the *Nature Conservation Act 1980*, the **Corroboree Frog (*Pseudophryne corroboree*)*** was declared a **vulnerable** species on 15 April 1996 (formerly Determination No. 29 of 1996 and currently Determination No. 89 of 1997). Section 23 of the Act requires the Conservator of Flora and Fauna to prepare an Action Plan in response to each declaration. This is the Action Plan for the:

Corroboree Frog
*Pseudophryne corroboree**

*** Special Note:**

As a consequence of the very recent revision of the taxonomic status of the Corroboree Frog *Pseudophryne corroboree*, two species of corroboree frog are now recognised: the Northern Corroboree Frog *P. pengilleyi*, which occurs in the ACT and the Southern Corroboree Frog *P. corroboree*, which occurs in the Snowy Mountains. The Flora and Fauna Committee has recommended that the declaration P. corroboree as a vulnerable species be revoked, and replaced by a declaration of *P. pengilleyi* as a vulnerable species. This Action Plan has been drafted to take this proposed change into account.

Addendum: A new declaration was made on 12 January 1998 (Determination No. 7 of 1998), revoking the Corroboree Frog *Pseudophryne corroboree* and replacing it with the Northern Corroboree Frog *Pseudophryne pengilleyi*. This Action Plan is for the **Northern Corroboree Frog *Pseudophryne pengilleyi*.**

Preamble

The *Nature Conservation Act 1980*, establishes the ACT Flora and Fauna Committee with responsibilities for assessing the conservation status of the ACT's flora and fauna and the ecological significance of potentially threatening processes. Where the Committee believes that a species or ecological community is threatened with extinction or a process is an ecological threat, it is required to advise the Minister for the Environment, Land and Planning, and recommend that a declaration be made accordingly.

Flora and Fauna Committee assessments are made on nature conservation grounds only and are guided by specified criteria as set out in its publication *"Threatened Species and Communities in the ACT*, July 1995".

In making its assessment of the Corroboree Frog, the Committee concluded that it satisfied the criteria indicated in the adjacent table.

An Action Plan is required in response to each declaration. It must include proposals for the identification, protection and survival of a threatened species or ecological community, or, in the case of a threatening process, proposals to minimise its effect.

While the legal authority of this Action Plan is confined to the Australian Capital Territory, management considerations are addressed in a regional context.

Criteria Satisfied

2.1 The species is known to occur in the ACT region and is already recognised as vulnerable in an authoritative international or national listing.

2.2 Species is observed, estimated, inferred or suspected to be at risk of premature extinction in the ACT region in the medium-term future, as demonstrated by the following:

2.2.1 Current serious decline in population or distribution from evidence based on :

2.2.1.1 direct observation, including comparison of historical and current records.

2.2.3 Continuing decline or unnaturally extreme fluctuations in population or distribution, for a species currently occurring over a moderately small range or having a moderately small area of occupancy within its range.

Species Description and

ENVIRONMENT ACT

Distribution

DESCRIPTION

There are two closely related species of corroboree frog; the Northern Corroboree Frog *Pseudophryne pengilleyi* (Wells & Wellington 1985) (Figure 1), and the Southern Corroboree Frog *P. corroboree* Moore (Osborne *et al*. 1996). Both are in the family Myobatrachidae and are amongst the most distinctive and easily recognised Australian frogs (Cogger 1992). *Pseudophryne pengilleyi* is confined to the high country of the ACT and the adjacent Fiery Range in NSW, whereas *P. corroboree* is found only in the Snowy Mountains in NSW (Osborne 1989).

The frogs are small (adults 2.5 to 3 cm in body length), and are characterised by yellow and black dorsal stripes (Pengilley 1966, Cogger 1992). This pattern extends over the limbs and flanks. The ventral surface is broadly marbled with black and white or black and yellow. A large flat femoral gland is present on each limb.

Adults of *P. pengilleyi* differ from *P. corroboree* in having: (1) a pattern of dorsal stripes that are usually yellow with a green tinge (rarely yellow) or lime-green; (2) mid-dorsal light-coloured stripes that are less than half the width of the adjacent black stripe at mid-body; and (3) a significantly smaller body and tibia length (Osborne *et al*. 1996). Another difference, which is less obvious, is the longer first component in the advertisement call of *P. pengilleyi*. There are also consistent genetic differences between the two species (Roberts and Maxson 1989, Osborne and Norman 1991).

HABITAT

The frogs use two distinct habitat types; a breeding season habitat associated with pools and seepages in *Sphagnum* bogs, wet tussock grasslands and wet heath, and a terrestrial non-breeding habitat in forest, sub-alpine woodland and heath adjacent to the breeding area (Pengilley 1966). During summer, the adult frogs breed in shallow pools and seepages within the breeding area, before returning to the adjacent woodland and tall moist heath at the end of the breeding season.

The breeding pools are characteristically shallow, and have relatively large surface areas, low water flow rates, and have a long duration (Osborne 1990). This allows the water in the preferred pools to become warmer during the day, possibly enhancing tadpole development.

Litter, logs and dense ground cover in the understorey of snow gum woodland and heathland provides over wintering habitat for subadults and adults (Pengilley 1966).

Figure 1: *P. pengilleyi*, Ginini Flats, Namadgi National Park, ACT. Shown four times actual size.

BEHAVIOUR AND BIOLOGY

Like most frogs, the Northern Corroboree Frog has a two stage life cycle; an aquatic tadpole stage and a terrestrial post-metamorphic juvenile and adult stage. However, they differ from most other frogs in that their eggs are laid out of water, in moss or dense vegetation at the edge of the breeding pool. The embryos develop to an advanced stage within the egg capsule before hatching, and moving to the nearby pool.

Adult males move into the breeding areas during January and February, and call from small chambers in moss or other soft vegetation at the edges of the breeding pools. Females only enter the bogs briefly to lay their eggs in the terrestrial oviposition site, and then leave the breeding site. The males continue calling for a number of weeks, presumably to continue mating. They then leave the bogs during late February and March to return to the over wintering habitat (Pengilley 1966, Osborne 1988). The eggs are laid in a small clutch of about 25 eggs (range 16-40) (Pengilley 1973).

Tadpole development initially occurs within the egg, and the relatively advanced tadpoles emerge from the egg when they are about 15 mm in length (Pengilley 1966, Osborne 1991). Hatching occurs during autumn and winter during periods of high rainfall or snow melt. The pre-metamorphic period is critical for reproductive success, because the tadpoles and eggs are vulnerable to desiccation and pool-drying at this time.

Very little is known about the life-history of the frogs after they leave the pools as juveniles. Pengilley (1966, 1973) suggested that they remain in moist vegetation near the breeding pools for several months, where they feed on a wide variety of small invertebrates. As they grow larger, the juveniles leave the breeding area and move into the adjacent non-breeding habitat where it is thought they remain until they are adults. The diet of subadults and adults consists mainly of ants and, to a lesser extent, other invertebrates (Pengilley 1971a).

DISTRIBUTION

The Northern Corroboree Frog has a high mountain distribution, occurring along the Brindabella and Bimberi Ranges from the summit of Mt Bimberi (ACT) in the south to near California Flats (NSW) in the north, and throughout the Fiery Range and Bogong Mountains in Kosciusko National Park and Buccleuch State Forest (Figure. 2). The species occurs over an altitudinal range from 900 to 1800 m.

In the ACT, the species occurs as two subpopulations (Osborne 1989), each represented by frogs that are genetically slightly different (Osborne and Norman 1991). The southern subpopulation is found only in the subalpine zone (above about 1400 m), occurring along the Bimberi Range from near the summit of Mt Bimberi (the breeding site is located at 1840 m) northwards to Ginini Flats. This subpopulation occurs only within Namadgi National Park (ACT) and the adjacent Bimberi Nature Reserve in NSW, with the largest populations occurring at Ginini Flats and Snowy Flats in the ACT.

The northern subpopulation (characterised by having greener stripes) occurs further north at lower altitudes along the Brindabella Range from Bushrangers Creek in the ACT northwards to near California Flats in NSW (Figure 2). This subpopulation occurs in Namadgi NP, Brindabella NP and an area of land in NSW near the ACT border which is the responsibility of the Commonwealth. This area includes Coree Flats, an area with a substantial population of northern corroboree frogs.

Figure 2: Map showing the distribution for *P. pengilleyi* in the ACT region - the two shaded areas show their known range. Source: GIS Systems Division, NSW National Parks and Wildlife Service, Hurstville.

Conservation Status

Pseudophryne pengilleyi is recognised as a threatened species in the following sources:

International

Vulnerable. - IUCN (1994) (as *P. corroboree*).

New South Wales

Vulnerable species. - (as *P. pengilleyi*): Schedule 2 of the *Threatened Species Conservation Act 1995*.

Australian Capital Territory

Special Protection Status Species. - Schedule 6 of the *Nature Conservation Act* 1980, Determination to be gazetted - Declaration agreed on 7 January 1998.

Vulnerable. - Section 21 of the *Nature Conservation Act 1980,* Determination No. 89 of 1997 (formerly Determination No. 29 of 1996) (as *P. corroboree*).

Threats

The Northern Corroboree Frog is faced with a considerable inherent risk from disturbance because of its specialised life history. It has a very low clutch size, each female breeds only once each season, and the tadpoles are slow-growing, spending over six months in the shallow pools. Such a strategy reduces the ability of the species to recover quickly during favourable seasons, and places it at risk from any long-term disturbance which affects the breeding sites.

The frogs are completely dependent on continued water seepage into the shallow breeding pools. During the lengthy (approximately six months) period that the

tadpoles are developing, they are vulnerable to mortality if the pools dry. Consequently, any disturbance that reduces flow into the breeding habitat is potentially detrimental.

Activities in the catchments of the breeding sites which may pose a threat include earthworks or road construction, and damage to soil, peat or vegetation.

Feral pigs are a threat as they disturb breeding areas in their search for food such as insect larvae and tubers (Alexiou 1983). Pigs also wallow in the bog pools and can disturb the breeding pools at the time they are being used by the frogs. Trampling by wild horses has caused extensive damage to some breeding sites by causing incision of the bogs, and altering drainage patterns (currently only in NSW) (see comments by Dyring 1992).

In some areas of NSW, exotic weeds, particularly blackberries, are smothering breeding sites. This is less of a problem in the ACT.

Wildfire can severely damage peat and bog areas, causing erosion and decreasing the capacity of the bogs to hold water (Good 1973; Clark 1986).

Drought presents a broader scale threat, and has been observed to prevent breeding, or to dry pools that contain developing tadpoles (Pengilley 1966; Osborne 1988, 1989).

There is considerable public interest in corroboree frogs, with many people expressing a wish to see them because of their bright markings. If human visitation to areas used as breeding sites increases there is a greater likelihood of people disturbing the frogs. This may occur through trampling of the pool edge vegetation, or by direct disturbance to the frogs.

The activities discussed above present obvious threats to the frogs. However, populations of both the Northern and Southern Corroboree Frog have declined considerably over the last ten years despite the implementation of measures to prevent the loss of breeding habitat from road construction, weed spread and the impact of feral animals (see Osborne 1991; 1996), and the absence of damaging wildfires.

In common with a number of other declining species of frogs in south-eastern Australia, the reason for the ongoing declines are not known (Mahoney 1996), and are the subject of continuing research.

Globally, including in parts of Australia, many locations where frog population declines have occurred are in wilderness areas, remote from human impact. There has been growing international concern about similar declines and extinctions of many populations of amphibians at high altitudes (McDonald 1990; Carey 1993; Fellers and Drost 1993; Hedges 1993; Hollis 1995).

Concern about global warming (Pearman 1988; Galloway 1988) has a particular significance for the conservation of cool-adapted species such as the Northern Corroboree Frog (Bennett *et al*. 1991). Due to its restricted high-altitude distribution, the species is likely to be particularly susceptible to climate change.

The depletion of the ozone layer and the consequent increase in ultraviolet radiation (UV-B) has been implicated as a possible cause of frog declines at higher altitudes (Blaustein *et al.* 1994). Its potential effects on Corroboree Frog populations are yet to be investigated.

Major Conservation Objective

The objectives of this Action Plan are to:

- maximise the possibility of ensuring the survival, in the long-term, of viable, natural populations of *P. pengilleyi* at sites across the geographic range of the species in the ACT. This includes the need to maintain the natural evolutionary development of the species in the wild.

The objective is to be achieved through the following strategies:

- Participating in research, monitoring and experimental management aimed at identifying the cause of the continuing population decline, and preventing it.
- Protecting sites and vegetation communities that are critical to the survival of the species. This includes the Ramsar listed Ginini Flat Subalpine Bog Complex in the ACT, which is internationally recognised and is the stronghold of the ACT population.
- Managing activities in the catchments of breeding sites to minimise or eliminate any threat to frog populations.
- Increasing community awareness of the need to protect the frogs and their habitat.

Conservation Issues and Intended Management Actions

LONG-TERM POPULATION DECLINE

During the 1960's and 1970's the Northern Corroboree Frog was quite common in suitable habitat. Many breeding aggregations in the ACT region were reported to be very large, often consisting of many hundreds of individuals (Pengilley 1966; Osborne 1988). The frogs present at some of these breeding sites have been monitored regularly over the last ten years, and the results indicate a substantial decline has occurred, particularly in the Brindabella and Bimberi Ranges in and near the ACT. Observations over a shorter period in the Fiery Range indicate that there may not have been a substantial decline in this area (P. O'Brien, NSW National Parks and Wildlife Service, pers. comm.; B. Gay, State Forests of NSW, pers. comm.).

The causes of the overall decline are not known. Originally it was assumed that the decline was the result of drought that affected the region in the early 1980's, and that once conditions had improved, the frog population would recover (Osborne 1989). However, this has not been the case; many local populations have continued declining, or remained low for over a decade (Osborne 1991, 1996).

- Environment ACT (Wildlife Research and Monitoring) will continue to be represented on the Corroboree Frog National Recovery Team. This group has representation from all agencies responsible for management of land with corroboree frogs.

LOCAL IMPACTS TO BREEDING AREAS

Localised human impacts are known to have had a deleterious effect on some breeding sites (Osborne 1991). Erosion from poorly maintained roads, and the spread of blackberries, have destroyed or damaged some sites (mostly in NSW) where the species occurred (Osborne 1988).

Livestock grazing and trampling may also have caused habitat deterioration, particularly in NSW. Trampling by livestock, including horses, increases erosion and causes incision of bogs (Dyring 1992; Wimbush and Costin 1979). Trampling by wild horses has caused considerable damage to breeding sites in the Fiery Range in NSW (W. Osborne and D. Hunter pers. obs). In some areas feral pigs have caused obvious disturbance to the habitat of the frogs including breeding areas, although the actual extent of impact on the ecology of the frogs requires further research.

- Environment ACT (ACT Parks and Conservation Service) will continue its program of pig control in Namadgi National Park including and around the Ramsar wetlands at Ginini Flats and other Northern Corroboree Frog breeding sites.

Bushfires also have the potential to impact on the frogs by burning vegetation and peat in breeding and non-breeding areas (Clark 1986), although the actual long-term effects of fire are not known. Osborne (1991) considered that autumn fires burning through woodland and heath surrounding breeding sites had the greatest potential influence. At this time adult and subadult frogs have moved into these areas to feed and to find suitable over-wintering sites. Regular burning of understorey litter and grass cover in these areas, such as occurs during prescribed burns, is likely to reduce the shelter available to the frogs and make them more vulnerable to predation, dehydration or freezing.

A fire fuel management plan is currently being prepared by Environment ACT (ACT Parks and Conservation Service). This plan provides the basis for the protection of breeding sites by controlling the use of fire in the catchments of areas frequented by the Northern Corroboree Frog. Specifically the plan provides for:

- Maps of sensitive sites including all known breeding sites in the ACT. These maps will be available for use in fire emergencies.
- No deliberate burning in the area within 500 metres of each recognised Corroboree Frog breeding site.
- Restrictions on the use of heavy machinery to the minimum necessary for maintenance of existing roads and emergency access. Notwithstanding the above and wherever possible, heavy machinery will not be used within 500 metres of breeding sites. The bushfire suppression agency will be advised of this measure at the appropriate times. This Action Plan and the fuel plan cannot make a prescriptive statement on the use of heavy fire suppression equipment because the *Bushfire Act 1936* overrides the *Nature Conservation Act 1980.*

GLOBAL CLIMATE CHANGE

Changes in climate may have a number of potential impacts on the biology of the frogs; these include altering the breeding season and changing the period required for egg and tadpole development, so that these events occur earlier or later than at an optimum time. Climate change is also likely to influence the hydrology of the breeding pools, and affect the growth and dynamics of vegetation in the breeding habitat. With warmer temperatures, or longer periods of drier weather during

spring and early summer, the pools still containing tadpoles may dry before tadpole development is complete (Osborne 1990; Pengilley 1992).

- Environment ACT (Wildlife Research and Monitoring, and the ACT Parks and Conservation Service) will liaise with, and assist, the NSW National Parks and Wildlife Service and researchers in tertiary institutions in undertaking a coordinated research program to establish whether long-term changes in snow cover, precipitation patterns and temperature may have contributed to the ongoing population decline; this will be done under the general direction of the Corroboree Frog National Recovery Team (for both *P. pengilleyi* and *P. corroboree*).

Ultraviolet radiation (UV-B) has increased significantly in recent years due to increasing ozone (e.g. Jones and Shanklin 1995), and is likely to increase as reduction in ozone in the upper atmosphere continues. Although UV-B is implicated in frog declines at high altitudes (Blaustein *et al.* 1994), ultraviolet radiation is unlikely to affect *P. pengilleyi* adults, eggs and embryos because they are hidden within the moss and are unlikely to be exposed. However, the tadpoles may be at risk, as they are exposed in shallow, clear pools.

- Environment ACT will support research on the susceptibility of the tadpoles to ultraviolet radiation; this will be done under the general direction of the Corroboree Frog National Recovery Team (for both *P. pengilleyi* and *P. corroboree).*

SURVEY

An extensive survey has been conducted to determine the distribution of the Northern Corroboree Frog in the ACT and northern Brindabella Range (Osborne 1990; Osborne unpublished data). This information provides a basis for selection of long-term monitoring and research sites, as well as for site protection and management.

- A survey data base will be developed to provide baseline survey information for the species. New searches will be conducted in any potentially suitable areas not yet surveyed.
- As part of the Corroboree Frog National Recovery Team, Environment ACT will participate in a joint ACT/NSW assessment of the distribution of the species.

MONITORING

The continuing decline in populations of the Northern Corroboree Frog, and the disappearance of the species from a number of sites in the ACT region, is reason for considerable concern, and underscores the need for careful population monitoring.

It should be noted that Osborne (1991) cautions that any studies conducted on severely depleted local populations run the risk of causing further losses to those populations if physical searches are made for individuals. This is because the disturbance caused by searching through moss and other vegetation to find frogs may cause any males found to abandon their nest sites, and may dry the eggs.

- Environment ACT (Wildlife Research and Monitoring) will implement a program of population monitoring to assist recording long-term population trends, and to address hypotheses concerning the reasons for the declines.
- Monitoring will be conducted by suitably experienced personnel, and will follow procedures agreed by the Corroboree Frog National Recovery Team to allow for consistency of technique across the region.
- The monitoring program will be coordinated with other similar programs and the results will be made available to the Corroboree Frog National Recovery Team, who will provide general advice to relevant land managers.

RESEARCH

There is considerable existing information on the biology and ecology of the Corroboree Frog. Distribution (Osborne 1989), breeding biology (Pengilley 1966, 1973), diet (Pengilley 1971a), population genetics (Osborne and Norman 1991) and habitat use (Osborne 1990) are reasonably well known. However, some important aspects remain unknown. Basic demographic information is lacking and further research is required on the ecology of juveniles and adults after they leave the breeding pools. Information still required includes estimates of embryonic mortality, tadpole survival, longevity, breeding age, and juvenile and adult mortality.

Other important aspects of research relate to the landscape processes that influence metapopulations, of particular importance in the conservation of this patchily distributed species. Research is required on the extent of movement between breeding sites by individuals and the effect of catchment hydrology on population persistence,

particularly with respect to long-term survival during droughts. It is still not clear why the frogs choose particular breeding pools, and in what way hydrology and vegetation interact in the formation of pools.

Research is also needed to examine the possible influence of global climate change on the frogs, including the impact of ultraviolet radiation, changed precipitation patterns and global warming.

Both species of corroboree frog are currently the subject of ongoing research by the Applied Ecology Research Group (University of Canberra). This work has been funded by the NSW National Parks and Wildlife Service and is coordinated by the Corroboree Frog National Recovery Team (see Osborne 1996).

- Environment ACT will support, assist and encourage long-term research coordinated by the Corroboree Frog National Recovery Team aimed at developing a better understanding of: (1) basic population demography including breeding success and tadpole survival; (2) physical and biological properties influencing breeding pool formation and condition of breeding habitat in the ACT and (3) global climatic influences on the frogs.

CAPTIVE HUSBANDRY

Given the recent extinction of a number of species of Australian frogs (Tyler in press), conservation biologists have recommended that efforts be undertaken to improve knowledge of captive rearing and breeding of declining or rare species, before the populations become too small for these efforts to succeed.

- Environment ACT will assess the need to develop procedures for artificial rearing of tadpoles and for captive breeding of adult Northern Corroboree Frogs in the ACT in response to expert advice or a proposal from the Corroboree Frog National Recovery Team.

MANAGEMENT OF GININI FLATS WETLANDS

The most extensive breeding habitat for the Northern Corroboree Frog in the ACT occurs in association with the Ginini Flats wetlands complex, a system of interlinked subalpine Sphagnum bogs (Clark 1980) occupying approximately 125 ha (Lintermans and Ingwersen 1996). As a designated Ramsar wetland of international significance this area is managed primarily for conservation purposes within Namadgi National Park. The area also attracts a moderate amount of recreational use, both in summer and winter, which has the potential to conflict with the conservation of the frog population.

Osborne (1991) noted that the frogs are most vulnerable during two periods of their life-history; firstly the adult males and eggs are easily disturbed by people searching through the moss at the edges of pools, and secondly the tadpoles are entirely reliant on the continued presence of water in the breeding pools for a period of at least six months.

The survival of the Northern Corroboree Frog metapopulation in the Ginini Flats area depends particularly on the maintenance of the network of breeding pools and protection from disturbance of breeding adults and eggs. This will require careful monitoring.

- Environment ACT (Wildlife Research and Monitoring, and the ACT Parks and Conservation Service) will continue to monitor the Ginini Flats population of the Northern Corroboree Frog, including the condition of the general breeding habitat and breeding pools.
- A strict policy of protection will continue to be enforced.
- A policy will be developed to cover the activities of land managers, the general public and individuals undertaking research.
- Guidelines and a code of conduct will be prepared by Environment ACT for park access and interpretation, covering both private tour operators and employees of the ACT Parks and Conservation Service.
- Guidelines will be prepared by Environment ACT for the development and maintenance of any walking trails or vehicle management tracks located, or proposed to be built within the Ramsar wetland area.
- Any proposal for new trails will be subject to environmental assessment.
- Control of feral animals, particularly pigs, will continue as a high priority for Namadgi National Park including areas around the Ginini Flats wetland, and other Corroboree Frog breeding sites in the ACT.
- Feral horses, eradicated from Namadgi National Park in 1987, will not be allowed to re-establish within the Park.

In any feral animal control work, especially in regard to pigs, consideration will be given to ensure achievement of desired outcomes whilst avoiding deleterious side effects.

The fire fuel management plan being developed by Environment ACT will meet the requirements of the Namadgi National Park Management Plan for fire management planning. It will provide fire management policy and prescriptions for areas that include all Corroboree Frog habitat in Namadgi National Park. No burning will be planned for areas within 500 m of breeding sites.

Whilst it is impossible for either this action plan or the fire fuel management plan to rule out the use of heavy equipment near Corroboree Frog habitat during a bushfire, the fuel plan will identify the sensitivity of the breeding sites to this form of disturbance and will identify the means for this information to be made available to the people responsible for fire suppression decisions.

- Active management of known breeding sites and surrounding non-breeding habitat will include removal of exotic tree wildings and prevention of spread of blackberries and other invasive shrubs. Weed removal programs will recognise the need to utilise techniques and chemicals which have the least potential impact on the frog population.

Protection

All but one of the known breeding sites for the Northern Corroboree Frog in the ACT occurs within Namadgi National Park (W. Osborne unpublished data). The single known site outside the park consists of only a few individuals, and occurs in an area surrounded by pine plantation (Blundell's Flat). The largest populations occur in sub-catchments of the Cotter River above Bendora and Corin Dams. Public access and camping are restricted in these areas, which are managed primarily for conservation and water catchment protection.

- General guidelines for the conservation management of the Northern Corroboree Frog and its habitat in the ACT will be included in the Management Plan for Namadgi National Park (scheduled for revision commencing in 1997).

Legislative Provisions

The following ACT legislation applies to the conservation of flora and fauna in the ACT:

Nature Conservation Act 1980

The Nature Conservation Act protects native plants and animals. Activities affecting native plants and animals require a licence which may specify to apply to the activity.

- A person may not kill, take, keep, sell, import, export or interfere with the "nest" of a native animal without a licence.

Native plants and animals may be declared as *protected* or having *special protection status* in recognition of a particular conservation concern that warrants additional protection. Increased controls apply to declared species and licensing constraints are specified.

Licence Conditions (SPS)

Special Protection Status (SPS) is the highest level of statutory protection and is conferred on species which are either threatened with extinction or are a migratory animal subject to an international agreement for their protection. Conservation requirements are a paramount consideration and only activities related to conservation of the species or serving a special purpose are permissible.

The Conservator of Flora and Fauna may only grant a licence for activities affecting a species with SPS where satisfied that the act specified in the licence:

- is required to be done for scientific, educational, propagative or other similar purposes;
- is required to be done for the purpose of protecting persons or property and will be conducted in a way that will, so far as is practicable, keep to a minimum any impact on the species concerned;
- is merely incidental to other acts, and will not appreciably reduce the chances of survival or recovery in the wild of the species concerned; or
- is of particular significance to Aboriginal tradition and will not appreciably reduce the chances of survival or recovery in the wild of the species concerned.

Other Relevant Provisions

The Nature Conservation Act provides authority for the Conservator to manage Public Land reserved for conservation of the natural environment. Activities that are inconsistent with management objectives for nature conservation are controlled. Special measures for conservation of a species or community of concern can be introduced in a reserved area, including restriction of access to important habitat.

Section 47 of the Act allows the Conservator to give the occupier of land directions for protection or conservation of native plants and animals. This provision is relevant to the

management of threats to the conservation requirements of a species or community of concern that occurs on leased land.

- The Ginini Flats *Sphagnum* bogs in Namadgi National Park, which provide an important habitat for the Northern Corroboree Frog, are listed as wetlands of international importance under the Ramsar Agreement. This Action Plan will, when read in association with the Management Plan for Namadgi National Park, provide the basis for ongoing management of Ginini Flats.

Land (Planning and Environment) Act 1991

The Land (Planning and Environment) Act is the primary authority for land planning and administration. It establishes the Territory Plan and several of its provisions are relevant to the protection of flora and fauna.

- **Public Land** is reserved via the Territory Plan. Land reserved as wilderness area, national park or nature reserve has conservation of the natural environment as a paramount management objective. The Conservator of Flora and Fauna must prepare a **plan of management** setting out how management objectives are to be implemented or promoted.
- **Places of natural heritage significance**, including important habitat for native species, may be entered in the Heritage Places Register, with conservation requirements specified.
- **Environmental Assessments and Inquiries** may be initiated as part of the approvals process for defined land use and development decisions or activities prescribed as controlled. Assessments are required to address potential environmental impact, including threats to a species of flora and fauna, an ecological community or an area.

Consultation and Community Participation

Environment ACT (Wildlife Research and Monitoring) is a member of the National Recovery Team that covers both species of Corroboree Frog (*P. corroboree and P. pengilleyi*). This Recovery Team was established in January 1996 to direct and facilitate surveys, monitoring, research, captive husbandry and regional conservation efforts. The membership also includes representatives from the NSW National Parks and Wildlife Service, State Forests of NSW, Victorian Department of Natural Resources and Environment, Snowy Mountains Hydro-Electricity Authority, University of Canberra, ACT Herpetological Association and the Amphibian Research Centre (Victoria).

Where appropriate, community participation with activities assisting the conservation of the Northern Corroboree Frog will be encouraged through groups such as the ACT Herpetological Association and the Frog and Tadpole Study Group (Sydney).

Implementation and Review

RESPONSIBILITY FOR IMPLEMENTATION

Environment ACT (Wildlife Research and Monitoring) will have responsibility for coordination of the implementation of this Action Plan subject to the availability of Government resources. Primary responsibility for conservation and management of the species within Namadgi National Park and areas that are Territory Land will also rest with the ACT Parks and Conservation Service.

EVALUATION

Implementation of this Action Plan will be a collaborative exercise between government agencies, landholders and the community generally. NSW participation will be critical in some cases. The Action Plan will be reviewed after three years. The review will comprise an assesssment of progress using the following performance indicators:

- completion of commitments that can reasonably be expected to be finalised within the review timeframe (e.g. introduction of a statutory protection measure for a species; development of a management plan);
- completion of a stage in a process with a time line that exceeds the review period (e.g. design or commencement of a research program);
- commencement of a particular commitment that is of a continuing nature (e.g. design or commencement of a monitoring program for population abundance); and
- expert assessment of achievement of conservation objectives of the Action Plan.

The review will be reported to the ACT Flora and Fauna Committee. This will provide Environment ACT and the Flora and Fauna Committee an opportunity to assess progress, take account of developments in nature conservation knowledge, policy and administration and review directions and priorities for future conservation action.

The following conservation actions will be given priority attention:

- establishment of monitoring of ACT populations and its coordination with NSW agencies;
- appropriate application in the ACT of research into breeding success and global climatic influences on the species; and
- protection of habitat, especially the Ginini Flats wetlands,with proper control of feral animals, and minimal impact generated by management and visitor activities.

Acknowledgements

Material for the draft Action Plan was prepared for Environment ACT by Dr W. Osborne, of the Applied Ecology Research Group, University of Canberra. Officers of Environment ACT provided additional information, advice and comments.

References

Alexiou, P.N., 1983. Effects of feral pigs (*Sus scrofa*) on subalpine vegetation at Smokers Gap, ACT. *Proceedings of the Ecological Society of Australia* 12: 135-142.

Bennett, S., Brereton, R., Mansergh, I., Berwick, S., Sandford, K. & Wellington, C., 1991. *The potential effect of the enhanced greenhouse climate change on selected Victorian fauna*. Arthur Rylah Institute for Environmental Research, Heidelberg.

Blaustein, A.R., Hoffman, P.D., Hokit, D.G., Kiesecker, J.M., Walls, S.C. & Hayes, J.B., 1994. UV repair and resistance to solar UV-B in amphibian eggs: A link to population declines? *Proceedings National Academy of Sciences USA* 91: 1791-1795.

Carey, C., 1993. Hypothesis concerning the causes of the disappearances of the boreal toads from the mountains of Colorado. *Conservation Biology* 7: 355-362.

Cogger, H.G., 1992. *Reptiles and amphibians of Australia.* Reed Books, Chatswood.

Clark, R., 1980. *Sphagnum growth on Ginini Flats, ACT*. Unpublished report to ACT Parks and Conservation Service, Canberra.

Clark, R., 1986. *The fire history of Rotten Swamp, ACT.* Unpublished Report to ACT Parks and Conservation Service, Canberra.

Dyring, J., 1992. Introduced animals in the Australian Alps with special reference to feral horses. *Review de Geographie Alpine,* pp. 409-423.

Fellers, G.M. & Drost, C.A., 1993. Disappearances of the Cascades Frog *Rana cascadae* at the southern end of its range, California, USA. *Biological Conservation* 65: 177-181.

Galloway, R.W., 1988. The potential impact of climate change on the Australian ski fields. In Pearman, G.I., (ed.) *Greenhouse: Planning for climate change*, pp. 428-437. CSIRO, Canberra.

Good, R.B., 1973. A preliminary assessment of erosion following wildfires in Kosciusko National Park, NSW in 1973. *Soil Conservation Journal of NSW* 29: 191-199.

Hedges, S.B., 1993. Global amphibian declines: A perspective from the Carribbean. *Biodiversity and Conservation* 2: 290-303.

Hollis, G.J., 1995. Reassessment of the distribution, abundance and habitat of the Baw Baw Frog *Philoria frosti* Spencer: Preliminary findings. *Victorian Naturalist* 112: 190-201.

Jones, A.E. & Shanklin, J.D., 1995. Continued decline of total ozone over Halley, Antarctica, since 1985. *Nature* 376: 409-411.

Lintermans, M. & Ingwersen, F., 1996. Australian Capital Territory chapter. In Australian Nature Conservation Agency*. A directory of important wetlands in Australia*. Second Edition. Australian Nature Conservation Agency, Canberra.

Mahony, M., 1996. The decline of the Green and Golden Bell Frog (*Litoria aurea)* viewed in the context of declines and disappearances of other Australian frogs. *Australian Zoologist* 30: 237-247.

McDonald, K.R., 1990. *Rheobatrachus* Liem and *Taudactylus* Straughan and Lee (Anura: Leptodactylidae) in Eungella National Park, Queensland: Distribution and decline. *Transactions of the Royal Society of South Australia* 114: 187-194.

Osborne, W.S., 1988. *A survey of the distribution and habitats of Corroboree Frogs* (Pseudophryne corroboree) *in Kosciusko National Park: With a reference to ski resort development*. Report to NSW National Parks and Wildlife Service, Kosciusko District.

Osborne, W.S., 1989. Distribution, relative abundance and conservation status of Corroboree Frogs (*Pseudophryne corroboree)* Moore (Anura: Myobatrachidae). *Australian Wildlife Research* 16: 537-547.

Osborne, W.S., 1990. *The conservation biology of* Pseudophryne corroboree *Moore* (*Anura: Myobatrachidae*): *A study of insular populations.* PhD thesis, Department of Zoology, Australian National University.

Osborne, W.S., 1991. *The biology and management of the Corroboree Frog* (Pseudophryne corroboree). *In NSW.* Species Management Report No. 8. NSW National Parks and Wildlife Service, Sydney.

Osborne, W.S. (1996). *Recovery plan for the Southern Corroboree Frog (Pseudophryne corroboree).* NSW National Parks and Wildlife Service, Queanbeyan.

Osborne, W.S. & Norman, 1991. Conservation genetics of Corroboree Frogs, (*Pseudophryne corroboree)*: Population subdivision and genetic divergence. *Australian Journal of Zoology* 39: 285-297.

Osborne, W. S., Zentelis, R. A. & Lau, M., 1996. Geographical variation in corroboree frogs, (*Pseudophryne corroboree)* Moore (Anura: Myobatrachidae): A reappraisal supports recognition of *P. pengilleyi* Wells and Wellington. *Australian Journal of Zoology* 44: 569-587.

Pearman, G.I. (ed.), 1989. *Greenhouse planning for climate change.* CSIRO, Canberra.

Pengilley, R.K., 1966. *The biology of the genus* Pseudophryne *(Anura: Leptodactylidae).* MSc thesis, Department of Zoology, Australian National University.

Pengilley, R.K., 1971a. Calling and associated behaviour of some species of *Pseudophryne* (Anura: Leptodactylidae). *Journal of Zoology Lond.* 163: 73-92.

Pengilley, R.K., 1971b. The food of some Australian anurans (Amphibian). *Journal of Zoology Lond.* 163: 93-103.

Pengilley, R.K., 1973. Breeding biology of some species of *Pseudophryne* (Anura: Leptodactylidae) of the Southern Highlands, NSW. *Australian Zoologist* 18: 15-30.

Pengilley, R.K., 1992. Natural history of *Pseudophryne* species (Anura : Myobatrachidae) in the Southern Highlands of NSW, Australia. *Sydney Basin Naturalist* 1: 9-29.

Tallis, J.H., 1994. Pool-and-hummock patterning in a southern Pennine blanket mire II. The formation and erosion of the pool system. *Journal of Ecology* 82: 789-803.

Wells, R.W., & Wellington, C.R., 1985. A classification of the Amphibia and Reptilia of Australia. *Australian Journal of Herpetology Supplementary Series* 1: 1-61.

Wimbush, D.J. & Costin, A.B., 1979. Trends in vegetation at Kosciusko: 1 Grazing trails in the subalpine zone, 1957-1971. *Australian Journal of Botany* 27: 741-787

List of Action Plans - December 1997

In accordance with Section 23 of the *Nature Conservation Act 1980,* the following Action Plans have been prepared by the Conservator of Flora and Fauna:

No. 1: Natural Temperate Grassland - an endangered ecological community.

No. 2: Striped Legless Lizard (*Delma impar*) - a vulnerable species.

No. 3: Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*) - an endangered species.

No. 4: A leek orchid (*Prasophyllum petilum*) - an endangered species.

No. 5: A subalpine herb (*Gentiana baeuerlenii*) - an endangered species.

No. 6: Corroboree Frog (*Pseudophryne corroboree*) - a vulnerable species.

FURTHER INFORMATION

Further information on this Action Plan or other threatened species and ecological communities can be obtained from:

Environment ACT
(Wildlife Research and Monitoring)
Phone: (02) 6207 2126
Fax: (02) 6207 2122

This document should be cited as:

ACT Government, 1997. *Corroboree Frog* (Pseudophryne corroboree): *A vulnerable species*. Action Plan No. 6. Environment ACT, Canberra.

ACTION PLAN No. 7

In accordance with section 21 of the *Nature Conservation Act 1980*, **the Golden Sun Moth (*Synemon plana*)** was declared an **endangered** species on 15 April 1996 (formerly Determination No. 29 of 1996 and currently Determination No. 7 of 1998). Section 23 of the Act requires the Conservator of Flora and Fauna to prepare an Action Plan in response to each declaration. This is the Action Plan for the:

Golden Sun Moth
Synemon plana

Preamble

The *Nature Conservation Act 1980* establishes the ACT Flora and Fauna Committee with responsibilities for assessing the conservation status of the ACT's flora and fauna and the ecological significance of potentially threatening processes. Where the Committee believes that a species or ecological community is threatened with extinction or a process is an ecological threat, it is required to advise the Minister for the Environment, Land and Planning and recommend that a declaration be made accordingly.

Flora and Fauna Committee assessments are made on nature conservation grounds only and are guided by specified criteria as set out in its publication *Threatened Species and Communities in the ACT,* July 1995.

In making its assessment of the Golden Sun Moth, the Committee concluded that it satisfied the criteria indicated in the adjacent table.

An Action Plan is required to ensure, as far as is practicable, the identification, protection and survival of the species or the ecological community, or proposals to minimise the effect of any process which threatens any species or ecological community.

While the legal authority of this Action Plan is confined to the Australian Capital Territory, management considerations are addressed in a regional context.

Criteria Satisfied

1.2 The species is observed, estimated, inferred or suspected to be at risk of premature extinction in the ACT region in the near future, as demonstrated by:

- 1.2.1 Current severe decline in population or distribution, from evidence based on:
  - 1.2.1.1 Direct observation, including comparison of historical and current records; and
  - 1.2.1.3 Severe decline in quality or quantity of habitat.
- 1.2.5 Continuing decline or severe fragmentation in population, for species with a small current population.

Links with other Action Plans

Measures proposed in this Action Plan complement those proposed in the Action Plan for Natural Temperate Grassland and other component threatened species, such as the Striped Legless Lizard (*Delma impar*), Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*) and the Button Wrinklewort (*Rutidosis leptorrhynchoides*). Action Plans are listed at the end of this document.

Species Description and Ecology

DESCRIPTION

The Golden Sun Moth *(Synemon plana)* is a medium sized moth belonging to the family Castniidae, which is thought to be of Gondwanan origin (Edwards, 1990). The male has a wingspan of about 34 mm, larger than the female with about 31 mm wing span. The male having a larger wingspan than the female is unique in the Australian Castniidae. The upperside of the forewing of the male is dark brown with patterns of pale grey scales and the hind wing is dark bronzy brown with dark brown patches. The underside of both wings of the male is mostly pale grey with dark brown spots. The upperside forewing of the female is very dark grey with patterns of pale grey scales and the hind wing is bright orange with black submarginal spots. The underside of both wings of the female is silky white with small black submarginal spots. The adults are without functional mouthparts; they have strongly clubbed antennae and the female has a long extensible ovipositor. Coloured illustrations may be found in Common (1990) and Fraser and McJannett (1996).

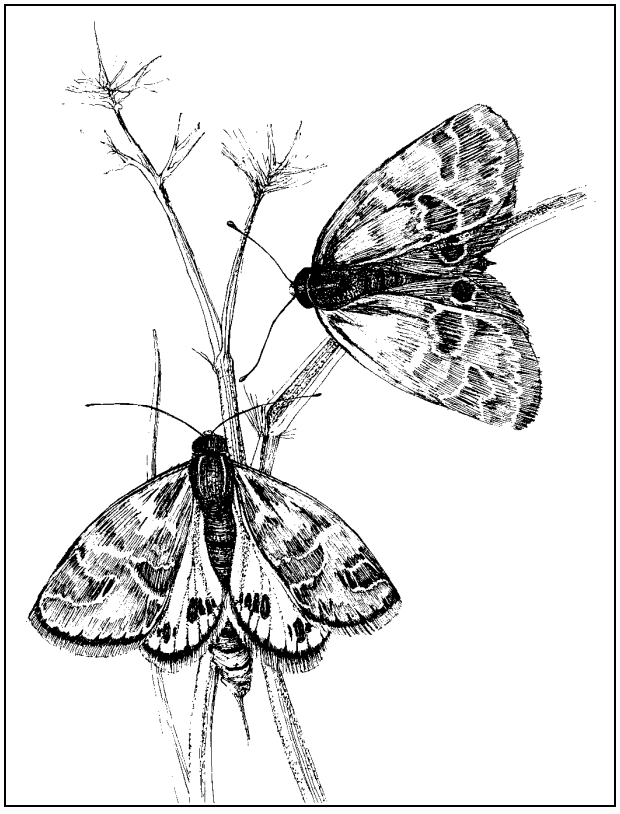

Figure 1: Golden Sun Moth (*S. plana*) - the female is on the bottom left and the male on the top right. Scale: 1.7 times natural size.

HABITAT

In the ACT, *S. plana* usually occurs in natural temperate grassland dominated by *Danthonia carphoides,* a wallaby grass. Some populations of the moth at Mulligans Flat occur in known grassy areas within an open woodland but all other sites are believed to have been treeless grassland prior to European settlement. In the ACT, these grasslands are not found at an altitude above 630 m.

Areas dominated by *D. carphoides* occur in grasslands containing *Danthonia* or *Stipa* associations, and may occur in patches in Dry *Themeda* grasslands (see the Action Plan for Natural Temperate Grassland for a more detailed description of natural temperate grassland associations). Wallaby Grass is a very low growing grass with tussocks usually separated by bare ground. These grasslands normally contain several species of *Danthonia* and the species actually fed on by the moth larvae are uncertain. It is not known what proportion of suitable *Danthonia* species must be present in a *Danthonia* or *Stipa* grassland to support *S. plana*. Nor is it known what factors are responsible for determining the proportions of *Danthonia* and *Stipa* in such a grassland.

In NSW, *S. plana* is also found in grasslands dominated by *D. setacea*.

In Victoria, *S. plana* may be found in grassland dominated by *D. setacea* (Douglas 1993) and *D. pilosa* (Britten *et al.* 1995). Recent field studies at Mt Piper have indicated that the habitat of *S. plana* was a native grassland dominated by *Danthonia*, in particular, *D. carphoides*, *D. auriculata*, *D. setacea* and *D. eriantha.* The percentage cover of *Danthonia* at all sites was greater than 40%, which was shown to be the minimum density required to sustain a *S. plana* population in Victoria (Dear 1997).

BEHAVIOUR AND BIOLOGY

Adult *S. plana* may be found in the ACT from about mid November until early January, but most usually fly in early December. There is some seasonal variation, with flights occurring earlier in a warm dry spring and later, and extending for longer, in a cool moist spring. In 1982 (a warm dry spring), moths were flying plentifully on 5 November and at York Park the flight period was nearly over on 25 November, whereas in 1992-3 (a cool moist spring), the flight commenced on 24 November and extended until 30 January (Cook and Edwards 1993). *Synemon plana* adults are day flying and are only active under sunny conditions. On days of bright sunshine they are active from about 11 am to 1 pm. The males fly rapidly at about one metre

from the ground. Females rarely fly, unless disturbed. Compared with the males, they are relatively immobile and tend to walk from tussock to tussock to lay eggs. As the adults are unable to feed or drink, they must mate and lay eggs rapidly and are also short-lived. Five days is the longest recorded life span for the male, but one to two days is normal (Cook and Edwards 1993).

Eggs are laid between the tillers of a *Danthonia* tussock or between the tillers and the soil. They are inserted into the crevices by the long ovipositor of the female and each female is capable of laying up to about 200 eggs. The larvae feed on the underground parts of the *Danthonia*. Whether the larva needs a single tussock for development or must move between tussocks to complete its development is unknown. The length of the life cycle is unknown, but two years is the best current estimate.

The larvae remain underground throughout development and pupate underground after preparing a tunnel to the surface through which the pupa eventually emerges. The pupal stage probably lasts for about six weeks. The pupa partially emerges from the tunnel at the surface and the adult moth escapes, leaving the empty pupal shell protruding from the soil (Edwards 1991, 1994).

Predation of adults has been observed at York Park, Barton, by several species of birds including the Willie Wagtail (*Rhipidura leucophrys*), the Magpie Lark (*Grallina cyanoleuca*), the Starling (*Sturnus vulgaris*) as well as robber flies (*Colepia abludo* and *Brachypogon* sp.) (Cook and Edwards 1993, 1994). Some reptiles may also be predators. No parasites or predators of the early stages have been recorded.

Table 1. List of Locations with Conservation Ratings for *Synemon plana*

Population Number and Location	*Synemon plana* Conservation Value (Rating) 1=high; 4=minimal (see P.10 for explanation)	Area (ha) *	Grassland Action Plan Location No. (GAP) and Botanical Significance of Site (1=high; 5=low)	Other Significant Species in Vicinity	Proposed Protection Measure
ACT SITES:					
1. Belconnen Naval Station (Site A)	1	106.5	GAP 20: - 2	#	Reserve ϑ
2. Majura Valley East:					
(Site A, Firing Range)	1	142.2	GAP 28: - 1(3)	Di, Tlp, Rl, #	Memorandum
(Site D, Airport)	1	47.1	GAP 28: - 2	Tlp, #	of Understanding
3. Jerrabomberra West (Site A, "Woden")	1	72.4	GAP 36: - 2	Tlp, Ap, #	Reserve ϑ
4. Mulanggary Grassland Reserve (Site C)	1	82.8	GAP 6: - 3(5)	Di, #	Reserve
5. Campbell Park:					
Offices	2	3.3	GAP 27: - 3	Rl, Tlp, #	Reserve ϑ
paddocks	2	9.0	GAP 27: - 3	Rl, Tlp, #	Reserve ϑ
6 Mulligans Flat North		30.0 <			
(a) Reserve	2				Reserve
(b) paddock	2			#	Urban Open Space
7. York Park, Barton	2	0.4	GAP 34: - 3		Memorandum of Understanding
8. Mulligans Flat South		20.0 <			
(a) Reserve	2				Reserve
(b) paddock	2				Urban Open Space
9. Black Street, Yarralumla	3	4.1	GAP 32: - 3		Urban Open Space
10. Dunlop Hills Grassland Reserve	3	20.0	GAP 3: - 3	#	Reserve
11. Dudley Street, Yarralumla	4	0.9	GAP 30: - 3		Urban Open Space
12. Lady Denman Drive, Yarralumla	4	2.5	GAP 29: - 3	#	Urban Open Space
13. Lake Ginninderra (Site A)	4	0.1	GAP 19: - 3		Urban Open Space
14. Constitution Avenue, Campbell	4	3.0	GAP 26: - 3	#	Urban Open Space
15. CSIRO Limestone Avenue, Campbell	4	2.8	GAP 25: - 3		Memorandum of Understanding
16. Yarramundi Reach (Site C)	4	1.0	GAP 24: - 4		Memorandum of Understanding
NSW SITES:					
17. "The Poplars"	(-)	1.0		Rl, Tlp	
18. Letchworth ♠	(-)	55.0		Rl	
19. Ginninderra Road ♠	(-)	91.0			
20. Gundaroo Common ♠	(-)	1.0			
21. Spring Range Road ♠	(-)	2.0			
22. Sutton ♠	(-)	1.0			

Shaded areas indicate sites that are Public Land - Nature Reserve.

♠ = Recently surveyed grassland sites near the ACT border (Clarke and Dear 1998). ϑ = Reservation to be considered as part of further evaluation of planning and conservation issues.

* = Areas indicated in column are for the general area for Natural Temperate Grassland. *Synemon plana* and *Danthonia* sp. may occupy all the area or part of the area where the grassland is dominated by *Stipa* or *Themeda*.

< = The areas shown for *S. plana* occupation are an estimate only and cover both (a) and (b), which refer to the one population. Each of the two populations partially occurs within the Mulligans Flat Reserve and partially in an adjoining rural lease. However, there is much of Mulligans Flat which the species is not likely to occupy.

Key to species - Ap = *Aprasia parapulchella*, Di = *Delma impar*, Rl = *Rutidosis leptorrhynchoides*, Tlp = *Tympanocryptis lineata pinguicolla*, # = uncommon or declining species which are not formally listed.

GAP = Grassland Action Plan Location Number - this number is used as a location reference in the Natural Temperate Grassland Action Plan (Action Plan No. 1). Its use in Action Plans for component species, such as *S. plana* indicates that the habitat of the species in question more or less coincides with the natural temperate grassland site referred to.

Note: The Campbell Park and Majura Valley East sites are represented by two entries - this is because the two locations are subject to different land uses.

Population size estimates of males at York Park were 520 (1992-3), 456 (1993-4) and 736 (1994-5) or a mean for the three years of 571 (Harwood *et al.* 1995). The area of York Park is approximately 0.4 hectare and this gives a crude population of 1700 males per hectare. There is no information about the sex ratio in adult *S. plana* and the females are so much more inconspicuous than the males that no population estimates were attempted at York Park. A 1:1 sex ratio would give a population density of 3500 per hectare. A two year life cycle would mean that double the number of adults observed are potentially present but the genetic interchange between the odd and even cohorts may be low.

The observed population size may be very different from the effective population size which is the important parameter in terms of genetic criteria. Preliminary unpublished results by Dr Geoff Clarke (conservation biologist, CSIRO Entomology) suggest that, in the *S. plana* populations in the ACT, the effective population size (the number of individuals actually reproducing each generation) is much lower than the observed population size. This suggests that small sites may be less viable than the observed population size would indicate (G. Clarke pers. comm.).

DISTRIBUTION

Museum records show that the species was common and widespread prior to 1950. The known distribution of *S. plana* from museum specimens extended from Bathurst, NSW, through the Southern Tablelands of NSW and central Victoria to the South Australian border (Edwards 1993). There are about 30 localities in Victoria represented by museum specimens. Currently, the species is known from 16 sites in the ACT of various sizes, 11 sites in NSW, and five sites in Victoria. The NSW sites are at Boorowa, Binalong, Rye Park, Sutton, Gundaroo and areas immediately north of the ACT, and at Queanbeyan (Clarke and Dear 1998). The same survey has not located any populations in the Goulburn, Tarago and Bungendore areas, or on the Monaro (Bredbo, Cooma, Adaminaby and Dalgety). All are below 700 m which suggests that *S. plana* is a western species at the limits of its range (Clarke and Dear 1998).

In the ACT, the species occurs in lowland areas adjacent to the city of Canberra and within the city (Figure 2, Table 1). There are extensive populations within the Majura Field Firing Range and the Belconnen Naval Station. There are less extensive populations within large grassland sites at "Woden" Property in the Jerrabomberra Valley and in the Mulanggary Grassland Reserve in Gungahlin. Together, these make up the four sites of high conservation value. Smaller sites at Campbell Park, York Park in Barton, Mulligans Flat (North and South), Black Street in Yarralumla and the Dunlop Hills Grassland Reserve in Belconnen contain populations of high to moderate density (Edwards 1994). A further six sites contain very small populations, which may not be viable in the short to medium term.

Conservation Status

S. plana is recognised as a threatened species in the following sources:

Australian Capital Territory

Endangered. - Section 21 of the *Nature Conservation Act 1980,* Determination No. 7 of 1998 (formerly Determination No. 29 of 1996).

Special Protection Status Species. - Schedule 6 of the *Nature Conservation Act 1980,* Determination No. 77 of 1996.

New South Wales

Endangered. - Part 1, Schedule 1 of the *Threatened Species Conservation Act 1995* (NSW). Final determination made by NSW Scientific Committee (1996).

Victoria

Endangered. - CNR (1995). *Threatened Fauna in Victoria - 1995*. Department of Conservation and Natural Resources, Victoria.

Threats to Populations in the ACT Region

Loss or degradation of habitat is the major threat to *S. plana*. There has been a serious decline in the quantity and quality of habitat throughout its range including the ACT. About 5% or 1000 hectares of the natural grassland still exists in moderate to good condition and only a subset of this is dominated by suitable *Danthonia* species. The habitat continues to be in demand for urban, industrial and infrastructure development as well as being vulnerable to alteration by agricultural practices.

Fragmentation and isolation of the remaining areas results from the loss of extensive areas of habitat. Fragmentation has impeded the ability of the relatively immobile female to recolonise areas and therefore restricts gene flow.

The invasion of native grasslands by weeds and other introduced species has contributed to a decline in the quality of the habitat, and in numerous cases, to the effective destruction of the native grasslands. Exotic species such as Toowoomba Canary Grass (*Phalaris aquatica*),

Paspalum (*Paspalum dilatatum*), Serrated Tussock (*Nasella trichotoma*), Chilean Needle Grass (*Stipa neesiana*), Brome Grasses (*Bromus* spp.), Wild Oats (*Avena* spp.), Clovers (*Trifolium* spp.), Flatweed (*Hypochoeris radicata*), Fescue (*Festuca elatior*) and Plantain (*Plantago lanceolata*), pose a continuing threat to the surviving areas of *Danthonia* dominated grassland.

Natural grazing by native animals and grazing by introduced livestock under some agricultural regimes may have done little damage to *Danthonia* grasslands and *S. plana* populations. Indeed, light grazing may have increased areas of native grassland dominated by *Danthonia* (Sharp 1997). Cessation of, or changes in, these regimes may modify structure, lead to changes in species composition and result in degradation of the grassland. More intense agricultural practices involving fertiliser application, sowing introduced pasture species, or cultivation, are also destructive to native grasslands.

There is no evidence that predators have contributed to the decline in *S. plana*.

Major Conservation Objectives

The objective of this Action Plan is to maintain, in the long term, the existing viable populations of *S. plana* in their natural habitat, as a component of the indigenous biological resources of the ACT and as a contribution to regional and national conservation of the species. This is interpreted to include the maintenance of the species' potential for evolutionary development in the wild.

This objective is to be achieved by:

- Protecting and managing those sites where habitat of high conservation value remains.
- Developing detailed management strategies for remaining sites of lower conservation value where populations of *S. plana* remain viable.
- Continuing monitoring and research on the native *Danthonia* grasslands, and on the species and its biology, so that potential threats may be recognised and understood, with effective management practices implemented with minimal loss of habitat.

These objectives will be assisted by:

- Developing cooperative management arrangements (Memoranda of Understanding) between the Commonwealth Government and ACT Government on the two major sites that occur on land occupied by the Department of Defence.
- Negotiating with rural lessees for cooperative management arrangements (Property Management Agreements) for the other sites of moderate to high conservation value.
- Managing remaining sites to consider habitat requirements for the species.
- Supporting survey of further habitat in the ACT region.

Conservation Issues and Intended Management Actions

GENERAL

The *Danthonia* grasslands currently harbouring the species are subject to some low intensity management activities which serve to benefit low growing plants. Suburban sites are mown, rural sites are grazed and the Belconnen Naval Station is both mown and grazed. It is desirable that these areas continue to be managed in a manner similar to current practices with a view to maintaining *S. plana* populations. An adaptive management regime will need to be implemented, allowing for practices to be adjusted in accordance with greater scientific knowledge and future monitoring results.

Predators are not viewed as a problem and no steps need be taken to control or exclude pests, except weeds. Nor is human access to sites a problem so long as it is not so intensive as to damage the grassland. Indeed, human access may be encouraged, consistent with the need to ensure interested people are well informed of the purpose of, and activities at, a site.

The protection of Natural Temperate Grassland, an **endangered** ecological community, and other threatened species which inhabit this community, will allow for significant and complementary conservation actions.

⇒ Issues, research needs and management actions set out in this Action Plan will be coordinated with the actions identified in the Action Plan for Natural Temperate Grassland, of which the species' principal habitat, the *Danthonia* grasslands, is a component.

Possible Management Conflicts

Some sites harbour *S. plana* and the Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*) (also listed as endangered), notably the site on "Woden" Property and at the Majura Field Firing Range. Although reptiles may be predators of *S. plana,* there is no reason on the basis of current knowledge why a site should not be managed for the dual conservation of both *S. plana* and *T. l. pinguicolla*.

On the other hand, *S. plana* has been found in sites also inhabited by Striped Legless Lizard *(Delma impar)* (listed as vulnerable). *D. impar* requires a dense grass cover, which does not provide suitable habitat for *S. plana*. Some grasslands inhabited by both *D. impar* and *S. plana* may have been maintained in a suitable condition for *S. plana* by mowing or grazing. Changing management by reducing grazing or mowing intensity may make these sites more suitable to the Striped Legless Lizard, but less suitable to *S. plana*. It should be clearly determined how a site is to be managed for the moth and the Striped Legless Lizard. In a similar manner, the possibilities and conflicts in managing a grassland for *S. plana* and for the vegetation community, including uncommon or threatened plants, such as the Button Wrinklewort (*Rutidosis leptorrhynchoides*) will also need to be assessed. Management programs should be developed accordingly.

⇒ Possible conflicts in conservation objectives will be resolved in the context of documented management arrangements for each location.

SURVEY

Surveys in November and December 1997 covered much of the potentially suitable grassland habitat in south-eastern NSW and located 10 new sites. These include five sites in close proximity to the ACT, two of which have areas greater than 50 ha (Ginninderra Road and Letchworth) and five in the area north-west of Yass, around Binalong, Boorowa and Rye Park (Clarke and Dear 1998). Additional small sites of lesser conservation value may not be currently known but it is likely that all significant regional sites are now recognised.

⇒ Sites known to contain *S. plana* in the ACT will be surveyed to determine the extent of populations.

⇒ Any additional sites in the ACT that contain the *Danthonia* vegetation association, which provide potential habitat for the species, will also be surveyed.

⇒ Where additional site information becomes available, management and protection measures consistent with this Action Plan will be implemented.

Knowledge of the significance and viability of populations in the region is an essential prerequisite to placing the ACT information into a proper biogeographical context. This will enable the relative significance of different areas in the region to be assessed for their importance to the survival of this species and will assist regional planning for both development and conservation purposes.

⇒ Environment ACT (Wildlife Research and Monitoring (WR&M)) will continue to liaise closely with the NSW National Parks and Wildlife Service (NSW NPWS) to ensure sharing of information, coordination, and a regional approach to the conservation of *S. plana*.

MONITORING

It is essential that the composition of the grasslands and *S. plana* populations of major sites continue to be monitored. This is because changes in management practices can lead to degradation of the grassland habitat. Invasion by weeds can damage and destroy a grassland without overt human activity. These changes can occur slowly, and unless monitored, may proceed too far before they are detected. Gaps in knowledge mean that changes in the *S. plana* population cannot be foreseen in any detailed way and direct observation is the only means of assessing the welfare of a population.

Intensive monitoring of the York Park population was conducted in the three seasons from late 1992 to early 1995 (Cook and Edwards 1993, 1994; Harwood *et al* 1995). This monitoring program involved marking individuals in a capture-mark-recapture procedure which permitted estimates of the population (males only) and estimates of longevity. These procedures are very labour intensive and not suitable for long term work, but could be used as an occasional quantitative check on a more practical procedure. Monitoring by a less rigorous method (outlined in Edwards 1994) is more practicable and should give an indication of the size of the population if conducted in optimal conditions. Monitoring by this method - ie. counting the number of males observed over a short period, has been continued by Environment ACT (WR&M) at the Majura Field Firing Range and at York Park since the more intensive studies ceased.

⇒ Environment ACT (WR&M) will maintain a long-term monitoring program for *S. plana* to assist it in applying appropriate management strategies.

⇒ The impacts of management practices on the *S. plana* and its grassland habitat will be monitored regularly. The impacts of changes to management practices will also be monitored.

⇒ A program of periodic review of the results of all monitoring will be implemented. The review program will provide a mechanism for adjustment and modification to management practices to achieve conservation goals.

RESEARCH

There is a need for further ecological research on *S. plana*. Some ecological research is being undertaken at CSIRO Entomology in Canberra and at the University of Melbourne on Victorian populations. Important aspects of the species' biology where further knowledge would be helpful for management purposes include:

- biology of the larval stage;
- fecundity and dispersal potential;
- ecological requirements of the species, including its relation to *Danthonia* spp., other flora, soils, and ability to move between fragmented habitat; and
- genetic variability within and among populations: preliminary genetic analyses of six ACT populations have indicated relatively low levels of genetic variability, which suggests that the effective population size is considerably lower than the observed population size; further information should make it possible to rank populations on their amount and pattern of variability.

⇒ Environment ACT (WR&M) will encourage research work directed towards an understanding of the key biological parameters of *S. plana* and their application to management related issues, requirements and constraints, particularly the:

1. dynamic response of the species and its grassland habitat to management practices, including burning, grazing, mowing, and soil disturbance;
2. impacts of grassland management on *S. plana* within reserves; and
3. population viability.

MANAGEMENT

Provisional management recommendations have been prepared for the National Capital Authority (NCA) for the maintenance of the York Park site (Edwards 1995). These recommendations hold for small sites in a suburban setting. The issues addressed were:

- invasion by weeds;
- changes in water regimes;
- shading, edge effects and fire;
- soil disturbance;
- spoil from surrounding activities;
- fertiliser application;
- vegetation, mulch and exotic species; and
- public access and information.

On larger sites and rural sites, invasion by weeds and fire management are the major concerns.

Management to maintain low grassland structure by controlling tall species, including other native grasses and exotic plants, is the principal reason for grazing or mowing. Essentially, taller more vigorous weeds shade and compete for light with *Danthonia,* which is very low growing. Taller plants are more likely to be cropped by grazing and mowing, disadvantaging the weeds and encouraging the *Danthonia*. Mowing and grazing should be most effective in early to mid spring when the vigorous weeds make most of their growth. Mowing several times in spring may therefore be necessary, in fact, mowing even while the moths are flying is better than not mowing at all (Edwards 1995). Grazing should be most intense in spring, if possible, for best control of weeds but care should be taken to ensure that grazing is not so heavy as to prevent seeding of the *Danthonia*. This may conflict with requirements to restrict mowing or grazing in spring in order to enable native plants to set seed and for seedlings to establish.

The effects of fire are largely unstudied. In theory *S. plana*, except as adults, should be resistant to fire as it is underground. Observations on other species suggest that moths fly in normal numbers after a fire. However, there are observations suggesting that populations may fall in the years following a fire before they build up again. *Synemon plana*, as larvae, feed on the underground reserves of plants and as these reserves are mobilised following a fire, the reserves available to the species must be reduced. It seems likely that the effects of fire are not catastrophic and infrequent wildfires can be withstood (E. Edwards, pers. comm.). Regular burning, unless balanced by very positive advantages to the health of the grassland, will in general be detrimental. As a precautionary measure, care should be taken with fire used as a management tool so that only a small proportion of any site is burnt at any one time.

⇒ An adaptive approach to management of habitat and species values (including fire regimes) will be developed. The approach will ensure that new knowledge, including results from research and monitoring studies, is used to adjust or modify management practice where necessary to achieve conservation outcomes.

⇒ Environment ACT (WR&M) will develop management guidelines based on considerations discussed in this Action Plan to assist landholders to manage sites so as to conserve and maintain the moth habitat and population consistent with other land activities and other conservation requirements.

EDUCATION AND LIAISON

As with any threatened species, the importance of informing the community and people responsible for managing their habitat is substantial.

⇒ Environment ACT will compile and distribute management guidelines and maintain contact with land managers responsible for areas on which populations presently occur.

⇒ Environment ACT will closely liaise with regional bodies, including the NSW NPWS, NSW local councils and the management team for the Joint Regional Biodiversity Survey of Grassy Ecosystems Project.

Environment ACT (Parks and Conservation Service) and CSIRO Entomology have jointly produced a poster *Disappearing Insects of Native Grasslands*, funded by the Endangered Species Program, Environment Australia. This poster prominently features *S. plana.*

⇒ Environment ACT will prepare and distribute to appropriate target audiences information about the species and its conservation - this will include providing information to the public on the conservation, management and research actions being undertaken, so that measures being implemented are understood and supported.

Protection

CONSERVATION VALUES

An approach to conservation planning for *S. plana* and its habitat is based on the grouping of all known ACT sites into categories of high (Rating 1), moderate (Rating 2), low (Rating 3) and minimal conservation value (Rating 4). Within these categories, each site is listed below in order of importance. The rating of sites is necessarily partly subjective but quantitative data were collected for the density of *S. plana* populations and the area and condition of most of the sites. The criteria used for establishing this ranking are:

- the size and density of the *S. plana* population; and
- the area and condition of the *Danthonia* grassland.

High Conservation Value (Rating 1):

1. Belconnen Naval Station (GAP 20).
2. Majura Valley East (Firing Range and Airport) (GAP 28).
3. Jerrabomberra West (Site A, "Woden") (GAP 36).
4. Mulanggary Grassland Reserve (Gungahlin -Site C) (GAP 6).

Moderate Conservation Value (Rating 2):

5. Campbell Park Offices (GAP 27).
6. Mulligans Flat North (Reserve and adjacent agisted paddock), Gungahlin.
7. York Park, Barton (GAP 34) - the rating is increased slightly because of the scientific work which has been based on the site.
8. Mulligans Flat South (Reserve and adjacent agisted paddock).

Low Conservation Value (Rating 3):

9. Black St, Yarralumla (GAP 32).
10. West Belconnen (GAP 3 - Site C).

Minimal Conservation Value (Rating 4):

The sites in this group are so small that continued survival of moth populations is doubtful, even under optimum conditions.

11. Dudley St, Yarralumla (GAP 30).
12. Lady Denman Drive, Yarralumla (GAP 29).
13. Lake Ginninderra (Site A) (GAP 19).*
14. Constitution Ave, Campbell (GAP 26).
15. CSIRO Limestone Avenue, Campbell (GAP 25). *
16. Yarramundi Reach (GAP 24). *

Note: GAP refers to the site number in the Natural Temperate Grassland Action Plan. A fuller explanation is provided as a footnote to Table 1.

Conservation management of these areas may be implemented in recognition of their conservation values to other species or the natural temperate grassland community. Protection of the *S. plana* population may therefore occur as a result of other measures. Recent surveys by Dr Geoff Clarke, CSIRO Entomology, failed to locate *S. plana* at the three sites indicated by *.

MEASURES FOR PROTECTION

The known *S. plana* populations occur in remnant native grassland on land under a variety of tenures including Territory Land-Nature Reserve managed by Environment ACT, rural leasehold land, Urban Open Space, and Commonwealth owned and managed land (National Land). Grassland remnants are often small in size, and may be isolated from one another by areas used for urban, agricultural or other land purposes.

Conservation effort in the ACT for *S. plana* will focus on protecting viable functional native grassland habitat in a cluster of sites occurring within the ACT. The four sites of high conservation value (Rating 1), located in Gungahlin, Belconnen, and the Majura and Jerrabomberra valleys, will be assigned the highest degree of protection. Their importance is based not only on the size and density of the *S. plana* population, but also on the botanical significance, representativeness and size of its habitat, along with the presence of other threatened species. The Majura Field Firing Range (GAP 28), the Belconnen Naval Station (GAP 20) and "Woden" property (GAP 36) are all identified in the Natural Temperate Grassland Action Plan as being core natural temperate grassland sites warranting the highest degree of protection.

In Gungahlin, the species is found in two reserved areas. The Mulanggary Grassland Reserve (Rating 1) contains significant populations and the Mulligans Flat Reserve (Rating 2) contains a small population in an open area within woodland and another small population in secondary grassland along the southern boundary. There is also a small population in the Dunlop Hills Grassland Reserve in West Belconnen. However, there is no formal protection for any of the other sites within the ACT. Consideration therefore needs to be given to the survival of the species, particularly at the other moderate to high conservation value sites at the Belconnen Naval Station and in the Majura and Jerrabomberra valleys.

The Belconnen Naval Station has been identified as an area to be transferred to the ACT Government on vacation of the site by the Navy.

In the Majura and Jerrabomberra valleys, there are opportunities to achieve protection coincidentally with that of grasslands and other threatened species, including the Striped Legless Lizard (*Delma impar)* and the Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla)*. In the case of the Majura Field Firing Range and the Campbell Park Offices in the Majura Valley, protection measures may also serve to protect a sizeable population of the endangered Button Wrinklewort (*Rutidosis leptorrhynchoides)*.

Protection of *S. plana* Populations

Protection of *S. plana* in native grassland habitat will be achieved through the provisions of the *Land (Planning and Environment) Act 1991*, the Territory Plan and Memoranda of Understanding with Commonwealth agencies. The mechanisms available to the Territory are reservation under the Territory Plan and Property Management Agreements (PMAs) with rural lessees. The Conservator of Flora and Fauna also has powers under the *Nature Conservation Act 1980* to protect threatened flora and fauna.

Measures for effective protection of *S. plana* are identified through an assessment of the conservation values of the species and needs of each native grassland habitat site. Where specific measures have been identified for the protection of natural temperate grassland sites (see the Natural Temperate Grassland Action Plan), these are given as the recommended protection for *S. plana.*

The areas identified in the following tables generally refer to the size of the area containing the natural temperate grassland; in most instances the exact extent of *S. plana* populations within these areas has not been ascertained.

(I) Territory Plan - Hills, Ridges and Buffers with Public Land Overlay of Type Nature Reserve

Reservation is generally recognised as the mechanism for ensuring that sites of high conservation value are not eventually converted to a land use incompatible with their natural values (Caughley and Gunn 1996). Reservation is therefore an important mechanism for the protection of *S. plana* and its habitat. Reservation does not exclude the option of managing controlled grazing to achieve conservation objectives through agistment arrangements with local rural landholders.

The Commonwealth owned component of the Campbell Park grasslands, along with the Belconnen Naval Station, are included as they are recommended for transfer to the ACT Government, with consideration for reservation, based on further evaluation of planning and conservation issues (refer to the Natural Temperate Grassland Action Plan).

Areas already set aside, together with those to be considered as Nature Reserve, are listed in Table 2.

Table 2. Hills, Ridges and Buffers: Public Land - Nature Reserve.

Location and site	GAP No.	Area (ha)	Cons. Rating	Current Status
Gungahlin: Mulanggary	6	82.8	1	Reserve
Mulligans Flat North & South (reserve)	N/A	*	2	Reserve
Dunlop Hills Reserve	3	20.0	3	Reserve
Reservation to be considered as part of further evaluation of planning and conservation issues				
Jerrabomberra West: "Woden"	36	72.4	1	Rural Lease
Belconnen Naval Station	20	106.5	1	National Land
Campbell Park: Offices Paddocks	27	3.3 9.0	2 2	National Land

The shaded area indicates sites that are Public Land - Nature Reserve.

* = Areas for the Mulligans Flat populations cannot be precisely determined as they overlap in part with adjoining rural leases.

Note: GAP No. = Grassland Action Plan Number. This number is used as a site reference in the Natural Temperate Grassland Action Plan.

(ii) Memoranda of Understanding

Memoranda of Understanding (MOU) provide another means of ensuring that sites with high conservation value will be managed so as to maintain their conservation value in perpetuity while enabling other compatible land uses, as identified in the MOU, to occur. An MOU with the Commonwealth does not preclude the possibility of the land being reserved in the future under Commonwealth legislation.

MOU are appropriate for Commonwealth-owned or occupied land, or other land where long-term land uses will not compromise conservation values (for example, land used for Defence purposes or communication facilities). Areas of National Land supporting *S. plana,* for which an MOU will be negotiated, are listed in Table 3.

In order to provide protection at the highest level for the sites of high conservation value (Rating 1), interim management arrangements will be put in place between land managers and Environment ACT until reservation or Memoranda of Understanding are achieved.

Table 3. Memorandum of Understanding to achieve protection equivalent to reservation.

Location and site	GAP No.	Area (ha)	Cons. Rating	Current Status
Majura Valley (E):				
Field Firing Range	28	142.2	1	National Land
Airport	28	47.1	1	National Land
York Park, Barton	34	0.4	2	National Land/ Urban Open Space
CSIRO: Limestone Avenue	25	2.8	4	National Land
Yarramundi Reach	24	1.0	4	National Land

Other Areas Supporting *S. plana*

There are several areas of varying sizes with modified grassland habitat supporting *S. plana*. These are not proposed to be protected either as nature reserves under the Territory Plan or through an MOU with the Commonwealth. However, parts of these areas may be appropriately managed to retain their conservation values for the species. Such arrangements include planning and management agreements with non-government landholders and protection of sites within the urban fabric.

⇒ Sites will be included where feasible in appropriate Public Land categories under the Territory Plan.

⇒ To ensure that the conservation values of these areas are protected, management agreements that incorporate conservation objectives will be developed for implementation by the relevant agency.

(i) Public Land (Urban Open Space)

Most land included in Hills, Ridges and Buffer Areas is identified as Public Land and can therefore be assigned a category under the Territory Plan. This would include (other than Nature Reserves), Urban Open Space and Special Purpose Reserves. Activities permitted in these land use categories can be compatible with conservation values, provided that appropriate conservation management is in place. In these cases, maintenance of the conservation values of the site is the responsibility of the relevant ACT Government agency. Other similar land uses include road reserves and powerline easements. Areas of Public Land supporting *S. plana* are listed in Table 4.

Table 4. Public Land - Urban Open Space

Location and site	GAP No.	Area (ha)	Cons. Rating	Current Status
Black St., Yarralumla	32	4.1	3	Urban Open Space
Dudley St., Yarralumla	30	0.9	3	Urban Open Space
Lady Denman Drive, Yarralumla	29	2.5	4	Urban Open Space
Lake Ginninderra	19	0.1	4	Urban Open Space

(ii) Other Land Categories

Where Territory Land includes other sites with populations of *S. plana,* these may be retained and appropriately managed within the development context, by consideration at the appropriate stages of the concept planning and development approval process. Such measures provide a means of enabling the primary land use to continue while accommodating the conservation needs of *S. plana* habitat on the site, but without the additional protection mechanism of being Public Land.

Where small sites occur within urban leases, advice can be provided to assist landholders to maintain conservation values. Advice may be given as site management guidelines and plans. This enables protection and management of areas occurring as road reserves, easements and urban parks, since they can be maintained as landscape features, research resources or buffers. Similar guidelines are relevant for sites which are currently under rural agistment pending development, such as the two areas adjacent to the Mulligans Flat Reserve. When incorporating these sites into the urban fabric, the entire site may not be retained. In these instances, boundaries of the areas to be incorporated require clarification.

These planning and site management measures do not preclude future land use changes, but are intended to retain the conservation values of the sites until future land use decisions are made. Urban leases supporting *S. plana*, for which negotiation of site management guidelines are appropriate, are listed in Table 5.

⇒ Planning and site management mechanisms will be applied as required to urban sites so that, where possible, the natural grassland values of the *S. plana* habitat are conserved in the context of the primary land use.

Table 5. Sites within the Urban Fabric

Location and site	GAP No.	Area (ha)	Cons. Rating	Current Status
Mulligans Flat North (paddock)	N/A		2	Rural Lease
Mulligans Flat South (paddock)	N/A		2	Rural Lease
Constitution Avenue, Campbell	26	3.0	4	Designated Land.

MFR = Mulligans Flat Reserve.

Grassland Areas Requiring Further Investigation

There are several further sites containing the *Danthonia* grassland association, which provide potential habitat for the species. These are yet to be assessed to determine their conservation significance and value. Assessment of the conservation significance of these sites will be conducted as soon as practicable. Protection measures for each are already outlined in the Natural Temperate Grassland Action Plan.

OTHER ACTIONS FOR PROTECTION

The Draft Canberra Nature Park Management Plan and the Action Plan for Natural Temperate Grassland will provide further support for the conservation management of *S. plana* and its habitat.

Environment ACT will work with Planning and Land Management and the National Capital Authority to ensure that land uses in areas adjacent to sites supporting *S. plana* are compatible with conservation objectives and to minimise any adverse impacts.

The Royal Australian Naval Transmitting Station site (Belconnen Naval Station) has been listed on the Register of the National Estate, on the basis of its conservation value for *S. plana*.

Socio-economic Issues

The main social benefits of conserving representative communities of natural temperate grassland in which *S. plana* occurs are:

- meeting community concerns that further loss or extinction of significant ecological communities, together with their component native species, be prevented;

- the amenity and recreational values associated with the grassland reserves, in which the species occurs; and
- the tourism potential of a successful program to protect a threatened species along with its endangered habitat.

The potential for economic utilisation of native grassland habitat sites is relevant for those sites where current management or land uses are deemed to be compatible with the retention of conservation values.

There are four main aspects of planning in Canberra that will be affected by the implementation of this Action Plan: These are:

1. Future Urban Areas

Proposals for future urban areas, as identified in either the National Capital Plan or the Territory Plan, and provided for in the Residential Land Release Program may for some areas have their viability affected by the size and location of possible future *S. plana* reserves.

2. Transport Facilities

The provision and/or upgrading of the following transport facilities may be affected:

- Majura Parkway - southern section and connections
- William Slim Drive - possible extension (Belconnen Naval Station)
- Very High Speed Train corridor (Majura and Jerrabomberra valleys)
- John Dedman Parkway- Kaleen East paddocks (potential *S. plana* habitat*).*

3. Industrial Areas

The planning for future industrial areas, in particular, a possible extension to the Hume industrial area and a possible industrial complex associated with the Airport in the Majura Valley. Some potential habitat adjacent to the Mitchell Industrial Area may also be affected.

4. Rural Leasing Aspects

One of the four sites of high conservation value, Jerrabomberra West (Site A) on "Woden" property, is within a rural lease. Preliminary investigations indicate that this lease currently contains withdrawal clauses allowing for the use of land for public purposes. The Rural Policy Taskforce has recently reviewed all aspects of rural leases including the recommendation of appropriate lease terms. Two recommendations of the Taskforce that will affect the Action Plans are that:

- the lease term for the Jerrabomberra Valley will be to the year 2020; and
- there will be no withdrawal clauses over any part of a rural lease unless it has been clearly defined for an imminent public work, such as a road, stormwater or other infrastructure.

This will mean that the Territory would have to withdraw any area of land having conservation significance at the time of an application for a new lease, or acquire it subsequently under the provisions of the *Land Acquisition Act 1994*.

It is expected that it will be sometime later in 1998 before rural lessees are able to take up a new lease as proposed by the Taskforce. In the meantime, Environment ACT will need to identify areas requiring special conservation measures before applications for extended lease terms are received. In the event that large areas of a lease will be withdrawn for conservation purposes, consideration will be given to the viability of the remainder of the lease.

In addition to the issues outlined above, there are some site specific issues which need to be addressed in order to implement the protection measures specified in this Action Plan. These are:

- Belconnen Naval Station, Lawson (GAP 20): This area potentially has high value as residential land. A decision on conservation will be complex given that the land is currently owned by the Commonwealth and may be transferred to the Territory in the near future.

- Mulligans Flat (north) agistment paddocks, Forde: This area has yet to have detailed planning conducted. Grassland conservation will be considered in the urban structure review of Forde and Horse Park, and lease boundaries and land use policies will be determined at that stage. This will be undertaken during the urban structure review process.

Legislative Provisions

The following legislation is relevant to conservation of flora and fauna in the ACT:

Nature Conservation Act 1980

The Nature Conservation Act provides a mechanism to encourage the protection of native plants and animals (including fish and invertebrates), the identification of threatened species and communities, and management of Public Land reserved for nature conservation purposes. Specified activities are managed via a licensing system.

Native plants and animals may be declared in recognition of a particular conservation concern

and increased controls and penalties apply. Species declared as endangered must also be declared as having special protection status, the highest level of statutory protection that can be conferred.
As an endangered species, *S. plana* must be declared a special protection status (SPS) species and any activity affecting an SPS species is subject to special scrutiny. Conservation requirements are of paramount consideration and only activities related to conservation of the species or serving a special purpose are permissible. The Conservator of Flora and Fauna may only grant a licence for activities affecting a species with SPS where satisfied that the act specified in the licence meets a range of stringent conditions. Further information can be obtained from the Licensing Officer, Compliance and Quarantine Services, Environment ACT, telephone 6207 6376.

Natural Temperate Grassland, of which the *Danthonia* component provides habitat for *S. plana*, has been declared as an endangered ecological community (currently Determination No. 7 of 1998). The Conservator of Flora and Fauna has prepared an Action Plan for its conservation.

Land (Planning and Environment) Act 1991

The Land (Planning and Environment) Act is the primary authority for land planning and administration. It establishes the Territory Plan, which identifies nature reserves, national parks and wilderness areas within the Public Land estate. The Act also establishes the Heritage Places Register. Places of natural heritage significance be identified and conservation requirements specified.

Environmental Assessments and Inquiries may be initiated in relation to land use and development proposals.

***Australian Heritage Commission Act 1975* (C'th)**

The Australian Heritage Commission Act establishes the Register of the National Estate (RNE) and imposes a special duty of care on Commonwealth agencies in relation to actions that have an adverse effect on any part of a place entered in the Register. The Belconnen Naval Station and precinct have been entered in the RNE in recognition of its habitat value for *S. plana.*

Consultation and Community Participation

For the best management of National Land and rural leases, liaison and agreements between Environment ACT and Commonwealth agencies and rural lessees will be necessary.

Community participation with activities assisting the conservation of native grasslands and *S. plana* will be encouraged through groups such as the Friends of Grasslands and Park Care Groups operating near grassland areas supporting the species. Information on the conservation of the species will be incorporated into community education programs conducted by Environment ACT.

The conservation of *S. plana* and its associated *Danthonia* habitat will be promoted through suitable information signs, community liaison and public education. The National Capital Authority has an information sign in preparation for York Park to explain the purpose of that site.

⇒ Public access to sites will be encouraged provided it is consistent with the requirements of landholders or lessees and is not likely to cause damage to the grassland. Encouragement will be given to the constructive involvement of community organisations.

⇒ Environment ACT will cooperate with NSW NPWS in surveying for *S. plana* and in identifying likely habitat in southern NSW.

Implementation and Review

RESPONSIBILITY FOR IMPLEMENTATION

Environment ACT (WR&M) will be responsible for coordinating implementation of this Action Plan, subject to the availability of Government resources. Primary responsibility for conservation and management of grassland communities supporting *S. plana* on Territory Land will rest with the ACT Parks and Conservation Service whilst relevant Commonwealth agencies will have responsibility for National Land, although provisions in the *Nature Conservation Act 1980* (ACT) are still applicable.

⇒ The ACT Government will seek the cooperation of the Commonwealth Government in setting in place coordinated and complementary action to protect the species' native grassland habitat in the ACT.

EVALUATION

Implementation of this Action Plan will be a collaborative exercise between government agencies, landholders and the community generally. Commonwealth and NSW participation will be critical in some cases. The Action Plan will be reviewed after three years. The review will

comprise an assessment of progress using the following performance indicators:

- completion of commitments that can reasonably be expected to be finalised within the review timeframe (e.g. introduction of a statutory protection measure for a species; development of a management plan);
- completion of a stage in a process with a time line that exceeds the review period (e.g. design or commencement of a research program);
- commencement of a particular commitment that is of a continuing nature (e.g. design or commencement of a monitoring program for population abundance); and
- expert assessment of achievement of conservation objectives of the Action Plan.

The review will be reported to the ACT Flora and Fauna Committee. This will provide an opportunity for Environment ACT and the Flora and Fauna Committee to assess progress, take account of developments in nature conservation knowledge, policy and administration, and review directions and priorities for future conservation action.

The following conservation actions will be given priority attention:

⇒ completion of surveys in all known native grassland sites where the species occurs (including those that contain potential habitat) to determine the extent of the population;

⇒ establishment of a monitoring program to provide information on how populations respond to management practices and environmental pressures;

⇒ putting in place protection measures; and

⇒ establishing liaison mechanisms with NSW authorities and determining the regional distribution and conservation status of the species.

Acknowledgments

Material for this draft Action Plan was prepared for Environment ACT by Mr E.D.Edwards, CSIRO Entomology.

The illustration of the species (Figure 1) was prepared for Environment ACT by Sarah Reglar.

References

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

Britten, D.R., New, T.R. & Jelinek, A., 1995. Rare Lepidoptera at Mt Piper, Victoria: The role of a threatened butterfly community in advancing understanding of insect conservation. *Journal of the Lepidopterists' Society* 49: 97-113.

Caughley, G. & Gunn, A., 1996. *Conservation biology in theory and practice.* Blackwell Science, Carlton.

Clarke, G. & Dear, C., 1998. *A survey of native grassland site in southeastern New South Wales for the endangered Golden Sun Moth,* Synemon plana. A report prepared for the Threatened Species Unit, NSWNPWS Southern Zone. CSIRO, Canberra.

Common, I.F.B., 1990. *Moths of Australia*. Melbourne University Press, Carlton.

Cook, L. & Edwards, E.D., 1993. *Population monitoring of endangered moth* Synemon plana *1992-93, York Park, Barton*. CSIRO Division of Entomology report to the National Capital Planning Authority, Canberra.

Cook, L. & Edwards, E.D., 1994. *Population monitoring of endangered moth* Synemon plana *1993-94, York Park, Barton*. CSIRO Division of Entomology report to the National Capital Planning Authority.

Dear, C., 1997. *Restoration of a native grassland inhabited by* Synemon plana *(Lepidoptera).* MSc thesis, University of Melbourne.

Douglas, F., 1993. *The conservation status, distribution and habitat requirements of diurnal Lepidoptera in central and western Victoria. Part 1: Family Castniidae*. Report to the Department of Conservation and Natural Resources, Victoria.

Edwards, E.D., 1990. *Belconnen Naval Station harbours endangered moth.* Bulletin of the National Parks Association of the ACT, June 1990: pp. 16-17.

Edwards, E.D., 1991. *Synemon plana.* A grasslands case history. In Falconer, R., (ed.) *The ACT's native grasslands: Proceedings of a workshop*, pp. 20-23. Conservation Council of the South-east Region and Canberra, Canberra.

Edwards, E.D., 1993. The Golden Sun Moth, *Synemon plana* - an endangered species. *ANIC News* No. 2: 7-8.

Edwards, E.D., 1994. *Survey of lowland grassland in A.C.T. for the Golden Sun Moth* (Synemon plana). Report to the Wildlife Research Unit, ACT Parks and Conservation Service. CSIRO Division of Entomology, Canberra.

Edwards, E.D., 1995. *Provisional management recommendations for York Park moth site.* Report to the National Capital Planning

Authority. CSIRO Division of Entomology, Canberra.

Fraser, I. & McJannett, M., 1996. *Neighbours in trouble! Endangered plants and animals in the ACT.* Conservation Council of the South-East Region and Canberra, Canberra.

Harwood, T., Narain, S. & Edwards, E.D., 1995. *Population monitoring of endangered moth* Synemon plana *1994-95, York Park, Barton.* CSIRO Division of Entomology. report to the National Capital Planning Authority, Canberra.

Sharp, S.B., 1997. *Diversity, patterns and processes of vegetation and invertebrate orders in natural temperate grassland in the Australian Capital Territory*. MAppSc thesis, Faculty of Applied Science, University of Canberra.

List of Action Plans - June 1998

In accordance with Section 23 of the *Nature Conservation Act 1980,* the following Action Plans have been prepared by the Conservator of Flora and Fauna:

No. 1: Natural Temperate Grassland - an endangered ecological community.

No. 2: Striped Legless Lizard (*Delma impar*) - a vulnerable species.

No. 3: Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*) - an endangered species.

No. 4: A leek orchid (*Prasophyllum petilum*) - an endangered species.

No. 5: A subalpine herb (*Gentiana baeuerlenii*) - an endangered species.

No. 6: Corroboree Frog (*Pseudophryne corroboree*) - a vulnerable species.

No. 7: Golden Sun Moth (*Synemon plana*) - an endangered species.

No. 8: Button Wrinklewort (*Rutidosis leptorrhynchoides*) - an endangered species.

No. 9: Small Purple Pea (*Swainsona recta*) - an endangered species.

FURTHER INFORMATION

Further information on this Action Plan or other threatened species and ecological communities can be obtained from:

Environment ACT
(Wildlife Research and Monitoring)
Phone: (06) 207 2124
Fax: (06) 207 2122

or on the Environment ACT Homepage
http://www.act.gov.au/ environ

This document should be cited as:

ACT Government, 1998. *Golden Sun Moth* (Synemon plana): *An endangered species*. Action Plan No. 7. Environment ACT, Canberra.

ACTION PLAN No. 8

In accordance with section 21 of the *Nature Conservation Act 1980*, the **Button Wrinklewort (*Rutidosis leptorrhynchoides*)** was declared an **endangered** species on 15 April 1996 (formerly Determination No. 29 of 1996 and currently Determination No. 7 of 1998). Section 23 of the Act requires the Conservator of Flora and Fauna to prepare an Action Plan in response to each declaration. This is the Action Plan for the:

Button Wrinklewort
Rutidosis leptorrhynchoides

Preamble

The *Nature Conservation Act 1980* establishes the ACT Flora and Fauna Committee with responsibilities for assessing the conservation status of the ACT's flora and fauna and the ecological significance of potentially threatening processes. Where the Committee believes that a species or ecological community is threatened with extinction or a process is an ecological threat, it is required to advise the Minister for the Environment, Land and Planning, and recommend that a declaration be made accordingly.

Flora and Fauna Committee assessments are made on nature conservation grounds only and are guided by specified criteria as set out in its publication *Threatened Species and Communities in the ACT,* July 1995.

In making its assessment of the Button Wrinklewort, the Committee concluded that it satisfied the criteria indicated in the adjacent table.

An Action Plan is required to ensure, as far as is practicable, the identification, protection and survival of the species or the ecological community, or proposals to minimise the effect of any process which threatens any species or ecological community.

While the legal authority of this Action Plan is confined to the Australian Capital Territory, management considerations are addressed in a regional context.

Criteria Satisfied

1.1 The species is known or suspected to occur in the ACT region and is already recognised as endangered in an authoritative international or national listing.

1.2 The species is observed, estimated, inferred or suspected to be at risk of premature extinction in the ACT region in the near future, as demonstrated by the following:

- 1.2.1 Current severe decline in population or distribution, from evidence based on:
  - 1.2.1.1 direct observation, including comparison of historical and current records.
  - 1.2.1.3 severe decline in quality or quantity of habitat.
- 1.2.2 Imminent risk of severe decline in population or distribution from evidence based on 1.2.1.3
- 1.2.4 Severely fragmented distribution for a species currently occurring over a small range or having a small area of occupancy within its range.

Links with other Action Plans

Measures proposed in this Action Plan complement those proposed in the Action Plans for Natural Temperate Grassland, Yellow Box/Red Gum Grassy Woodland (in prep.), and component threatened species such as the Striped Legless Lizard (*Delma impar*), Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*) and the Golden Sun Moth (*Synemon plana*). Action Plans are listed at the end of this document.

Species Description and Ecology

DESCRIPTION

The Button Wrinklewort *(Rutidosis leptorrhynchoides)* (Figure 1) is a slender perennial forb, 25 - 35 cm tall and branching mainly at the base. The leaves are narrow, dark green, ageing to yellow-green and up to 2.5 cm long, with rolled edges concealing the undersides. The stems usually die back in late summer or autumn, and the new basal leaves appear by early winter. The species has yellow button flowers (2 cm wide) from December to April.

Figure 1: Button Wrinklewort (*Rutidosis leptorrhynchoides*). Scale: One third natural size.

Table 1. List of Regional Site Locations for *Rutidosis leptorrhynchoides*

Site Number and Location	Population Size ♠	Area* (ha)	Grassland Action Plan Location No. (GAP) (where appropriate)	Ecological Community	Landholder and Current Status	Other Significant Species in Vicinity
ACT SITES:						
1. Red Hill: (a) - East (b) - North	 3,500 1,300	 0.3 0.5		 woodland woodland	Canberra Nature Park: Reserve Reserve	
2. Stirling Park	70,000	12.0		woodland	National Capital Authority: National Land	
3. Capital Hill: (a) - West Block (b) - Capital/State Circle	 5 220	 0.01 1.0		 woodland woodland	National Capital Authority: National Land	
4. St Mark's, Barton	130	1.8	GAP 33	grassland	Anglican Church: Perpetual Lease	#
5. Campbell Park: - Offices - Paddocks	100 (1998)	4.0	GAP 27	grassland	Department of Defence: National Land	Sp, Tlp, Po, #
6. Majura Valley East: - Field Firing Range	30,000 (1996)	3.75	GAP 28	grassland	Australian Army: National Land	Di, Sp, Tlp, Po, #
7. Jerrabomberra Valley East: - Tharwa Lane	50 (1996)	2.0	GAP 37	grassland	Canberra South District: Unleased Territory Land	
NSW SITES:						
8. Queanbeyan Nature Reserve	10,000	1.5		woodland	NSW National Parks & Wildlife Service: Crown Land	
9. "The Poplars"	8,000	1.0		woodland	Private land: Freehold	
10. Letchworth	450	0.4		secondary grassland	NSW Department of Housing: Crown Land	
11. Queanbeyan - Captains Flat Road	150	0.03		grassland	Yarrowlumla Shire Council: Crown Land - roadside	
12. Jerrabomberra Heights	9	0.01		woodland	Queanbeyan City Council: Public Reserve	
13. Gundary Travelling Stock Reserve	at least 95,000 (1996)	3.0		grassland	Rural Lands Protection Board: Crown Land	Di, Ks, #
14. Googong Foreshores	(1996)	1 m2 (1 plant)		grassland	Commonwealth: Wildlife Refuge managed by Environment ACT	

♠ Population sizes refer to the estimated no. of plants in 1994/95, unless otherwise indicated.

Shaded areas indicate sites that are located within reserved areas.

* = Area column refers to the area occupied by *R. leptorrhynchoides*.

Key to species - Di = *Delma impar*, Ks = Keyacris scurra, Sp = *Synemon plana*, Tlp = *Tympanocryptis lineata pinguicolla*, Po = *Perunga ochracea*, # = uncommon or declining species which are not formally listed.

GAP = Grassland Action Plan Location Number - this number is used as a location reference in the Natural Temperate Grassland Action Plan (Action Plan No. 1) Its use in Action Plans for component species, such as *R. leptorrhynchoides,* indicates that the habitat of the species in question more or less coincides with the natural temperate grassland site referred to.

DISTRIBUTION

R. leptorrhynchoides appears to have been formerly widespread across the westernplains of Victoria, and south-eastern New South Wales. The species has a disjunct distribution and is known from 16 populations in the ACT region (nine within the ACT, six across the border near Queanbeyan and one recently discovered near Goulburn) (Figure 2, Table 1) and nine in Victoria. Current populations range in size from five to round 95,000 plants and are often restricted to small, scattered refugia that have escaped grazing, ploughing and the application of fertilisers, for example, road margins, railway easements and cemeteries (Young 1997).

Of the nine sites occurring within the ACT, two have large populations. The larger is within Stirling Park, Yarralumla, where close to 70,000 plants have been recorded (Young and Zich unpublished data). The other, comprising about 30,000 plants, was discovered recently on the Majura Field Firing Range, although this is confined to a small area and is therefore vulnerable to damage (Crawford and Rowell 1996). Smaller populations occur on Red Hill, at Barton, on the edge of Capital Hill, near West Block and the Campbell Park Offices and near HMAS Harman, in the Jerrabomberra Valley.

In NSW, the species is known to occur naturally at six sites within the Queanbeyan area, with the largest population (10,000 plants in February 1995) being found within the Queanbeyan Nature Reserve (Young and Zich unpubl. data). Other sites occur at “The Poplars” near Jerrabomberra, Letchworth, along the slopes of Mt. Jerrabomberra, and along a roadside by the Queanbeyan-Captains Flat Road. Recently, one individual plant was found at Googong Foreshores, and further survey work will be undertaken to determine the extent of the population.

The largest known population of 95,000 plants (Young unpubl. data) was recently discovered at Gundary Reserve, a Travelling Stock Reserve and Arboretum, 5km SSE of Goulburn, NSW.

HABITAT AND REPRODUCTIVE BIOLOGY

Habitat

In the ACT, *R. leptorrhynchoides* occurs on the margins of open stands of Yellow Box/Red Gum Grassy Woodland with a ground layer of various native grasses and other forbs, and extends into Natural Temperate Grassland. Soils are usually shallow stony red-brown clay loams. Occasionally, Apple Box (*Eucalyptus bridgesiana)* is also present.

Rutidosis leptorrhynchoides prefers an open habitat and is a poor competitor amongst tall, dense sward-forming grasses. It is found where the soil is too shallow to support the growth of plants that may rapidly overtop it, or on deeper soils where the vegetation is kept short by regular disturbance (Scarlett and Parsons 1990). It may also be adapted to the sparser *Themeda* growth found under trees in woodlands (Morgan 1995a).

Reproductive Biology

The population density of the species affects seed production, with sparsely distributed individuals producing fewer seeds per inflorescence than plants from denser colonies. This suggests that the species is dependent on the maintenance of the standing population for recruitment (Morgan 1995a).

In Victoria, recruitment may be limited by high summer mortality of seedlings in open microsites and by deep shading in dense, unburnt grasslands (Morgan 1995b).

The reproductive potential and viability of small remnant populations may also be limited by inbreeding and related reductions in fitness (inbreeding depression). Research using genetic markers to characterise the mating patterns of *R. leptorrhynchoides* shows evidence of increased potential for mating among relatives in populations of less than 200 plants, especially when these are isolated by more than 5 km from other populations. The demographic consequences of this are as yet unknown, but could be significant.

Reproductive capability of populations also depends on their chromosome number. Chromosome counts of *R. leptorrhynchoides* show the species to be cytologically complex. Northern populations in the ACT and NSW are diploid (2n=26), while in the south of the range, Victorian populations are either wholly diploid, or primarily tetraploid (2n=44), with a mix of anueploids and even some hexaploids. Diploids produce more seed per head than tetraploids and any mating between the two ploidy levels produces few seed, all of which are triploids with low pollen fertility (Young 1997).

Conservation Status

Rutidosis leptorrhynchoides is recognised as a threatened species in the following sources:

National

Endangered. - ANZECC Endangered Flora Network (1998).

Endangered. - ROTAP (1996).

Endangered. - Part 1, Schedule 1 of the *Endangered Species Protection Act 1992* (Commonwealth).

Australian Capital Territory

Endangered. - Section 21 of the *Nature Conservation Act 1980,* Determination No. 7 of 1998 (formerly Determination No. 29 of 1996).

Special Protection Status Species. - Schedule 6 of the *Nature Conservation Act 1980,* Determination No. 77 of 1996.

New South Wales

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

Victoria

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

The species is also the subject of Action Statement No. 28, prepared by the Victorian Department of Conservation and Environment.

Threats to Populations in the ACT Region

- **The species is at risk from habitat loss throughout its range** due to agricultural and urban development, and weed invasion.
- **Competition with other vegetation** presents a disadvantage to the species at some sites. In Victoria, "intermittent" burning of some grassland communities is recommended to maintain floristic diversity (McDougall 1987, Lunt 1990).
- **Under heavy grazing**, the species disappears because it is palatable to stock. However, intermittent grazing in late summer may not be detrimental.
- **Erosion of genetic diversity and increased inbreeding** may compromise both short and long-term population viability by reducing individual fitness and limiting the gene pool on which selection can act in the future. This applies to populations of fewer than 200 plants.

Major Conservation Objectives

The objective of this Action Plan is to maintain viable populations of *R. leptorrhynchoides* in functional native grassland and grassy woodland habitat in the known sites across the geographic range of the species in the ACT. This is interpreted to include the maintenance of the species' potential for evolutionary development in the wild.

This objective is to be achieved by:

- Protecting and managing the major sites where significant populations occur.
- Developing detailed management strategies to maintain or expand remaining sites while populations of *R. leptorrhynchoides* remain viable.
- Maintaining as diverse a gene pool as possible, as more evidence is coming to light about the tendency for inbreeding and subsequent sterility arising in very small populations, especially in Victoria.
- Participating on the National Recovery Team which brings together all agencies responsible for the species throughout its geographic range.
- Liaising with regional NSW agencies under the umbrella of the National Recovery Team, especially the NSW National Parks and Wildlife Service (NSW NPWS), Queanbeyan City Council and Yarrowlumla Shire Council, to preserve small areas round Queanbeyan and the Queanbeyan/Captains Flat Road.
- Negotiating with the Commonwealth to protect as much habitat on National Land as possible, in particular, Stirling Ridge and the Majura Field Firing Range.
- Continuing surveys of areas of Yellow Box/Red Gum Grassy Woodland to locate new populations.

Conservation Issues and Intended Management Actions

GENERAL

The long term conservation of *R. leptorrhynchoides* depends on the retention of its native grassy habitat, which in the ACT region is the Natural Temperate Grassland and the Yellow Box/Red Gum Grassy Woodland. Both of these ecological communities have been declared endangered in the ACT and management principles for each are set out in the respective Action Plans. For *R. leptorrhynchoides*, the principal management focus will be on managing and maintaining it as a component of the grassland or woodland ecological community.

It has been suggested that for the species to persist, it requires some treatment that reduces competition from other vegetation, such as fire, high mowing or seasonal light grazing (Scarlett and Parsons 1990). However, preliminary analysis of data from recent monitoring of populations in the ACT region indicates that the maintenance of reproductive plants should be given priority over intervention aimed at increasing germination and seedling establishment. A large increase in germination would be required to offset the small increase in the mortality of adult plants which might follow treatments such as autumn burning (A. Young pers. comm.). Where management to reduce ground vegetation density at a site is desirable for other reasons (eg. maintaining species diversity in the community, fuel reduction), areas containing regenerating *R. leptorrhynchoides* stands may be excluded from the treatment, pending the results of further monitoring and research in the ACT region.

Management prescriptions also need to address a general concern about the survival of remnant populations, namely the increased random fluctuations in demographic parameters such as seedling mortality, genetic erosion owing to genetic drift and inbreeding depression. The actual roles of these processes are poorly understood and managers are often unsure as to their long term conservation significance (Young 1997).

A suggested recovery action is to establish a seed-store and off-site conservation area to ensure maintenance of long-term genetic viability, given that a number of small populations are highly susceptible to "catastrophic" events (Briggs *et al.* 1998). The National Recovery Team anticipates that the Australian National Botanic Gardens and other institutions concerned with the long-term protection of threatened native plants will play a significant role, and will assume some responsibility for investigating these issues (Briggs *et al.* 1998).

RESEARCH AND SURVEY

The need for information on the amount and distribution of genetic variation in the Button Wrinklewort with regard to overall management for conservation has been recently highlighted and will have implications for a nationally coordinated management approach to the species (Briggs *et al.* 1998). For instance, variations in chromosome numbers need to be taken into account when undertaking replanting or translocation, as mixing plants with different numbers of chromosomes may result in the production of infertile offspring (Young 1997).

The Centre for Plant Biodiversity Research, CSIRO Division of Plant Industry, is conducting research to develop understanding as to how habitat fragmentation is associated with genetic and demographic changes, and how these changes influence the viability of small populations (Young 1997).

The Centre is also conducting comparative demographic monitoring of large genetically diverse, outbred populations as compared with small genetically depauperate, possibly inbred populations, which is providing data on seed production, germination, seedling survivorship and adult mortality. This information will be used for developing models which will be used to predict the fate of populations under a range of management scenarios (Young 1997).

⇒ The CSIRO's research work directed towards understanding how genetic variations influence the viability of small populations, and their implications for conservation and management will be monitored for application to management of ACT sites containing the species.

Research is needed into the role of fire (including season of burning) in maintaining and increasing populations of *R. leptorrhynchoides*. This would target the effects of a range of burning frequencies on population demographics and community integrity. This research would provide a basis for a fire management regime to assist in the maintenance of populations and would have relevance to the fire management of other Natural Temperate Grassland communities (Briggs *et al.* 1998).

As an initial step, an experimental burn by CSIRO is planned for the Queanbeyan Nature Reserve which is managed by NSW NPWS. This action is in accordance with the recommendations of the National Recovery Team who proposed that a three year research project into the effects of burning frequency and season of burning on the maintenance and expansion of *R. leptorrhynchoides* populations be undertaken by either CSIRO and/or universities (Briggs *et al.* 1998).

⇒ Environment ACT (Wildlife Research and Monitoring (WR&M)) will liaise with Commonwealth, NSW and Victorian members of the National Recovery Team to coordinate protection and management activities.

MONITORING

Intermittent and *ad hoc* monitoring of some sites has shown a decline in a few populations and increases in others. Systematic monitoring of all populations in the ACT region is required to assess the effects of management actions in stabilising or increasing populations and to measure effectiveness of research-based management actions.

- **Seedling Establishment** - Monitoring is required to show whether the relative paucity of seedlings in areas of denser vegetation leads to a long-term decline in the number of adult plants present. This should be undertaken in conjunction with monitoring of small experimental burning/slashing plots in some of the larger populations. The results of any accidental burning should also be monitored.

- **Site inspection for damage** - Sites should be inspected quarterly, or as appropriate, for deliberate or accidental damage. This includes unauthorised grazing, mowing, burning or planting; access by cars, trail bikes or other motor vehicles; trampling; rock, soil, wood or plant removal; and dumping of rubbish. Fences/barriers and signs should be installed or upgraded where necessary.

- **Research and Monitoring Coordination -** Environment ACT will cooperate with other researchers to ensure that research and monitoring on *R. leptorrhynchoides* is coordinated and made available to the National Recovery Team.

MANAGEMENT

Management will aim to protect *R. leptorrhynchoides* and its habitat, and promote its regeneration. It will maintain species diversity, and take account of the needs of other sensitive species present, and of the whole community. Vehicle access, trampling and soil disturbance will be kept to a minimum.

⇒ An appropriate management regime will be developed for each site, in the form of a Management Plan or be agreed to under the terms of a Memorandum of Understanding.

⇒ Environment ACT will take an adaptive management approach, liaising with the National Recovery Team, CSIRO Centre for Plant Biodiversity Research and other regional researchers, and incorporating the results of research into management prescriptions for ACT *R. leptorrhynchoides* sites.

Specific management issues relating to conservation of the species are:

- **Woody weed control** - This is most important on the woodland sites. Older woody weeds should be cut and removed, and the stumps dabbed with herbicide. Seedlings and suckers should be controlled annually by hand-pulling and spot-spraying with herbicide (no spot spraying of herbicide should be used within 2 metres of any *R. leptorrhynchoides* plant).

- **Regeneration of native trees and shrubs** - Non-indigenous native trees (eg. *Acacia baileyana*, *A. cultriformis*) and shrubs should be treated as woody weeds. In the absence of fire, slashing or grazing, regeneration of eucalypts and some native shrubs such as *Cassinia quinquefaria,* Bitter Pea *(Daviesia mimosoides), Silver Wattle (Acacia dealbata)* and Green Wattle (*A. mearnsii)* may shade out *R. leptorrhynchoides*. Where necessary, a selection of these should be removed (cut and dabbed) annually, to maintain an open mixed-age/species woodland.

- **Herbaceous weed control** - Priority should be given to weeds which can be invasive in native grassland/woodland, such as St John's Wort (*Hypericum perforatum*) and African Lovegrass (*Eragrostis curvula*). Control methods should take account of the characteristics of each site, and proximity to *R. leptorrhynchoides* plants.

- **Understorey competition** - Where monitoring shows a continuing lack of seedling establishment around adult plants in dense understorey vegetation, and/or deterioration in the quality of the community, intervention may be necessary. Grazing is not recommended as a routine management method, as it can have an adverse effect on *R. leptorrhynchoides* and its habitat. Occasional slashing in late summer may be used on sites where other factors (eg. fire risk to property) make burning undesirable. Patch burning may be appropriate on other sites but its effects should be monitored. Burning should not be used as a broad-scale management tool on *R. leptorrhynchoides* sites in the ACT until it has been established by experimentation that the benefits (seedling establishment) are likely to outweigh the costs (mortality of adult plants).

- ***Ex situ* conservation of the species -** This will be encouraged, with expert advice being obtained in this regard. Long term storage of seed may not be feasible if *R. leptorrhynchoides* follows the pattern of many other species of Asteraceae, with short seed life.

⇒ Environment ACT (WR&M) will explore possibilities for horticultural effort being applied as a conservation measure for *R. leptorrhynchoides*.

- **Documentation of plantings** - Control of plantings from nursery stock and other sources in areas near sites where the species naturally occurs needs to be undertaken to reduce or avoid any adverse effects of genetic mixing.

EDUCATION AND LIAISON

As with any threatened species, the importance of informing the community and people responsible for managing their habitat is substantial.

⇒ Environment ACT, in consultation with the National Recovery Team, will compile and distribute management guidelines and maintain contact with land managers responsible for areas on which populations presently occur.

⇒ As recommended by the National Recovery Team, Environment ACT will prepare and distribute to appropriate target audiences information about *R. leptorrhynchoides* and its conservation - this will include providing information to the public on the conservation, management and research actions being undertaken, so that measures being implemented are understood and supported.

⇒ Environment ACT will also promote conservation of the species through provision of suitable information signs at key sites.

The Queanbeyan City Council has adopted *R. leptorrhynchoides* as its Parks and Recreation logo for display on items such as vehicles.

Protection

This Action Plan, together with the National Recovery Plan, are the main instruments by which continued survival of *R. leptorrhynchoides* and its habitat can be ensured.

Conservation effort will be focussed on protecting the existing ACT populations as a cluster of sites, since there are only a small number of viable populations remaining in NSW and Victoria. Special emphasis will be placed on protecting the two largest populations, being on Stirling Ridge Yarralumla and within the Majura Field Firing Range. The other sites are located at Red Hill, St Mark's Barton, Capital Hill, near Campbell Park Offices and near HMAS Harman, in the Jerrabomberra Valley.

On the Majura Field Firing Range, protection of this species can be achieved coincidentally with that of grasslands and other threatened species including the endangered Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla)* and Golden Sun Moth (*Synemon plana*), as well as the vulnerable Striped Legless Lizard (*Delma impar*).

Most of the known ACT populations of *R. leptorrhynchoides* occur on Commonwealth owned and managed land (National Land); with exceptions being the Red Hill site occurring on Territory Land - Nature Reserve and the Jerrabomberra Valley site near HMAS Harman, which is unleased Territory Land, both being managed by Environment ACT (ACT Parks and Conservation Service (ACTPCS)). A further exception is the St Mark's Barton site, which occurs on a perpetual lease held by the Anglican Church.

Two locations with *R. leptorrhynchoides* currently have reserve status: Red Hill (part Canberra Nature Park (CNP)) and the Queanbeyan Nature Reserve (NSW). However, there is no formal protection for any part of the other known disjunct populations. Consideration therefore needs to be given to protection of these sites, especially those at Stirling Ridge and at the Majura Field Firing Range.

Protection of *R. leptorrhynchoides* Populations

⇒ Protection of *R. leptorrhynchoides* in native grassland habitat will be achieved through the provisions of the *Land (Planning and Environment) Act 1991*, the Territory Plan and Memoranda of Understanding with the Commonwealth and the Anglican Church.

(I) Territory Plan - Hills, Ridges and Buffers with Public Land Overlay of Type Nature Reserve

Reservation is generally recognised as the mechanism for ensuring that sites of high conservation value are not eventually converted to a land use incompatible with their natural values (Caughley and Gunn 1996). Reservation is therefore an important mechanism for the protection of *R. leptorrhynchoides* and its habitat. Reservation does not exclude the option of managing controlled grazing to achieve conservation objectives through agistment arrangements with rural lessees. One small area of grassy woodland containing populations of *R. leptorrhynchoides* is currently reserved as part of Canberra Nature Park (CNP) (Table 2).

Although the Campbell Park area contains a relatively small population of *R. leptorrhynchoides*, its overall conservation value is significant for other species, given that it is natural temperate grassland habitat supporting

the endangered Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*), Golden Sun Moth (*Synemon plana*) and the Perunga Grasshopper (*Perunga ochracea*). This area will be considered for reservation as part of a future review of planning for the Majura Valley (Table 2 below).

Table 2. Hills, Ridges and Buffers: Public Land - Nature Reserve.

Location and site	Pop'n size	GAP No.	Area (ha)	Current Status
Red Hill:				
East	3,500	N/A	0.3	Reserve
North	1,300	N/A	0.5	Reserve
Reservation to be considered as part of further evaluation of planning and conservation issues				
Campbell Park: Offices	50	27	3.3	National Land

Note: GAP No. = Grassland Action Plan Number. This number is used as a site reference in the Natural Temperate Grassland Action Plan. A full explanation is given as a footnote below Table 1. N/A = Not applicable.
The shaded area indicates sites that are Public Land - Nature Reserve.

(ii) Memoranda of Understanding

Memoranda of Understanding (MOU) provide another means of ensuring that sites with high conservation value will be managed so as to maintain their conservation value in perpetuity while enabling other compatible land uses, as identified in the MOU, to occur. An MOU with the Commonwealth does not preclude the possibility of the land being reserved in the future under Commonwealth legislation.

MOU's are appropriate for Commonwealth owned or occupied land, or other land where long-term land uses will not compromise conservation values (for example, land used for Defence purposes). Areas of National Land supporting *R. leptorrhynchoides,* for which an MOU will be negotiated, are listed in Table 3.

Table 3. Memorandum of Understanding to achieve protection equivalent to reservation.

Location and site	Pop'n size	GAP No.	Area (ha)	Current Status
Stirling Ridge	70,000	N/A	25.0 <	National Land
Majura Valley: Field Firing Range (parts)	30,000	28	3.75	National Land
Capital Hill:				
West Block	5	N/A	0.01	National Land
Between State & Capital Circle	220	N/A	1.0	
St Mark's, Barton	130	33	1.8	Perpetual Lease

N/A = Not applicable < = Area is approximate only.

Once MOU's have been agreed, populations of *R. leptorrhynchoides* will be protected in native habitat across the species' distribution in the ACT.

Other Areas Supporting *R. leptorrhynchoides*

Public Land categories of the Territory Plan (other than Nature Reserves) include Urban Open Space and Special Purpose Reserves. Activities permitted in these land use categories can be compatible with conservation values, provided that appropriate conservation management is in place. In these cases, maintenance of the conservation values of the site is the responsibility of the relevant ACT Government agency. Other similar land uses include road reserves and powerline easements.

The site near HMAS Harman in the Jerrabomberra Valley (Jerrabomberra East - Site D, Tharwa Road) is a road verge being managed by Environment ACT (ACTPCS) (Table 4 below). It will be appropriately managed as Public Land (Urban Open Space) to retain its conservation value.

Table 4. Public Land - Urban Open Space.

Location and site	Pop'n size	GAP No.	Area (ha)	Current Status
Jerrabomberra Valley (East): (Tharwa Road).	50	37	2.0	Unleased Territory Land

Other Actions for Protection

Additional actions that will be implemented to protect known sites where *R. leptorrhynchoides* occurs are:

⇒ Complementary protection through reservation in NSW will be promoted through the National Recovery Team.

⇒ Any conservation area established primarily for *R. leptorrhynchoides* will be managed as a component of the grassy community.

Further Supporting Mechanisms

This Action Plan, together with the National Recovery Plan, the Canberra Nature Park Management Plan and the Action Plans for Natural Temperate Grassland and Yellow Box/Red Gum Grassy Woodland, complement conservation management guidelines for this species and its habitat.

⇒ Environment ACT will work with the Planning and Land Management group of the Department of Urban Services and the National Capital Authority to ensure that land uses adjacent to sites supporting *R. leptorrhynchoides* are compatible with

conservation objectives and to minimise any adverse impacts.

The Stirling Ridge and Red Hill sites have been listed on the Register of the National Estate, on the basis that they comprise major known remaining ecologically viable areas of *R. leptorrhynchoides*.

Socio-economic Issues

The main social benefits of conserving representative communities of natural temperate grassland or grassy woodland in which *R. leptorrhynchoides* occurs are:

- meeting community concerns that further loss or extinction of significant ecological communities, together with their component native species, be prevented; and
- the amenity and recreational values associated with the grasslands and woodlands reserves, in which the species occurs.

The potential for economic utilisation of native grassland habitat sites is relevant for those sites where current management or land uses are deemed to be compatible with the retention of conservation values.
There are four main aspects of planning in Canberra that will be affected by the implementation of this Action Plan. These are:

1. Transport Facilities

The provision and/or upgrading of the following transport facilities may be affected:

- Majura Parkway - southern section and connections
- Very High Speed Train corridor (Majura and Jerrabomberra valleys).

2. Industrial Areas

The planning for future industrial areas, in particular, a possible industrial complex associated with the Airport in the Majura Valley.

3. National Uses

The Stirling Ridge area of National Land has been set aside for "National Use" under the *National Capital Plan*. This reservation relates to the consideration of the area by the Official Establishments Trust as a future site for the Prime Minister's residence.

Legislative Provisions

The following legislation is relevant to conservation of flora and fauna in the ACT:

Nature Conservation Act 1980

The Nature Conservation Act provides a mechanism to encourage the protection of native plants and animals, the identification of threatened species and ecological communities, and the management of Public Land reserved for nature conservation purposes. Specified activities are managed via a licensing system.

Native plants and animals may be declared in recognition of a particular conservation concern and increased controls and penalties apply. Species declared as endangered must also be declared as having special protection status, the highest level of statutory protection that can be conferred.

As an endangered species, *R. leptorrhynchoides* must be declared a special protection status (SPS) species and any activity affecting an SPS species is subject to special scrutiny. Conservation requirements are a paramount consideration and only activities related to conservation of the species or serving a special purpose are permissible. The Conservator of Flora and Fauna may only grant a licence for activities affecting a species with SPS where satisfied that the act specified in the licence meets a range of stringent conditions. Further information can be obtained from the Licensing Officer, Compliance and Quarantine Services, Environment ACT, telephone 6207 6376.

Land (Planning and Environment) Act 1991

The Land (Planning and Environment) Act is the primary authority for land planning and administration. It establishes the Territory Plan, which identifies nature reserves, national parks and wilderness areas within the Public Land estate.

The Land (Planning and Environment) Act establishes the Heritage Places Register. Places of natural heritage significance may be identified and conservation requirements specified.

Environmental Assessments and Inquiries may be initiated in relation to land use and development proposals.

***Endangered Species Protection Act 1992* (C'th)**

Under this legislation, *R. leptorrhynchoides* has been declared an **endangered** species. The Commonwealth is required to prepare and implement recovery plans for the species as it occurs in Commonwealth areas, and to cooperate with both the ACT and NSW authorities in implementing protection measures. The Commonwealth also encourages joint preparation and implementation of a recovery plan across State and Territory boundaries (ANCA 1994). This is being achieved through joint membership on the National Recovery Team, which has already prepared a draft national recovery plan for the species.

***Australian Heritage Commission Act 1975* (C'th)**

The Australian Heritage Commission Act establishes the Register of the National Estate (RNE) and imposes a special duty of care on Commonwealth agencies in relation to actions that have an adverse effect on any part of a place entered in the Register. Currently there are two sites listed in the RNE in recognition of their habitat value for *R. leptorrhynchoides*.

Consultation and Community Participation

Environment ACT (WR&M) actively participates on the National Recovery Team, which has representatives from NSW NPWS, the Centre for Plant Biodiversity Research (CSIRO), Environment Australia, the National Capital Authority, Department of Defence, NSW Department of Housing, Queanbeyan City Council, Yarrowlumla Shire Council, Goulburn Rural Lands Protection Board, the Monaro Conservation Society, the Society for Growing Australian Plants and the Victorian Department of Natural Resources and Environment.

Representatives of Environment ACT (WR&M) maintain regular contact with the managers of the Majura Field Firing Range, officers of the National Capital Authority and lessees of the St Mark's, Barton site to raise awareness of issues associated with the protection of *R. leptorrhynchoides*. There are also links with the management team for the Joint Regional Biodiversity Survey of Grassy Ecosystems Project.

⇒ Environment ACT will encourage community groups including the Friends of Grasslands and appropriate Park Care Groups to assist in the conservation of native grasslands and their component species including *R leptorrhynchoides*.

⇒ Environment ACT will conduct community education programs which will include general community awareness of grassland conservation issues, including those associated with endangered species.

⇒ Environment ACT will promote the conservation of *R. leptorrhynchoides* through suitable information signs, community liaison and public education.

Implementation, Evaluation and Review

RESPONSIBILITY FOR IMPLEMENTATION

Environment ACT will have responsibility for coordination of the implementation of this Action Plan, subject to the availability of Government resources. Primary responsibility for conservation and management of grassy communities supporting *R. leptorrhynchoides* on Territory Land will rest with the ACTPCS whilst relevant Commonwealth agencies will have responsibility for National Land, although provisions in the *Nature Conservation Act 1980* (ACT) are still applicable.

⇒ The ACT Government will seek the cooperation of the Commonwealth Government in setting in place coordinated and complementary action to protect the species' grassy habitat on Commonwealth land in the ACT.

The National Recovery Team will also be advising on, or encouraging the implementation of management measures to safeguard the species' conservation. Individual management authorities will be responsible for the on-ground implementation.

EVALUATION

Implementation of this Action Plan will be a collaborative exercise between government agencies, landholders and the community generally. Commonwealth and NSW participation will be critical in some cases. The Action Plan will be reviewed after three years. The review will comprise an assesssment of progress using the following performance indicators:

- completion of commitments that can reasonably be expected to be finalised within the review timeframe (e.g. introduction of a statutory protection measure for a species; development of a management plan);
- completion of a stage in a process with a time line that exceeds the review period (e.g. design or commencement of a research program);

- commencement of a particular commitment that is of a continuing nature (e.g. design or commencement of a monitoring program for population abundance); and
- expert assessment of achievement of conservation objectives of the Action Plan.

The review will be reported to the ACT Flora and Fauna Committee. This will provide an opportunity for Environment ACT and the Flora and Fauna Committee to assess progress, take account of developments in nature conservation knowledge, policy and administration and review directions and priorities for future conservation action.

The following conservation actions will be given priority attention:

⇒ completion of surveys in native grassland and woodland sites yet to be fully assessed, where the species may possibly occur;

⇒ establishment of a monitoring program to provide information on how populations respond to management practices and environmental pressures, especially those relating to genetic aspects and the effects of fire;

⇒ assessment of *ex-situ* conservation measures;

⇒ putting in place protection measures;

⇒ establishing liaison mechanisms with NSW authorities and ensuring that complementary protection measures have been put in place for NSW populations, and

⇒ maintaining stability of or generating an increase in ACT populations of *R. leptorrhynchoides* over the three year period.

Acknowledgments

This Action Plan draws on expert advice provided by Alison Rowell, Biologist and Environmental Consultant, and from research work undertaken by Dr Andrew Young, Centre for Plant Biodiversity Research (CSIRO).

The illustration of the species (Figure 1) was prepared for Environment ACT by John Pratt.

References

ANCA, 1994. Endangered Species Protection Act 1992*: An outline*. Australian Nature Conservation Agency, Canberra.

Australian and New Zealand Environment and Conservation Council. Endangered Flora Network, 1998. *ANZECC List of Threatened Australian Flora*. 1997 revision. Environment Australia, Canberra.

Briggs, J.D., Corrigan, V.T. & Zich, F.A., 1998. Rutidosis leptorrhynchoides *(Button Wrinklewort)* Recovery Plan. Unpublished report.

Caughley, G. & Gunn, A., 1996. *Conservation biology in theory and practice*. Blackwell Science, Carlton.

Crawford, I.L. & Rowell, A.M., 1996. *Uncommon or declining plants of lowland native grasslands of the ACT*. Unpublished report to the ACT Parks and Conservation Service, Canberra.

Department of Conservation and Environment, (Vic), 1995. *Action Statement No. 28: Button Wrinklewort* (Rutidosis leptorrhynchoides). Department of Conservation and Environment, Melbourne.

Department of Urban Services, ACT Government, 1996. *Canberra Nature Park Draft Management Plan*. ACT Government, Canberra.

Lunt, I.D., 1990. Floristic survey of the Derrimut Grassland Reserve, Melbourne, Victoria. *Proceedings of the Royal Society of Victoria* 102(1): 41-52.

McDougall, K.M., 1987. *Sites of botanical significance in the Western Region*. Department of Geography, University of Melbourne.

Morgan, J.W., 1995a. Ecological studies of the endangered *Rutidosis leptorrhynchoides*. 1. Seed production, soil seed bank dynamics, population density and their effects on recruitment. *Australian Journal of Botany* 43: 1-11.

Morgan, J.W., 1995b. Ecological studies of the endangered *Rutidosis leptorrhynchoides*. 2. Patterns of seedling emergence and survival in a native grassland. *Australian Journal of Botany* 43: 13-24.

Scarlett, N.H. & Parsons, R.F., 1990. Conservation biology of the Southern Australian Daisy *Rutidosis leptorrhynchoides*. In Clark, T. & Seebeck, J., (eds) *Management and conservation of small populations: Proceedings of a conference, Melbourne, Australia, September 26 and 27, 1989*, pp 195-205. Chicago Zoological Society, Brookfield, Illinois.

Young, A., 1997. Viable or Vulnerable - Genetic and demographic studies on *Rutidosis leptorrhynchoides*. *Danthonia* 5(4): 8-9.

List of Action Plans - June 1998

In accordance with Section 23 of the *Nature Conservation Act 1980,* the following Action Plans have been prepared by the Conservator of Flora and Fauna:

No. 1: Natural Temperate Grassland - an endangered ecological community.

No. 2: Striped Legless Lizard (*Delma impar*) - a vulnerable species.

No. 3: Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*) - an endangered species.

No. 4: A leek orchid (*Prasophyllum petilum*) - an endangered species.

No. 5: A subalpine herb (*Gentiana baeuerlenii*) - an endangered species.

No. 6: Corroboree Frog (*Pseudophryne corroboree*) - a vulnerable species.

No. 7: Golden Sun Moth (*Synemon plana*) - an endangered species.

No. 8: Button Wrinklewort (*Rutidosis leptorrhynchoides*) - an endangered species.

No. 9: Small Purple Pea (*Swainsona recta*) - an endangered species.

FURTHER INFORMATION

Further information on this Action Plan or other threatened species and ecological communities can be obtained from:

Environment ACT
(Wildlife Research and Monitoring)
Phone: (02) 6207 2126
Fax: (02) 6207 2122

or on the Environment ACT Homepage
http://www.act.gov.au/ environ

This document should be cited as:

ACT Government, 1998. *Button Wrinklewort* (Rutidosis leptorrhynchoides): *An endangered species*. Action Plan No. 8. Environment ACT, Canberra.

ACTION PLAN No. 21

In accordance with section 21 of the *Nature Conservation Act 1980*, **the Perunga Grasshopper (*Perunga ochracea*)** was declared a vulnerable species on 19 May 1997 (formerly Instrument No. 89 of 1997 and currently Instrument No. 192 of 1998). Section 23 of the Act requires the Conservator of Flora and Fauna to prepare an Action Plan in response to each declaration. This is the Action Plan for the:

Perunga Grasshopper
Perunga ochracea

Preamble

The *Nature Conservation Act 1980* establishes the ACT Flora and Fauna Committee with responsibilities for assessing the conservation status of the ACT's flora and fauna and the ecological significance of potentially threatening processes. Where the Committee believes that a species or ecological community is threatened with extinction or a process is an ecological threat, it is required to advise the responsible Minister and recommend that a declaration be made accordingly.

Flora and Fauna Committee assessments are made on nature conservation grounds only and are guided by specified criteria as set out in its publication *Threatened Species and Communities in the ACT,* July 1995.

In making its assessment of the Perunga Grasshopper, the Committee concluded that it satisfied the criteria indicated in the adjacent table.

An Action Plan is required to ensure, as far as is practicable, the identification, protection and survival of the species or the ecological community, or proposals to minimise the effect of any process which threatens any species or ecological community.

This Action Plan was prepared by the Conservator of Flora and Fauna in accordance with the requirements of the Nature Conservation Act, in consultation with the Flora and Fauna Committee and after the statutory period for public comment.

While the legal authority of this Action Plan is confined to the Australian Capital Territory, management considerations are addressed in a regional context.

Criteria Satisfied

2.2 The species is observed, estimated, inferred or suspected to be at risk of premature extinction in the ACT region in the medium-term future, as demonstrated by:

- 2.2.1 Current serious decline in population or distribution, from evidence based on:
  - 2.2.1.1 direct observation, including comparison of historical and current records; and
  - 2.2.1.3 serious decline in quality or quantity of habitat.
- 2.2.4 Seriously fragmented distribution for a species currently occurring over a moderately small area of occupancy within its range.

Links with other Action Plans

Measures proposed in this Action Plan complement those proposed in the Action Plan for Natural Temperate Grassland, Yellow Box/Red Gum Grassy Woodland and other component threatened species, such as the Striped Legless Lizard (*Delma impar*), Grassland (formerly Eastern Lined) Earless Dragon (*Tympanocryptis lineata pinguicolla*), the Golden Sun Moth (*Synemon plana*), the Button Wrinklewort (*Rutidosis leptorrhynchoides*) and a number of threatened bird species, particularly the Hooded Robin (*Melanodryas cucullata*) and the Brown Treecreeper (*Climacteris picumnus*). Action Plans are listed at the end of this document.

Species Description and Ecology

DESCRIPTION

The Perunga Grasshopper, *Perunga ochracea* is the only described species in the genus (Orthoptera: Acrididae: Catantopinae), although the Australian National Insect Collection (ANIC), Canberra, has specimens of an undescribed species (designated as *Perunga* sp. 1), known only from South Australia. *Perunga* belongs to the subtribe Apotropina of the tribe Catantopini (Rentz 1996). Members of the subtribe are characterised principally by the stout femur of the hind leg and the presence of an auditory tympanum on the anterior abdomen under the wings. In males, there is a furcula (a forked structure) near the tip of the abdomen.

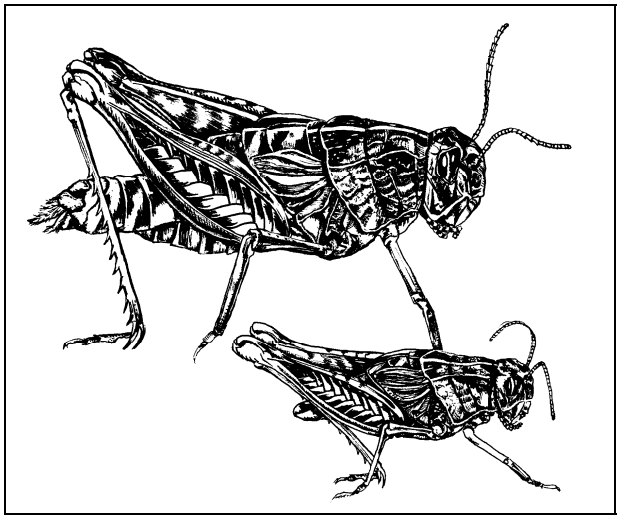

Figure 1: Perunga Grasshopper (*P. ochracea*). Female (above) and male (below).

Scale: Approximately twice natural size.

Both sexes of *P. ochracea* are short-winged and flightless (Figure 1).

The species is distinctive in having the pronotum (the dorsal surface of the first thoracic segment) wrinkled and slightly extended caudally. In the Canberra region, the species is distinguished further by the appearance on the pronotum of a pale 'X' (D. Rentz pers. comm.), which is the most useful field identification characteristic. The wings are shorter than the length of the pronotum and possess many raised longitudinal veins. Adult females range in length from 26-35 mm and adult males from 15-20 mm. Males possess short, rounded furculae and simple, elongate cerci (the pair of appendages at the apex of the abdomen), each with a blunt, rounded tip which is slightly deflexed. Females bear very short, stout cerci and the dorsal ovipositor valves are strongly recurved. Adults are variable in colour, ranging from brown to grey and often with green. Colour can vary from year to year with a tendency toward grey-brown in dry years and greenish in wet years (R.C. Lewis pers. comm.). A colour photograph is found in Rentz (1996).

HABITAT

In the ACT, *P. ochracea* has been found in both Natural Temperate Grassland dominated by *Danthonia* spp., *Stipa* spp. or *Themeda triandra*, and in native pasture (Stephens 1998, M. Dunford pers. comm.). The species may also occur in open woodland areas with a grassy understorey, including the endangered Yellow Box/Red Gum Grassy Woodland community, as suggested by earlier collections from the Black Mountain and Mt Majura areas. Field observations suggest that the species uses grass tussocks as shelter spaces. Stephens (1998) recorded several individuals in heavily grazed habitats, where the availability of dense grass tussocks was low. Despite this, these individuals were found in or near grass tussocks, suggesting the need for these tussocks in the habitat.

BEHAVIOUR AND BIOLOGY

P. ochracea is a cryptic grasshopper which is difficult to see unless first disturbed. When disturbed, the species appears to actively seek shelter, jumping once or twice before burying itself into a grass tussock. It is a powerful jumper, covering distances of a metre or more.

Nymphs hatch in late summer and autumn, and develop over the winter and early spring (Rentz 1996), which is unusual compared with most other ACT grasshopper species which overwinter as eggs rather than nymphs. Adults of *P. ochracea* have been collected from late October to mid February (ANIC specimens). The life cycle is a single year.

It has been suggested that *P. ochracea* has a dietary relationship with *Chrysocephalum* spp. (Rentz 1996), largely due to collection of the species at sites containing these forb species, particularly Common Everlasting (*Chrysocephalum apiculatum)*. Dietary analysis undertaken by Stephens (1998) found that all six individuals of *P. ochracea* examined consumed forb species. *Perunga* sp. 1, from South Australia, has been recorded eating several species of forbs, both flowerheads and leaves. In feeding trials, *Perunga* sp. 1 readily fed on the petals and flowers of Capeweed (*Arctotheca calendula)* and less so on wild geranium (*Erodium* spp.) and *C. apiculatum* (P. Birks pers. comm.). Although Stephens (1998) ultimately made no attempt to determine the exact forb species that *P. ochracea* was eating, there was no evidence from crop contents that the individuals collected had

consumed *C. apiculatum*, despite this forb species being present where the individuals were collected.

Although no work has been done to identify predators of *P. ochracea*, parasitic wasps (*Scelio* spp.) in south-eastern Australia have been shown to regulate some populations of other acridid grasshoppers (Baker *et al*. 1996). Vertebrate predators such as birds may reduce population numbers, as shown in other studies of grasshopper assemblages (e.g. Belovsky and Slade 1993).

DISTRIBUTION

Perunga ochracea was first described from Wagga Wagga in NSW. Until the collection of individuals in surveys in late 1997 and early 1998, and one individual taken at Mt Majura in 1992, all specimens in the ANIC were collected prior to 1970. They came either from near Wagga Wagga (at Uranquinty), Boorowa or nearby Galong, or from the ACT and adjacent areas of NSW, including Jeir, Murrumbateman and Queanbeyan. Localities in the ACT where ANIC specimens of *P. ochracea* had been collected include Black Mountain, Gungahlin, 1.6 km SW of Hall, 3.2 km NE of Kambah Pool, at the foot of Mt Stromlo, at Reid and near Weetangera.

More recent records (1975-76) of *P. ochracea* are from specific localities in Tuggeranong (now the suburbs of Calwell and Gordon) and the lower slopes of Mt Jerrabomberra (in areas that are now housing estates). There are also records from sites on the edge of Naas Road north of the junction of the Gudgenby and Naas rivers and near the cork oak plantation adjacent to William Hovell Drive (R.C. Lewis pers. comm.). The latter two sites may still support populations of this grasshopper but further surveys are required to confirm this.

Invertebrate surveys and opportunistic sightings during routine monitoring of other species in 1997 and 1998 have revealed that *P. ochracea* occurs in Natural Temperate Grassland in the Mulanggari, Gungaderra and Crace Nature Reserves at Gungahlin, in the Majura Valley (Majura Field Firing Range, Air Services Australia Beacon site and the Campbell Park paddocks), in the Jerrabomberra Valley ("Woden" property) and in Belconnen Naval Station (Figure 2, Table 1) (Stephens 1998, Dunford pers. comm.). In addition, a female specimen was collected in the grassland at Letchworth Housing Estate near Queanbeyan in December 1997 (Stephens 1998). This suggests that a population may still exist near Mt Jerrabomberra.

On the basis of ANIC and other records, it is suggested that the species has a small range stretching 180 km east-west and 150 km north-south. However, the area of occupancy within this range is likely to be low because of the reduction in size or extinction of populations through habitat alteration and fragmentation. The ANIC records and recent collections suggest that the species was once quite widespread across the ACT.

No population studies have been undertaken, which therefore makes it impossible to estimate population sizes. Recent surveys (Stephens 1998, M. Dunford pers. comm.) have collected *P. ochracea*, mostly as individuals or in low numbers, although population densities may vary among years and sites (A. Rowell pers. comm.).

Conservation Status

P. ochracea is recognised as a threatened species in the following source:

Australian Capital Territory

Vulnerable. - Section 21 of the *Nature Conservation Act 1980,* Instrument No. 192 of 1998 (formerly Instrument No. 89 of 1997).

Threats to Populations in the ACT Region

Loss or degradation of habitat is the major threat to *P. ochracea*. There has been a serious decline in the quantity and quality of habitat throughout its range including the ACT. About 5% or 1000 hectares of the Natural Temperate Grassland still exists in moderate to good condition (ACT Government 1997) and it is possible that as little as 3-4% of the original area of Yellow Box/Red Gum Grassy Woodland community of the ACT may remain in something like its natural state (ACT Government 1999). *P. ochracea* appears to occur in only a few of the remnants of these communities, and the ecological parameters of sites containing the species have not yet been identified. The native grassland habitat continues to be in demand for urban, industrial and infrastructure development as well as being vulnerable to alteration by agricultural practices.

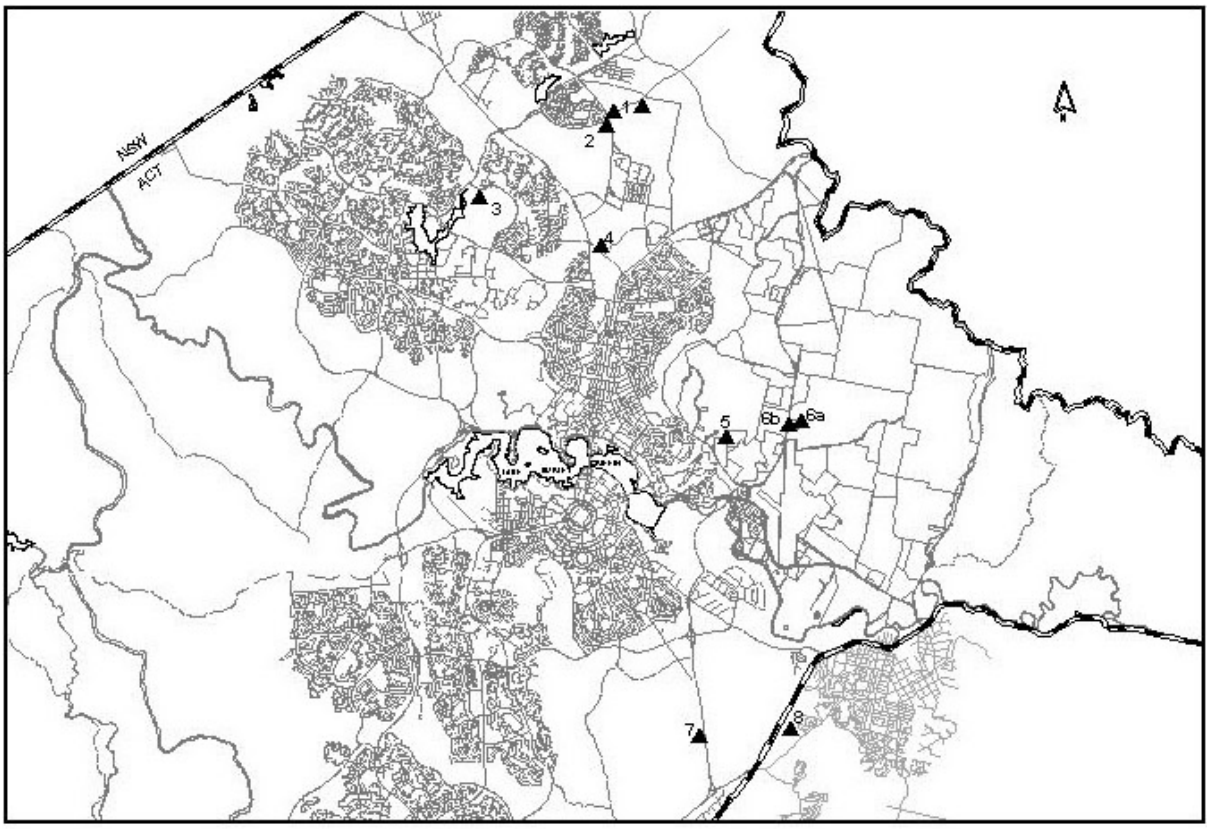

Figure 2: Known distribution of the Perunga Grasshopper (*Perunga ochracea*) (▲ in the ACT.
Map produced by Environment ACT (Wildlife Research and Monitoring).

Table 1. List of locations of *Perunga ochracea* (1997-1998 survey)

Population Number and Location	Area (ha) *	Grassland Action Plan No. (GAP) and Botanical Significance	Other Significant Species in Vicinity	Landholder and Current Status	Proposed Protection Measure
ACT SITES:					
1. Mulanggari Nature Reserve	82.8	GAP 6: - 3(5)	Di, Sp, #	Canberra Nature Park	Reserve
2. Gungaderra Nature Reserve	10.0	N/A	Di	Canberra Nature Park	Reserve
3. Belconnen Naval Station	106.5	GAP 20 - 2	Sp	Australian Navy: National Land	Reserve ϑ
4. Crace Nature Reserve	44.7	GAP 13 - 3	Sp, Di, Rl.	Canberra Nature Park	Reserve
5. Campbell Park paddocks	9.0	GAP 27: - 3	Rl, Tlp, Sp, #	Department of Defence: National Land	Reserve ϑ
6. Majura Valley East: **(a)** Majura Field Firing Range **(b).** Airport Beacon	 142.2 5.6	 GAP 28: - 1(3) GAP 28: - 3(2)	 Di, Tlp, Sp, Rl, # #	 Australian Army: National Land	 Memorandum of Understanding
7. Jerrabomberra West ("Woden" property)	72.4	GAP 36: - 2	Tlp, Sp, Ap	Rural Lease	Reserve ϑ
NSW SITES:					
8. Letchworth (near Queanbeyan)	0.4	N/A	Sp, Rl	NSW Department of Housing: Crown Land	

Shaded areas indicate sites that are Public Land - Nature Reserve.

Key to species - Ap = *Aprasia parapulchella*, Di = *Delma impar*, Rl = *Rutidosis leptorrhynchoides*, Sp = *Synemon plana* Tlp = *Tympanocryptis lineata pinguicolla*, # = uncommon or declining species which are not formally listed.

GAP = Grassland Action Plan Location Number - location reference in the Natural Temperate Grassland Action Plan (ACT Government 1997). Its use in Action Plans for component species, such as *P. ochracea* indicates that the habitat of the species in question more or less coincides with the Natural Temperate Grassland site referred to. N/A = Not applicable.

* = Area column refers to the area occupied by Natural Temperate Grassland.

ϑ = Reservation of areas (for the general NTG area) are to be considered as part of further evaluation of planning and conservation issues. *P. ochracea* may occupy all or part of this area.

Fragmentation and isolation of the remaining areas has resulted from the loss of extensive areas of habitat. Movement between habitat fragments or recolonisation after local extinctions is likely to be limited because adults of *P. ochracea* are flightless. This relative immobility also restricts gene flow between populations.

The invasion of native grasslands by exotic plant species changes the floristic composition of native grasslands. The effect of weed invasion on the habitat and food plants of *P. ochracea* is unknown. The effect that predators may have in reducing population numbers is also unknown.

Major Conservation Objectives

The objective of this Action Plan is to maintain, in the long term, the existing viable populations of *P. ochracea* in their natural habitat, as a component of the indigenous biological resources of the ACT and as a contribution to regional and national conservation of the species. This is interpreted to include the maintenance of the species' potential for evolutionary development in the wild.

This objective is to be achieved by:

- Protecting and managing those sites where habitat remains.
- Continuing monitoring and research on the species and its biology, and on its native grassland habitat, so that potential threats may be recognised and understood, with effective management practices implemented with minimal loss of habitat.

These objectives will be assisted by:

- Protecting and managing the sites where *P. ochracea* has been recorded in recent survey work.
- Developing cooperative management arrangements (Memoranda of Understanding) between the Commonwealth Government and ACT Government on the sites that occur on land occupied by the Department of Defence and any other Commonwealth agencies.
- Negotiating with landholders for cooperative management arrangements for the other sites where *P. ochracea* has been recently recorded.
- Supporting survey of further potential native grassland habitat in the ACT region, both in Natural Temperate Grassland and grassy woodland areas.

Conservation Issues and Intended Management Actions

GENERAL

The protection of Natural Temperate Grassland and Yellow Box/Red Gum Grassy Woodland (both declared as endangered ecological communities), and other threatened species which inhabit these communities, will allow for significant and complementary conservation actions.

⇒ The research needs and management actions set out in this Action Plan will be coordinated with the actions identified in the Action Plans for Natural Temperate Grassland and Yellow Box/Red Gum Grassy Woodland, of which the species' principal habitat is a component.

Possible Management Conflicts

Until further research identifies the habitat requirements of *P. ochracea*, possible management conflicts cannot be determined. However, the use of forb species as food plants suggests the need for open grassland where these species grow. In addition, many grasshopper species require open areas in which to bask and for females to lay their eggs (Urarov 1977). The Striped Legless Lizard (*Delma impar*) requires a dense grass cover, thus sites where both *P. ochracea* and *D. impar* are found may have to be maintained in such a way that the requirements of both species are met. There should be no management conflicts with the Golden Sun Moth (*Synemon plana*) which inhabits the relatively open *Danthonia* grasslands. The effect of fire on *P. ochracea* adults and overwintering nymphs needs to be determined, particularly if burning is used as a tool to manage grassland flora.

⇒ Possible conflicts in conservation objectives will be resolved in the context of documented management arrangements for each location.

SURVEY

Few surveys designed to search specifically for the *P. ochracea* have been undertaken. With the success of the recent findings of the species at key grassland sites there is encouragement that the species may be found at a wider range of localities.

⇒ Sites known to contain *P. ochracea* in the ACT will be surveyed to estimate population sizes.

⇒ When habitat requirements are identified, additional sites in the ACT containing potential habitat for the species will also be surveyed.

⇒ If further sites are found to support *P. ochracea* populations, wherever possible, management and protection measures consistent with this Action Plan will be implemented.

Knowledge of the significance and viability of populations in the region is an essential prerequisite to placing the ACT information into a proper biogeographical context. This will enable the relative significance of different areas in the region to be assessed for their importance to the survival of this species and will assist regional planning for both development and conservation purposes.

⇒ Environment ACT (Wildlife Research and Monitoring (WR&M)) will continue to liaise closely with the NSW National Parks and Wildlife Service (NSW NPWS) to ensure sharing of information, coordination, and a regional approach to the conservation of *P. ochracea*.

MONITORING

Once further research determines the locations and sizes of *P. ochracea* populations, it is essential that the floristic composition of the native grasslands (both Natural Temperate Grassland and grassy woodland) and *P. ochracea* populations of major sites continue to be monitored. Monitoring is important because changes in management practices can lead to degradation of the grassland habitat. Invasion by weeds can damage and destroy a grassland without overt human activity. These changes can occur slowly, and unless monitored, may proceed too far before they are detected.

Lack of detailed knowledge about the biology and ecology of *P. ochracea* means that changes in populations cannot be foreseen in any detailed way. Therefore monitoring via direct observation is the only means of assessing the status of a population.

Intensive grasshopper sampling is usually undertaken via sweep netting, where a set number of sweeps using a standard sweep-net is taken within an area, flushing grasshoppers into the net (e.g. Evans 1988). However, *P. ochracea* is not easily collected via this method because of the species' tendency to burrow into grass tussocks when disturbed (Stephens 1998).

For this reason, timed direct searching for the species from November to March would be more useful in determining the locations and relative size of populations. Direct searching involves flushing grasshoppers by slowly walking through a pre-determined study area and stopping often to search grass tussocks. Adults of *P. ochracea* are distinct from the other grasshopper species which are present at this time of year in grassland habitats, allowing for easy identification. It is possible that early instars of *P. ochracea* may be collected via sweep-netting. In addition, indirect monitoring during surveys for other species, where *P. ochracea* are sighted or caught in pitfall traps, may provide new data on the distribution of the species.

⇒ Environment ACT (WR&M) will coordinate monitoring of the floristic composition of major sites, where the species occurs.

⇒ Environment ACT (WR&M) will coordinate monitoring of populations to further the knowledge of the species' abundance and distribution.

RESEARCH

Priority should be placed on the identification of populations of *P. ochracea* in the ACT. At present, the species distribution and abundance are unknown. Also, little is known about the ecology and biology of the species.

When populations are located and their abundance assessed, research into the following areas would assist management of the species:

- micro-habitat requirements;
- diet;
- dispersal abilities;
- soil requirements for oviposition site selection;
- effects of various grassland management practices, particularly grazing;
- possible competition with other forb-feeding grasshoppers, particularly those which are known to have high population numbers, e.g. *Phaulacridium vittatum*;
- the effect of predators on *P. ochracea* populations; and
- specific nymphal requirements.

The species appears to be an appropriate subject for post graduate research, on aspects such as food sources, flora association, fire effects and recolonisation of habitat areas.

⇒ Environment ACT (WR&M) will liaise with appropriate research organisations and encourage research activities leading to greater knowledge of management requirements.

MANAGEMENT

Successful management of populations will require consideration of vegetation structure as well as floristic composition. Although the importance of particular plant species is not yet known, it appears that *P. ochracea* requires some vertical structure in its habitat in the form of grass tussocks. Observations in the field showed that these tussocks were important escape spaces

and may also be important shelter spaces for the species. The importance of dense tussocks as invertebrate shelter spaces during low temperature conditions such as frost have been highlighted by Bossenbroek *et al*. (1977). Nymphs of the spring emerging *Phaulacridium vittatum* seek shelter from wind and low temperatures (Clark 1967), suggesting that nymphs of *P. ochracea* may require substantial shelter from low winter temperatures which occur in the ACT.

If *P. ochracea* is specialising on forb species, it may require open grassland with intertussock spaces in which forb species can grow. Investigation is required to assess if grazing or fire reduces forb species required by *P. ochracea* as food.

⇒ Environment ACT will liaise with appropriate research bodies to determine vegetation management requirements for the species.

EDUCATION AND LIAISON

As with any threatened species, it is important to provide information to both managers and the general community.

⇒ Environment ACT will compile and distribute management guidelines and maintain contact with land managers responsible for areas on which populations presently occur.

⇒ Environment ACT will closely liaise with regional bodies, including the NSW NPWS, NSW local councils and the management team for the Joint Regional Biodiversity Survey of Grassy Ecosystems Project.

Environment ACT (WR&M) and CSIRO Entomology have jointly produced a poster *Disappearing Insects of Native Grasslands*, funded by the Endangered Species Program, Environment Australia. This poster includes details about *P. ochracea.*

⇒ Environment ACT will prepare and distribute to appropriate target audiences information about *P. ochracea* and its conservation. This will include providing information on the conservation, management and research actions being undertaken, so that conservation and management measures are understood and supported.

Protection

CONSERVATION VALUES

Until further research determines population numbers, conservation ratings of grassland sites for *P. ochracea* cannot be established. When this research is completed, possible criteria which could be used to determine conservation ratings of habitat sites include:

- the size and density of the *P. ochracea* population; and
- habitat quality, which may include variables such as food abundance and/or shelter plants.

The conservation and management of these habitat sites may be implemented in recognition of their conservation values to other species or the native grassland communities. Thus, protection of the *P. ochracea* population may occur as a result of other measures.

MEASURES FOR PROTECTION

The known *P. ochracea* populations occur in remnant native grassland on land under the following tenures: Territory Land-Nature Reserve managed by Environment ACT, rural leasehold land, and Commonwealth owned and managed land (National Land). As native grassland remnants are often isolated from one another by areas used for urban, agricultural or other land purposes, conservation effort in the ACT for *P. ochracea* will therefore focus on protecting viable functional native grassland habitat occurring within the ACT.

At present, native grassland sites warranting the most protection (and further research) for conservation of *P. ochracea* are those where the species has been most recently found (1997-1998). All are Natural Temperate Grassland sites containing habitat of moderate to high botanical significance (ACT Government 1997) (Table 1).

Protection of *P. ochracea* populations

Protection of *P. ochracea* in native grassland habitat will be achieved through the provisions of the *Land (Planning and Environment) Act 1991*, the Territory Plan and Memoranda of Understanding with Commonwealth agencies. The mechanisms available to the Territory are reservation under the Territory Plan and Property Management Agreements (PMAs) with rural lessees. The Conservator of Flora and Fauna also has powers under the *Nature Conservation Act 1980* to protect threatened flora and fauna.

Measures for effective protection of *P. ochracea* will be identified through an assessment of the conservation values of the species and needs of each native grassland habitat site. Where specific measures have been identified for the protection of Natural Temperate Grassland sites (ACT Government 1997), these are given as the recommended protection for *P. ochracea.*

The areas identified in the following tables generally refer to the size of the area containing the Natural Temperate Grassland; the extent of *P. ochracea* populations within these areas has not been determined.

(I) Territory Plan - Hills, Ridges and Buffers with Public Land Overlay of Type Nature Reserve

Reservation is generally recognised as the mechanism for ensuring that sites of high conservation value are not eventually converted to a land use incompatible with their natural values (Caughley and Gunn 1996). Reservation is therefore an important mechanism for the protection of *P. ochracea* and its habitat. Reservation does not exclude the option of managing controlled grazing to achieve conservation objectives through agistment arrangements with local rural landholders.

The Commonwealth owned component of the Campbell Park grasslands, along with the Belconnen Naval Station, are included as they are recommended for transfer to the ACT Government, with consideration for reservation, based on further evaluation of planning and conservation issues (ACT Government 1997).

Areas already set aside, together with those to be considered as Nature Reserve, are listed in Table 2.

(ii) Memoranda of Understanding

Memoranda of Understanding (MOU) provide another means of ensuring that sites with high conservation value will be managed so as to maintain their conservation value in perpetuity while enabling other compatible land uses, as identified in the MOU, to occur. An MOU with the Commonwealth does not preclude the possibility of the land being reserved in the future under Commonwealth legislation.

MOU are appropriate for Commonwealth-owned or occupied land, or other land where long-term land uses will not compromise conservation values (for example, land used for Defence purposes or communication facilities). Areas of National Land supporting *P. ochracea,* for which an MOU will be negotiated, are listed in Table 3.

Table 2. Hills, Ridges and Buffers: Public Land - Nature Reserve.

Location and site	GAP No.	Area (ha)	Current Status
Mulanggari Nature Reserve	6	82.8	Reserve
Gungaderra Nature Reserve	N/A	10.0	Reserve
Crace Nature Reserve	13	44.7	Reserve
Reservation to be considered as part of further evaluation of planning and conservation issues:			
Jerrabomberra West ("Woden" property)	36	72.4	Rural Lease
Belconnen Naval Station (Site A)	20	106.5	National Land
Campbell Park: paddocks	27	9.0	National Land

Table 3. Memoranda of Understanding to achieve protection equivalent to reservation.

Location and site	GAP No.	Area (ha)	Current Status
Majura Valley East:			
(Site A, Firing Range)	28	142.2	National Land
(Site B, Airport Beacon)	28	5.6	National Land
Belconnen Naval Station (Site A)	20	106.5	National Land

The shaded area indicates sites that are Public Land - Nature Reserve.

Note: GAP No. = Grassland Action Plan Number. This number is used as a site reference in the Natural Temperate Grassland Action Plan. N/A = Not applicable.

Native Grassland Areas Requiring Further Investigation

There are further sites containing native grassland that may provide potential habitat for *P. ochracea*. These are yet to be surveyed for the species. Assessment of the conservation significance of these sites for *P. ochracea* will be conducted as soon as practicable. Protection measures for the Natural Temperate Grassland sites are already outlined in the Natural Temperate Grassland Action Plan.

OTHER ACTIONS FOR PROTECTION

⇒ Environment ACT will liaise with Planning and Land Management and the National Capital Authority to ensure that land uses in areas adjacent to sites supporting *P. ochracea* are compatible with conservation objectives and to minimise any adverse impacts.

Socio-economic Issues

The main social benefits of conserving representative communities of Natural Temperate Grassland in which *P. ochracea* occurs are:

- meeting community concerns that further loss or extinction of significant ecological communities, together with their component native species, be prevented; and
- the amenity and recreational values associated with the grassland reserves, in which the species occurs.

There is potential for economic utilisation of native grassland habitat sites where current management or land uses are deemed to be compatible with the retention of conservation values.

There are four main aspects of planning in Canberra that will be affected by the implementation of this Action Plan: These are:

1. Future Urban Areas

Proposals for future urban areas, as identified in either the National Capital Plan or the Territory Plan, and provided for in the Residential Land Release Program may for some areas have their viability affected by the size and location of possible future *P. ochracea* reserves. This may affect some native grassland sites with potential habitat for the species.

2. Transport Facilities

The provision and/or upgrading of the following transport facilities may be affected:

- Majura Parkway - southern section and connections.
- Very High Speed Train corridor (Majura and Jerrabomberra valleys).

3. Industrial Areas

The planning for future industrial areas, in particular, a possible extension to the Hume industrial area and a possible industrial complex associated with the Airport in the Majura Valley. Some potential habitat adjacent to the Mitchell Industrial Area may also be affected.

4. Rural Leasing Aspects

One of the sites where *P. ochracea* was recently recorded, Jerrabomberra West (Site A) on "Woden" property, is within a rural lease. Preliminary investigations indicate that this lease currently contains withdrawal clauses allowing for the use of land for public purposes. Rural lease administration is subject to some uncertainty until policy and legislative developments initiated by the Rural Policy Taskforce are finalised. Two policy developments are particularly relevant to Action Plan implementation:

- The lease term for some parts of the ACT will be to the year 2020 with significant areas of rural land being available for 99 year leases. A formal Property Management Agreement will be required for new leases.
- There will be no withdrawal clauses over any part of a rural lease unless it has been clearly defined for an imminent public work, such as a road, stormwater or other infrastructure, or where a habitat has been identified as needing special conservation status.

This will mean that the options for implementing conservation actions are for the Territory to withdraw any area of land having conservation significance at the time of an application for a new lease, acquire it subsequently under the provisions of the *Land Acquisition Act 1994*, or ensure that conservation values and actions are adequately identified and provided for in a Property Management Agreement.

It is expected that it will be sometime later in 1999 before rural lessees are able to take up a new lease under the proposed new arrangements. In the meantime, Environment ACT will need to identify areas requiring special conservation measures before applications for extended lease terms are received. In the event that large areas of a lease are to be withdrawn for conservation purposes, consideration will be given to the viability of the remainder of the lease.

Legislative Provisions

The following legislation is relevant to conservation of flora and fauna in the ACT:

Nature Conservation Act 1980

The Nature Conservation Act provides a mechanism to encourage the protection of native plants and animals (including fish and invertebrates), the identification of threatened species and communities, and management of Public Land reserved for nature conservation purposes. Specified activities are managed via a licensing system.

Native plants and animals may be declared in recognition of a particular conservation concern and increased controls and penalties apply. Species declared as endangered must also be declared as having special protection status, the highest level of statutory protection that can be conferred.

Natural Temperate Grassland and Yellow Box/Red Gum Grassy Woodland, which provide habitat for *P. ochracea*, have been declared as endangered ecological communities (currently Determination No.192 of 1998). The Conservator of Flora and Fauna has prepared Action Plans for their conservation.

Land (Planning and Environment) Act 1991

The Land (Planning and Environment) Act is the primary authority for land planning and administration. It establishes the Territory Plan, which identifies nature reserves, national parks and wilderness areas within the Public Land estate.

The Territory Plan also provides for flora and fauna guidelines which list criteria for the assessment of the potential impact of a land use proposal. These focus on a range of aspects of the ACT's ecological resources, including the protection of vulnerable and endangered species along with their habitats. The conservation requirements of threatened species and their habitats are considered specifically during this process.

The Act also establishes the Heritage Places Register. Places of natural heritage significance are to be identified and conservation requirements specified.

Environmental Assessments and Inquiries may be initiated in relation to land use and development proposals.

Consultation and Community Participation

For the best management of National Land and rural leases, liaison and agreements between Environment ACT and Commonwealth agencies and rural lessees will be necessary.

Community participation with activities assisting the conservation of native grasslands and *P. ochracea* will be encouraged through groups such as the Friends of Grasslands and Park Care groups operating near grassland areas supporting *P. ochracea*. Information on the conservation of the species will be incorporated into community education programs conducted by Environment ACT.

The conservation of *P. ochracea* and its associated grassland habitat will be promoted through suitable information signs, community liaison and public education.

⇒ Public access to sites in reserves will be encouraged provided it is not likely to cause damage to the grassland. Encouragement will be given to the constructive involvement of community organisations.

⇒ Environment ACT will cooperate with NSW NPWS in surveying for *P. ochracea* and in identifying likely habitat in southern NSW.

Implementation and Review

RESPONSIBILITY FOR IMPLEMENTATION

Environment ACT (Wildlife Research and Monitoring) will have responsibility for coordinating implementation of this Action Plan subject to government priorities and resources. Primary responsibility for conservation and management of grassland communities supporting *P. ochracea* on Territory Land will rest with the ACT Parks and Conservation Service whilst relevant Commonwealth agencies will have responsibility for National Land, although provisions in the *Nature Conservation Act 1980* (ACT) are still applicable.

⇒ The ACT Government will seek the cooperation of the Commonwealth Government in setting in place coordinated and complementary action to protect the species' native grassland habitat in the ACT.

EVALUATION

Implementation of this Action Plan will be a collaborative exercise between government agencies, landholders and the community generally. Commonwealth and NSW participation will be critical in particular cases. The Action Plan will be reviewed after three years. The review will comprise an assessment of progress using the following performance indicators:

- completion of commitments that can reasonably be expected to be finalised within the review timeframe (e.g. introduction of a statutory protection measure for a species, development of a management plan);
- completion of a stage in a process with a time line that exceeds the review period (e.g. design or commencement of a research program);
- commencement of a particular commitment that is of a continuing nature (e.g. design or commencement of a monitoring program for population abundance); and
- expert assessment of achievement of conservation objectives of the Action Plan.

The review will be reported to the ACT Flora and Fauna Committee. This will provide an opportunity for Environment ACT and the Flora and Fauna Committee to assess progress, take account of developments in nature conservation knowledge, policy and administration, and review directions and priorities for future conservation action.

The following conservation actions will be given priority attention:

⇒ completion of surveys in all known native grassland sites where the species has been recorded and additionally those that contain potential habitat, to determine the distribution and abundance of the population;

⇒ establishment of a monitoring program to provide information on how populations respond to management practices and environmental pressures;

⇒ putting in place protection measures; and

⇒ establishing liaison mechanisms with NSW authorities and determining the regional distribution and conservation status of the species.

Acknowledgments

Material for this draft Action Plan was prepared for Environment ACT by Ms Claire J. Stephens.

The illustration of the species (Figure 1) was prepared for Environment ACT by Fiona Sivyer.

Authorities cited

Mr P.R. Birks has undertaken feeding trials on the only other species in the genus, the South Australian *Perunga* sp 1.

Mr M.A. Dunford discovered *P. ochracea* at seven pitfall trap sites (three Natural Temperate Grassland areas) while conducting the annual monitoring for the Striped Legless Lizard (*Delma impar*) in November-December 1997. He also identified individuals while monitoring for the endangered Golden Sun Moth (*Synemon plana*) at the Belconnen Naval Base in November 1998.

Mr R.C. Lewis surveyed grasshoppers in the ACT from 1974-1980 and has a comprehensive collection of photographs and notes on ACT species. He also has an excellent knowledge of the biology and distribution of the local grasshoppers.

Dr D.C.F. Rentz is Curator of Orthopteroid Insects in the Australian National Insect Collection of the CSIRO and is author of numerous publications, including the reference *Grasshopper Country: the abundant orthopteroid insects of Australia*.

Ms A. Rowell is a private consultant, and has undertaken surveys and studies of grasshoppers in grasslands in the ACT over the past four years.

References

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

ACT Government, 1999. Yellow Box/Red Gum grassy woodland: An endangered ecological community. Action Plan No.10. Environment ACT, Canberra.

Baker, G.L., Dysart, R.J. & Pigott, R.G., 1996. Parasitism of grasshopper and locust eggs (Orthoptera: Acrididae) by *Scelio* species (Hymenoptera: Scelionidae) in southern Australia. *Australian Journal of Zoology* 44: 427-43.

Belovsky, G.E. & Slade, J.B., 1993. The role of vertebrate and invertebrate predators in a grasshopper community. *Oikos* 68: 193-201.

Bossenbroek, P., Kessler, A., Liem, A.S.N. & Vlijm, L., 1977. The significance of plant growth-forms as “shelter” for terrestrial animals. *Journal of Zoology* 182: 1-6.

Caughley, G. & Gunn, A., 1996. *Conservation biology in theory and practice.* Blackwell Science, Carlton.

Clark, D.P., 1967. A population study of *Phaulacridium vittatum* Sjostedt (Acrididae). *Australian Journal of Zoology* 15: 799-872.

Evans, E.W., 1988. Grasshopper (Insecta: Orthoptera: Acrididae) assemblages of tallgrass prairie: influences of fire frequency, topography and vegetation. *Canadian Journal of Zoology* 66: 1495-501.

Rentz, D.C.F., 1996. *Grasshopper country: the abundant orthopteroid insects of Australia*. University of NSW Press, Sydney.

Stephens, C.J., 1998. *Grasshopper (Orthoptera: Acrididae) assemblages in natural temperate grasslands of differing native plant diversities*. BSc (hons) thesis, Department of Botany & Zoology, Australian National University.

Uvarov, B., 1977. *Grasshoppers and locusts: a handbook of general acridology, Volume 2: Behaviour, ecology, biogeography and population dynamics*. Centre for Overseas Pest Research, London.

List of Action Plans - October 1999

In accordance with Section 23 of the *Nature Conservation Act 1980,* the following Action Plans have been prepared by the Conservator of Flora and Fauna:

No. 1: Natural Temperate Grassland - an endangered ecological community.

No. 2: Striped Legless Lizard (*Delma impar*) - a vulnerable species.

No. 3: Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*) - an endangered species.

No. 4: A leek orchid (*Prasophyllum petilum*) - an endangered species.

No. 5: A subalpine herb (*Gentiana baeuerlenii*) - an endangered species.

No. 6: Corroboree Frog (*Pseudophryne corroboree*) - a vulnerable species.

No. 7: Golden Sun Moth (*Synemon plana*) - an endangered species.

No. 8: Button Wrinklewort (*Rutidosis leptorrhynchoides*) - an endangered species.

No. 9: Small Purple Pea (*Swainsona recta*) - an endangered species.

No. 10: Yellow Box - Red Gum Grassy Woodland - an endangered ecological community.

No 11: Two-spined Blackfish (*Gadopsis bispinosus*) - a vulnerable species.

No. 12: Trout Cod (*Maccullochella macquariensis*) - an endangered species.

No. 13: Macquarie Perch (*Macquaria australasica*) - an endangered species.

No. 14: Murray River Crayfish (*Euastacus armatus*) - a vulnerable species.

No. 15: Hooded Robin (*Melanodryas cucullata*) - a vulnerable species.

No. 16: Swift Parrot (*Lathamus discolor*) - a vulnerable species.

No. 17: Superb Parrot (*Polytelis swainsonii*) - a vulnerable species.

No. 18: Brown Treecreeper (*Climacteris picumnus*) - a vulnerable species.

No. 19: Regent Honeyeater (*Xanthomyza phrygia*) - an endangered species.

No. 20: Painted Honeyeater (*Grantiella picta*) - a vulnerable species.

No. 21: Perunga Grasshopper (*Perunga ochracea*) - a vulnerable species.

No. 22: Brush-tailed Rock-wallaby (*Petrogale penicillata*) - an endangered species.

No. 23: Smoky Mouse (*Pseudomys fumeus*) - an endangered species.

No. 24: Tuggeranong Lignum (*Muehlenbeckia tuggeranong)* - an endangered species.

FURTHER INFORMATION

Further information on this Action Plan or other threatened species and ecological communities can be obtained from:

Environment ACT
(Wildlife Research and Monitoring)
Phone: (02) 6207 2126
Fax: (02) 6207 2122

Environment ACT Homepage:
http://www.act.gov.au/environ

This document should be cited as:

ACT Government, 1999. *Perunga Grasshopper* (Perunga ochracea): *A vulnerable species*. Action Plan No. 21. Environment ACT, Canberra.

ACTION PLAN No. 22

In accordance with section 21 of the *Nature Conservation Act 1980*, the **Brush-tailed Rock-wallaby *(Petrogale penicillata)*** was declared an **endangered** species on 27 December 1996 (formerly Instrument No. 1 of 1997 and currently Instrument No. 192 of 1998). Section 23 of the Act requires the Conservator of Flora and Fauna to prepare an Action Plan in response to each declaration. This is the Action Plan for the:

Brush-tailed Rock-wallaby
Petrogale penicillata

Preamble

The *Nature Conservation Act 1980* establishes the ACT Flora and Fauna Committee with responsibilities for assessing the conservation status of the ACT's flora and fauna and the ecological significance of potentially threatening processes. Where the Committee believes that a species or ecological community is threatened with extinction or a process is an ecological threat, it is required to advise the responsible Minister, and recommend that a declaration be made accordingly.

Flora and Fauna Committee assessments are made on nature conservation grounds only and are guided by specified criteria as set out in its publication *"Threatened Species and Communities in the ACT*, July 1995".

In making its assessment of the Brush-tailed Rock-wallaby, the Committee concluded that it satisfied the criteria indicated in the adjacent table.

An Action Plan is required in response to each declaration. It must include proposals for the identification, protection and survival of a threatened species or ecological community, or, in the case of a threatening process, proposals to minimise its effect.

This Action Plan was prepared by the Conservator of Flora and Fauna in accordance with the requirements of the Nature Conservation Act, in consultation with the Flora and Fauna Committee and after the statutory period for public comment.
While the legal authority of this Action Plan is confined to the Australian Capital Territory, management considerations are addressed in a regional context.

Criteria Satisfied

1.2 The species is observed, estimated, inferred or suspected to be at risk of premature extinction in the ACT region in the near future, as demonstrated by:

- 1.2.1 Current severe decline in population or distribution from evidence based on:
  - 1.2.1.1 direct observation, including comparison of historical and current records.
  - 1.2.1.5 severe threats from herbivores, predators, parasites, pathogens or competitors.

Species Description and Ecology

DESCRIPTION

The Brush-tailed Rock-wallaby *Petrogale penicillata* (Figure 1) is a member of the family Macropodidae. The animal is small to medium sized with a distinctive long dark tail having a conspicuous brush at the tip (Sharman and Maynes 1983, cited by Connolly 1995). The tail is often longer (560-670 mm; average 610 mm) than the head and body length (520 580 mm; average 540 mm) (Sharman and Maynes 1983, cited by Connolly 1995).

Males weigh between 5.9-7.5 kg and females 5.0-6.5 kg (Lee and Ward 1989; Sharman and Maynes 1983, cited by Connolly 1995). Size, pelage colour and body markings vary between localities (Lim *et al.* 1981; Ride 1970) and also within a colony (Baynes pers. comm., in Connolly 1995).

The fur is generally dull brown (Sharman and Maynes 1983, cited by Connolly 1995), grey on the shoulders and rufous on the rump (Close 1993, cited by Connolly 1995). There is a light-coloured stripe on the cheek and a black dorsal stripe extending from about eye level to the back of the head. The inside of the ears appears yellowish and a pale grey side-stripe of fur with a black ventral stripe may be present (Sharman and Maynes 1983, cited by Connolly 1995). In New South Wales, the colour of the fur on the belly is red/orange and the forepaws and hindlimbs are black (Short 1980). The soles of its feet are extensively granulated to grip steep surfaces (Sharman and Maynes 1983).

Figure 1: *Petrogale penicillata.*

HABITAT

P. penicillata inhabits cliffs and other steep rocky areas that have a combination of specialised features which provide areas for shelter, basking and social activities (Short 1980, 1982). Short (1980, 1982) concluded from comparative studies of areas occupied by the species in the tablelands and coastal mountains of NSW that it frequented sites having abundant ledges, caves and passageways, shorter ledges and a higher proportion of covered areas. Favoured sites also had a northerly aspect (Short 1982), which allows the animals to sun themselves during the morning and evening periods. In the ACT, there is evidence that the species formerly inhabited caves, crevices and sheltered ledges at certain boulder sites in the Tidbinbilla Nature Reserve and Namadgi National Park (Connolly 1995; Ormay 1996).

BEHAVIOUR AND BIOLOGY

The basic activity pattern observed from studies of the species inhabiting rocky outcrops in gorges near Armidale (Ralston 1983) was that at dusk, they usually left the outcrops to feed (Ralston 1983, cited by Connolly 1995). They returned to an outcrop before sunrise, then entered their refuges and emerged onto ledges exposed to the sun. Depending on the weather, they then spent the day either on the ledges or within their caves. While on the ledges, they rested, groomed themselves and engaged in social, alert or feeding activities. They also moved about the rock outcrops.

The species has a generalist diet with a preference for grasses and forbs. However, in times of shortage, it feeds on a wide variety of grasses and shrubs. This wide range of acceptable food items suggests an adaptation for survival, against both drought and competition from herbivores with more limited food preferences (Short 1989; Lim *et al*. 1987; Copley and Robinson 1983, cited by the Department of Conservation and Environment, Victoria (DC&E) 1991).

Females produce a single pouch young and breeding may be continuous. Once the pouch is permanently vacated, offspring are left in a rock shelter (DC&E 1991). The possession of a suitable shelter may be important for successful breeding (Joblin 1983, cited by DC&E 1991).

DISTRIBUTION

Former Distribution

P. penicillata was once common and ubiquitous throughout the mountainous country of south-eastern Australia (Short and Milkovits 1990, cited by Connolly 1995), being found in suitable rocky areas in a variety of habitats. It was formerly found along the Great Dividing Range from Nanango in south-east Queensland, through to East Gippsland in Victoria (Eldridge and Close 1992; Short and Milkovits 1990, cited by Connolly 1995). Scattered populations were also found in suitable habitat across the western slopes of NSW and the Grampian Ranges and nearby outcrops in western Victoria (Maxwell *et al.* 1996).

Present Distribution

There has been a dramatic decline in the distribution and abundance of the species, especially in Victoria, and in western and southern NSW, where its range has been severely reduced (Connolly 1995; Maxwell *et al.* 1996). Except for populations in the Warrumbungle Ranges, the species is now absent from the western slopes and plains of NSW. The geographic range since European settlement is estimated to have been reduced by 50-90% (Kennedy 1992, cited by Connolly 1995). The species is considered to be locally common only in the north-eastern part of its range (Hill 1991, cited by Connolly 1995). Introduced populations are present in Hawaii and New Zealand (Short 1980).

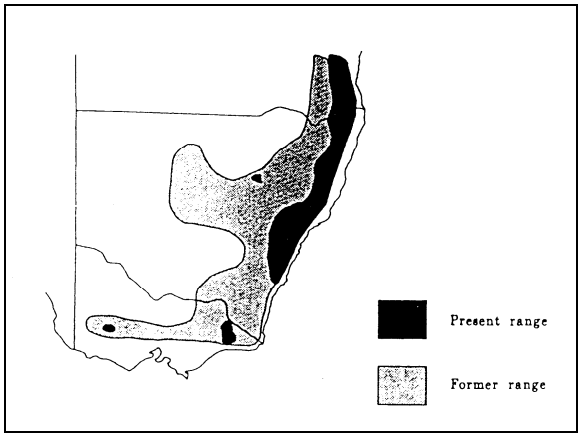

Figure 2: Map showing the present and former range of *P. penicillata* in south-eastern Australia (from Short and Milkovits 1994, cited by Connolly 1995).

In the ACT, the species is presumed to be extinct, with the last confirmed sighting occurring at Wallaby Rocks in the Tidbinbilla Nature Reserve in 1959 (Ormay 1996). However, findings of Rock-wallaby bones and evidence of the species in predator scats along the Orroral Ridge in Namadgi National Park suggest a more recent occurrence of the species (Reside and Martin 1996). The nearest known extant colonies to the ACT are at Taralga (near Goulburn) (136 km NNE of Canberra) and in Kangaroo Valley, NSW (187 km ENE of Canberra).

There are three known captive populations of the species in Australia (NSW NPWS 1998) which are the focus of behavioural, management and genetic research:

- Tidbinbilla Nature Reserve (TNR) ACT, where animals have been introduced from Kawau Island, New Zealand;
- Healesville Sanctuary, Victoria, that holds animals caught from Little Plains in Gippsland; and
- Adelaide Zoo, that holds animals from Healesville.

One means of artificially boosting wild populations which has been trialled is to accelerate the breeding rate by using Tammar Wallabies as surrogate mothers. The development of this technique is being advanced at TNR, Healesville and the Adelaide Zoo.

Conservation Status

P. penicillata is recognised as a threatened species in the following sources:

International

Vulnerable. - IUCN Red List of Threatened Animals 1994 (Groombridge 1993).

National

Vulnerable. - Part 2, Schedule 1 of the *Endangered Species Protection Act 1992* (Commonwealth).

Australian Capital Territory

Endangered. - Section 21 of the *Nature Conservation Act 1980,* Instrument No. 192 of 1998 (formerly Instrument No. 1 of 1997).

Special Protection Status Species. - Schedules 6 and 7 of the *Nature Conservation Act 1980,* Instrument No. 197 of 1998.

New South Wales

Vulnerable. - Schedule 2 of the *Threatened Species Conservation Act 1995.*

Endangered Population. - Warrumbungles population, Part 2, Schedule 1 of the *Threatened Species Conservation Act 1995*, December 1997.

Victoria

Endangered. - CNR (1995) Threatened Fauna in Victoria - 1995. Department of Conservation and Natural Resources, Victoria.

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

The species is also the subject of Action Statement No. 19, prepared by the Victorian Department of Conservation and Environment.

Threatening Processes

A number of factors have been cited as reasons for the dramatic decline in the distribution and abundance of the species. They include predation by the European Red

Fox (*Vulpes vulpes*), Cat (*Felis catus*), Dingo (*Canis familiaris dingo*) and/or wild Dog (*Canis familiaris familiaris*); competition with Goats (*Capra hircus*), European Rabbits (*Oryctolagus cuniculus*) and Sheep (*Ovis aries*); management of land between populations incompatible with the species' survival; hunting; disease; climatic change; wildfire; and drought (Hill 1991, cited by Connolly 1995).

Weeds, disturbance, habitat modification and inbreeding are also cited as possible contributors to a continuing decline in the population at Kangaroo Valley (NSW NPWS 1998).

Predation by dingos and introduced carnivores, in particular, the Red Fox and possibly feral cats, has reduced the likelihood of successfully recolonising areas where populations have become extinct in Victoria. Young and juvenile rock-wallabies appear to be particularly vulnerable to Red Fox predation (Hill 1991; Kinnear *et al.* 1988, cited by Connolly 1995), especially when dispersing between rocky habitat (Sharman and Maynes 1983, cited by Connolly 1995). Hill (1991, cited by Connolly 1995) notes that the feral cat has been known to hunt mammals which weigh up to 3 kg, implying that the pouch-emerged young Brush-tailed Rock-wallabies may be vulnerable to cat predation. Cats are also known to carry a protozoan parasite, *Toxoplasmosis*, which can cause death in a range of marsupial species (DC&E 1991).

Competition with introduced herbivores, namely goats, rabbits and sheep may have reduced the carrying capacity for the species and, in turn, the size of each population (Hill 1991, cited by Connolly 1995). Goats may also compete with the species for shelter (Hill 1991) and have been observed physically evicting Yellow-footed Rock-wallabies (*P. xanthopus*) from caves (Lim *et al.* 1980 in Lobert 1988, cited by Connolly 1995).

Hunting is cited as a cause of decline, since hundreds of thousands were shot as agricultural pests and hunted for fur during a sustained commercially-driven period late last century and early this century. Bounties were paid on over 500,000 Rock-wallabies between

1894 and 1914 (Short and Milkovits 1990, cited by Maxwell *et al*. 1996), and an extensive fur trade existed from before 1890 through to 1927 (Lunney, Law and Rummery pers. comm., in Maxwell *et al.* 1996). This led to the decline of many populations and local extinctions, and may have been the primary cause of the initial decline of the species, at least in central and southern NSW. The species was also hunted extensively in the Grampians area of Victoria (Maxwell *et al.* 1996).

Wildfire and drought are considered potentially serious threats to the survival of small isolated populations. Either could be the ultimate cause of extinction (Hill 1991, cited by Connolly 1995). They have been cited as causes of successive extinction of the remaining small isolated populations in Victoria (DC&E 1991).

Inbreeding and loss of genetic diversity may also be a threat where animals are unable to disperse from their natal colony (Buchan 1996). Barriers to movement between colonies have arisen through changes in land use, habitat destruction and loss of some colonies.

Management of land between populations is likely to affect the survival of dispersing individuals, especially through exposure to predation (Hill 1991, cited by Connolly 1995). The density of predators in the intervening habitat and hence the risk of mortality will be affected by the policies for Red Fox and Dingo/dog control in that area (Connolly 1995). Cleared land, roads and fences may also be obstacles to movement (Opdam 1990, in Hill 1991, cited by Connolly 1995).

Uncontrolled human disturbance effects to colonies are undefined, although a cautious approach should be adopted (Lobert and Waters 1988; Wakefield 1971, cited by Reside and Martin 1996). Reside and Martin (1996) consider that uncontrolled human usage of historic Rock-wallaby sites in the ACT severely jeopardises any attempts at re-introduction. The granite boulder piles afford little protection from climbers or adventurers scrambling over them.

Altered fire regimes (that is, less frequent fires) have been cited by Norris and Belcher (1986, cited by Reside and Martin 1996) as making a possible contribution to the decline of the species, as fire is likely to have a role in providing foraging habitat.

Major Conservation Objectives

The major long term conservation objectives are to re-establish viable, wild populations of *P. penicillata* as a component of the indigenous biological resources of the ACT region and to contribute to the national conservation of the species. This is interpreted to include the species' potential for evolutionary development in the wild.

Animals can only be reintroduced to a site when the processes which caused the local extinction of the species in the first place have been dealt with. Effective control measures directed at predators and feral goats need to be developed and established in the field.

These objectives are to be achieved by:

- continuing to manage suitable captive stock based on a sound knowledge of genetic differences between populations;
- continuing to support establishment of a captive colony in Victoria through enhanced reproductive techniques, which are undertaken at the Tidbinbilla Nature Reserve;
- developing a re-introduction strategy which will include reviewing potential areas suitable for the eventual release of the species into the wild. This will also require sustained effective fox control and an understanding of other threats to enable appropriate management measures to be put in place; and
- establishing a managed wild population within the ACT, consistent with the above re-introduction strategy.

Recovery teams for the species have been established in both NSW and Victoria and another for southern NSW, although there is as yet no national recovery strategy in place.

⇒ Environment ACT will support regional and national efforts for the recovery and conservation of the species.

Conservation Issues and Intended Management Actions

CAPTIVE POPULATION AT TIDBINBILLA NATURE RESERVE (TNR)

A captive population of *P. penicillata* is housed at TNR as part of a public display of wildlife. Besides playing a role in public education, other objectives of the captive management program for the species are to:

- maintain a manageable captive population and to ensure long-term genetic integrity of the population; and
- contribute to the conservation and re-establishment of the species within its former and present range (Underwood 1997).

The captive population housed at TNR originates from unprovenanced animals which were introduced to Kawau Island in New Zealand late last century. TNR currently maintains the largest captive group of the species. These animals are critical to the success of a number of *P. penicillata* conservation programs and are being used by researchers into cross-fostering which offers the potential for rapid increases in the size of colonies.

Recent and ongoing work in conjunction with Victoria and NSW has indicated that the TNR animals are genetically suitable for release in the ACT region.

⇒ Environment ACT, in conjunction with recovery teams, will continue the captive breeding program to increase captive populations for possible recolonisation in suitable habitat areas throughout the species' former range.

SURVEY

Following from the last confirmed sighting in the ACT in 1959, the first comprehensive survey work was undertaken by Ormay in 1982 and 1985, with 38 sites checked and five of these showing traces of former occupation (Ormay 1996).

In 1994, Connolly (1995) assessed sites for suitability for re-introduction and surveyed additional sites using colour and aerial photographs. She located a further 13 sites and selected six study areas for assessing their suitability, by applying a quantitative approach.

Both Ormay (1996) and Connolly (1995) concluded that there were no sites, at that stage, suitable in the ACT for re-introduction of the species, the main reasons being the accessibility of sites, presence of predators

and proximity of sites to cleared land (Connolly 1995).

Reside and Martin (1996) searched 13 sites in the ACT and obtained additional evidence of previously unknown prior occupation at seven of these. The results provided further indications that the species is extinct in the ACT. In this study, the ACT sites were classified on the basis of habitat qualities and predator susceptibility (high, medium or low), which serves as a useful basis for assessment of suitability for re-introduction of the species.

⇒ As part of developing a re-introduction strategy, Environment ACT will assess the suitability of those sites identified as being potentially favourable for re-introduction, and will follow up any new useful information on sites within Tidbinbilla Nature Reserve and Namadgi National Park.

RESEARCH

As part of the program established to assist the recovery of Victorian populations of Brush-tailed Rock-wallabies, TNR has been involved in a range of research programs designed to enhance the recovery of this species. These include:

- cross fostering of Brush-tailed Rock-wallaby pouch young to a surrogate species;
- the development of Brush-tailed Rock-wallaby pouch young transport and transfer management techniques;
- collection of biological data and other information relating to reproduction in the species; and
- DNA studies relating to the genetic diversity of captive and wild populations of the Brush-tailed Rock-wallaby.

⇒ Environment ACT will, through its partnership with the Cooperative Research Centre for the Conservation and Management of Marsupials, seek collaboration with scientists working on conservation genetics and breeding programs which may have application to a recovery strategy for the species.

PREDATOR CONTROL

Effective, long term predator control is fundamental to any re-introduction program for the Brush-tailed Rock-wallaby in the ACT. There are no current plans for sustained predator control at any of the potential release sites - this is likely to be a major undertaking and could not be carried out unless there is clear Government commitment and public support. The effectiveness of predator control measures will need to be considered as an integral part of any management program. Once initiated, predator control will need to be sustained indefinitely and this may be a costly exercise.

The Commonwealth Government is preparing the Threat Abatement Plan for predation by the European Fox, which will outline a national approach for controlling the impact of foxes on threatened species. This will be an important framework and reference for any predator control program initiated in the ACT as part of a Rock-wallaby introduction program.

⇒ Environment ACT will monitor development of fox control techniques and national fox threat abatement proposals as a component of any re-introduction strategy.

PROPOSED MANAGEMENT STRATEGY

In order to progress towards the objectives of this Action Plan, a re-introduction strategy will be developed, the main elements of which will be:

⇒ determining the most appropriate source and genetic attributes of animals;

⇒ identifying potentially favourable sites for re-introduction and assessing their suitability;

⇒ ensuring that effective control programs for predators and feral goats are capable of being put in place, sustained in the long term and closely monitored;

⇒ developing management strategies to conserve and enhance the sites where re-introductions have occurred;

⇒ developing community education and participation programs in support of Brush-tailed Rock-wallaby conservation, especially in regard to any re-introduction sites where there may be conflicting uses;

⇒ developing funding and support mechanisms for the program; and

⇒ determining and fostering public and Government support for re-introducing the species into the wild in the ACT.

Any decision to implement the strategy will be dependent on:

- general acceptance of the feasibility of implementing the proposed re-introduction strategy;

- establishing a recovery management team with relevant expertise to oversee the implementation of actions;
- long term commitment of funds to support predator control and other management activities; and
- Government commitment to a revised Action Plan setting out an implementation program for the re-introduction of the species.

EDUCATION AND LIAISON

The captive population of *P. penicillata* held at the Tidbinbilla Nature Reserve is part of the public display of many wildlife species. The Brush-tailed Rock-wallaby colony is maintained for scientific research, provides recreational opportunities and is a component of education, conservation, and species recovery programs (Underwood 1997).

Protection

All potential areas for re-introduction of *P. penicillata* are currently within TNR and Namadgi National Park, hence there will not be a need to establish further reserves.

Environment ACT (ACT Parks and Conservation Service) is undertaking management programs for predator control in reserved areas as part of other conservation objectives. The knowledge and experience developed in these programs will be valuable in any predator control program included in a proposed reintroduction strategy.

Socio- economic Issues

There are no current activities or land uses which are likely to conflict with achievement of the conservation objective during the term of this Action Plan.

Once sites for re-introduction have been identified and long term predator control measures put in place, implications for existing and proposed land use activities will require detailed consideration.

Current unrestricted use of sites for abseiling and rock climbing is likely to severely jeopardise any attempts at re-introduction (Reside and Martin 1996). These activities may therefore need to be reviewed at any sites where re-introductions are likely, and a public awareness program will need to be undertaken, with sufficient lead time prior to implementation.

Any additional predator and other feral animal control programs implemented for the conservation of this species will be beneficial for other species and for neighbouring landholders.

⇒ Environment ACT will include community consultation and public education about land-use issues, in any strategy for re-introduction of the species into the wild in the ACT.

Legislative Provisions

The following legislation is relevant to conservation of flora and fauna in the ACT region:

AUSTRALIAN CAPITAL TERRITORY

Nature Conservation Act 1980

The Nature Conservation Act provides a mechanism to encourage the protection of native plants and animals, the identification of threatened species and ecological communities, and the management of Public Land reserved for nature conservation purposes. Specified activities are managed via a licensing system.

Native plants and animals may be declared in recognition of a particular conservation concern and increased controls and penalties apply. Species declared as endangered must also be declared as having special protection status (SPS), the highest level of statutory protection that can be conferred.

Petrogale penicillata is listed as a SPS species and any activity affecting such a species is subject to special scrutiny. Conservation requirements are a paramount consideration and only activities related to conservation of the species or serving a special purpose are permissible.

The Conservator of Flora and Fauna may only grant a licence for activities affecting a species with SPS where satisfied that the act specified in the licence meets a range of stringent conditions. The public display at TNR complies with specified licence conditions for SPS species.

The Conservator must also approve a management plan for the keeping of animals for public display. A species management

plan has been approved for keeping the captive population of the species at TNR.

Further information on licensing can be obtained from the Licensing Officer, Nature Conservation Regulation, Environment ACT, telephone (02) 6207 6376.

Land (Planning and Environment) Act 1991

The Land (Planning and Environment) Act is the primary authority for land planning and administration. It establishes the Territory Plan, which identifies nature reserves, national parks and wilderness areas within the Public Land estate.

The Land (Planning and Environment) Act establishes the Heritage Places Register. Places of natural heritage significance are to be identified and conservation requirements specified.

Environmental Assessments and Inquiries may be initiated in relation to land use and development proposals.

NEW SOUTH WALES

Threatened Species Conservation Act 1995

The Act came into effect on 1 January 1996 and requires the preparation of recovery plans for endangered species (other than those presumed extinct), endangered populations, endangered ecological communities and vulnerable species. Threat abatement plans are required to manage key threatening processes with a view to their abatement, amelioration or elimination. A Species Impact Statement is required when a development application is made on land which contains areas declared to be critical habitat under Part 3 of the Act or which is likely to significantly effect threatened species, populations or ecological communities or their habitats.

The preparation of a Recovery Plan for *P. penicillata* is mandatory as the species has been listed as vulnerable.

The NSW Scientific Committee has made Final Determinations to list the Warrumbungles population of the species as an Endangered population (December 1997) and the European Red Fox (*Vulpes vulpes*) as a Key Threatening Process (March 1998).

Consultation and Community Participation

Environment ACT (TNR) is a member of the Southern NSW Recovery Team comprising representatives from the NSW NPWS (Southern Zone) and the Kangaroo Valley Friends of the Brush-tailed Rock-wallaby. This group is currently focussing on conservation actions for the Kangaroo Valley population, although its scope of activity is likely to be broadened to cover management issues in the ACT region if a re-introduction program is established.

Environment ACT (TNR) also has membership on the Victorian Brush-tailed Rock-wallaby Team, which includes representatives from the Department of Natural Resources, Parks Victoria, Healesville Sanctuary, Adelaide Zoo, Monash and Melbourne Universities, and private ecological consultants (Biosis Research and Wildlife Unlimited). This group meets regularly to review the status of colonies, predator control programs and cross-fostering trials. TNR is participating in the cross-fostering trials where rock-wallaby embryos are transferred to the pouches of Tammar Wallabies.

⇒ Environment ACT (ACT Parks and Conservation Service) will continue to support the Southern NSW and Victorian Recovery Teams.

⇒ Environment ACT (ACT Parks and Conservation Service) will encourage appropriate community participation in activities associated with the conservation of the species in the ACT. This will be arranged through groups such as the Friends of Tidbinbilla, the Canberra Bushwalkers Club, the ANU Rock-climbing Club and Outward Bound.

Implementation, Evaluation and Review

RESPONSIBILITY FOR IMPLEMENTATION

Environment ACT (Wildlife Research and Monitoring) will have responsibility for coordinating implementation of this Action Plan subject to government priorities and resources.

Actions will be implemented in consultation with the Southern NSW and Victorian recovery teams, and will be consistent with regional programs. The ACT Parks and Conservation Service will be responsible for the on-ground implementation in areas under its control.

EVALUATION

Implementation of this Action Plan will be a collaborative exercise between government agencies and the community generally. The Action Plan will be reviewed after three years. The review will comprise an assessment of progress in developing the proposed re-introduction strategy and, if appropriate, achieving the targets set within this strategy, including:

⇒ identification of suitable re-introduction sites;

⇒ setting a time frame for breeding of sufficient animals; and

⇒ implementing and setting a time frame for an effective long term predator control program.

The review will be reported to the ACT Flora and Fauna Committee. This will provide an opportunity for Environment ACT and the Flora and Fauna Committee to assess progress, particularly in regard to the likely effectiveness of any long term predator control program, take account of developments in nature conservation knowledge, policy and administration and review directions and priorities for future conservation action.

Acknowledgments

The illustration of the species (Figure 1) was prepared for Environment ACT by Mr Wayne Byatt.

Valuable comments on successive stages of drafting were provided by Dr John McIlroy, a former member of the ACT Flora and Fauna Committee, now residing in Akaroa, New Zealand.

References

Buchan, A., 1996. *A strategic plan for the Brush-tailed Rock-wallaby* Petrogale penicillata *in central New South Wales*. Unpublished report to Jenolan Caves Reserve Trust.

Close, R.L., 1993. Brush-tailed Rock-wallaby. Royal Zoological Society Series on NSW Animals.

Connolly, A., 1995. *Past and future refuge for the Brush-tailed Rock-wallaby (*Petrogale penicillata*) in the southern ACT. Preliminary research into the feasibility of a local re-introduction.* BSc (hons) thesis, Department of Forestry, Australian National University.

Copley, P.B. & Robinson, A.C., 1983. Studies on the Yellow-footed Rock-wallaby, *Petrogale xanthopus*. II. Diet. *Australian Wildlife Research* 10 (1): 63-76.

Department of Conservation & Environment, 1991. *Brush-tailed Rock-wallaby*, Petrogale penicillata. *Action Statement No. 19*. Department of Conservation & Environment, Melbourne.

Eldridge, M.D.B. & Close, R.K., 1992. Taxonomy of Rock-wallabies, *Petrogale* (Marsupialia: Macropodidae) 1. A revision of Eastern *Petrogale* with the description of three new species. *Australian Journal of Zoology* 40: 605-625.

Eldridge, M.D.B. & Close, R.K., 1995. Brush-tailed Rock-wallaby. In Strahan, R., (ed.) *The mammals of Australia*, pp 383-385. Reed Books, Chatswood, NSW.

Groombridge, B., (ed.), 1993. 1994 *IUCN Red List of threatened animals*. IUCN Gland, Switzerland & Cambridge, UK.

Hill, F.A.R., 1991. *A research recovery plan for the Brush-tailed Rock-wallaby* Petrogale penicillata (*Gray 1825) in south-eastern Australia*. Unpublished report to ANPWS, Department of Conservation and Environment, Melbourne.

Joblin, K.P.W., 1983. *Behaviour and ecology of the Brush-tailed Rock-wallaby,* Petrogale penicillata*, in the New England Region.* Unpublished MSc thesis, University of New England.

Kennedy, M., 1992. Brush-tailed Rock-wallaby: species recovery outline No. 23. In *Australasian marsupials and monotremes: An action plan for their conservation*. IUCN/SSC Australasian Marsupial and Monotreme Specialist Group, Sydney.

Kinnear, J., Onus, M.L. & Bromilow, R.N., 1988. Fox control and rock-wallaby population dynamics. *Australian Wildlife Research* 15: 435-450.

Lee, A.K. & Ward, S.J., 1989. Life histories of macropod marsupials. In Grigg, G.C. *et al*., (eds) *Kangaroos, wallabies and rat-kangaroos*, pp 105-115. Surrey Beatty & Sons, Chipping Norton.

Lim, L., Robinson, A.C., Copley, P.B., 1981. Rock-wallabies genus Petrogale. In Haigh,

C., (ed.) *Kangaroos and other macropods of New South Wales*, pp 21-26. NSW National Parks & Wildlife Service, Sydney.

Lim, L., Robinson, A.C., Copley, P.B., Gordon, G., Canty, P.D., & Remer, D., 1987. *The conservation and management of the Yellow-footed Rock-wallaby* Petrogale xanthopus *Gray 1854*. Dept Env. Plan. S.Aust. Spec. Publ. 1987. No. 4: 1-94.

Lobert, B. & Waters, R., 1988. *The Brush-tailed Rock-wallaby* Petrogale penicillata *in the Grampians National Park and Black Range, Victoria*. Part 2 - Management and research recommendations. A report to the National Parks and Wildlife Division, Department of Conservation, Forests and Lands, Victoria, by the Australian Biological Research Group.

Maxwell, S., Burbidge, A.A., & Morris, K. (eds), 1996. *The 1996 action plan for Australian marsupials and monotremes for the IUCN/SSC Australasian Marsupial and Monotreme Specialist Group*, p. 127. Endangered Species program, project no. 500, Wildlife Australia, Canberra.

Norris, K.C. & Belcher, C.A., 1986. *The Brush-tailed Rock-wallaby in Gippsland, 1986*. Compiled for the Bairnsdale region, Department of Conservation, Forests and Lands, Melbourne.

NSW National Parks and Wildlife Service, Nowra District, 1998. *Draft recovery plan for the Shoalhaven population of Brush-tailed Rock-wallabies*. 2nd edition draft February 1998.

Opdam, P., 1990. In Hill, F.A.R., 1991. A research recovery plan for the Brush-tailed Rock-wallaby *Petrogale penicillata penicillata* (Gray 1825) in south-eastern Australia. Unpublished report to the Australian National Parks and Wildlife Service. Department of Conservation and Environment, Victoria.

Ormay, P., 1996. *Status of the Brush-tailed Rock-wallaby* Petrogale penicillata *in the Australian Capital Territory*. Technical Report No. 13. ACT Parks and Conservation Service, Canberra.

Ralston, M., 1983. Unpublished Bachelor of Natural Resources thesis, University of New England, Armidale, NSW.

Reside, J. & Martin, R., 1996. *The status of the Brush-tailed Rock-wallaby* Petrogale penicillata *in the Australian Alps National Parks*. A report to the Australian Alps Liaison Committee.

Ride, W.D.L., 1970. *A guide to the native animals of Australia*. Oxford University Press, Melbourne.

Sharman, G.B. & Maynes, G.M., 1983. Rock-wallabies. In Strahan, R., (ed.) *Complete book of Australian mammals*, pp 207-212. Angus & Robertson, Sydney.

Short, J., 1980. *Ecology of the Brush-tailed Rock-wallaby*, Petrogale penicillata. MSc thesis, University of Sydney, NSW.

Short, J., 1982. Habitat requirements of the Brush-tailed Rock-wallaby, *Petrogale penicillata*, in New South Wales. *Australian Wildlife Research* 9: 239-246.

Short, J., 1989. The diet of the Brush-tailed Rock-wallaby *Petrogale penicillata* in New South Wales. *Australian Wildlife Research* 16: 11-18.

Short, J. & Milkovits, G., 1990. Distribution and status of the Brush-tailed Rock-wallaby in south-eastern Australia. *Australian Wildlife Research* 17: 169-179.

Underwood, G., 1997. *Brush-tailed Rock-wallaby* - Petrogale penicillata. Tidbinbilla Nature Reserve species management plan.

Wakefield, N., 1971. The Brush-tailed Rock-wallaby *Petrogale penicillata* in western Victoria. *Victorian Naturalist* 88: 92-102.

List of Action Plans - October 1999

In accordance with Section 23 of the *Nature Conservation Act 1980,* the following Action Plans have been prepared by the Conservator of Flora and Fauna:

No. 1: Natural Temperate Grassland - an endangered ecological community.

No. 2: Striped Legless Lizard (*Delma impar*) - a vulnerable species.

No. 3: Eastern Lined Earless Dragon (*Tympanocryptis lineata pinguicolla*) - an endangered species.

No. 4: A leek orchid (*Prasophyllum petilum*) - an endangered species.

No. 5: A subalpine herb (*Gentiana baeuerlenii*) - an endangered species.

No. 6: Corroboree Frog (*Pseudophryne corroboree*) - a vulnerable species.

No. 7: Golden Sun Moth (*Synemon plana*) - an endangered species.

No. 8: Button Wrinklewort (*Rutidosis leptorrhynchoides*) - an endangered species.

No. 9: Small Purple Pea (*Swainsona recta*) - an endangered species.

No. 10: Yellow Box - Red Gum Grassy Woodland - an endangered ecological community.

No 11: Two-spined Blackfish (*Gadopsis bispinosus*) - a vulnerable species.

No. 12: Trout Cod (*Maccullochella macquariensis*) - an endangered species.

No. 13: Macquarie Perch (*Macquaria australasica*) - an endangered species.

No. 14: Murray River Crayfish (*Euastacus armatus*) - a vulnerable species.

No. 15: Hooded Robin (*Melanodryas cucullata*) - a vulnerable species.

No. 16: Swift Parrot (*Lathamus discolor*) - a vulnerable species.

No. 17: Superb Parrot (*Polytelis swainsonii*) - a vulnerable species.

No. 18: Brown Treecreeper (*Climacteris picumnus*) - a vulnerable species.

No. 19: Painted Honeyeater (*Grantiella picta*) - a vulnerable species.

No. 20: Regent Honeyeater (*Xanthomyza phrygia*) - an endangered species.

No. 21: Perunga Grasshopper (*Perunga ochracea*) - a vulnerable species.

No. 22: Brush-tailed Rock-wallaby (*Petrogale penicillata*) - an endangered species.

No. 23: Smoky Mouse (*Pseudomys fumeus*) - an endangered species.

No. 24: Tuggeranong Lignum (*Muehlenbeckia tuggeranong)* - an endangered species.

FURTHER INFORMATION

Further information on this Action Plan or other threatened species and ecological communities can be obtained from:

Environment ACT
(Wildlife Research and Monitoring)
Phone: (02) 6207 2126
Fax: (02) 6207 2122

Environment ACT Homepage:
http://www.act.gov.au/environ

This document should be cited as:

ACT Government, 1999. *Brush-tailed Rock-wallaby* (Petrogale penicillata): *An endangered species*. Action Plan No. 22. Environment ACT, Canberra.