Australian Capital Territory

Nature Conservation (Threatened Ecological Communities and Species) Action Plan 2012 (No 1)

Disallowable instrument DI2012–108

made under the

***Nature Conservation Act* 1980, s 42 (Preparation of action plan)**

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1 Name of instrument

This instrument is the *Nature Conservation (Threatened Ecological Communities and Species) Action Plan 2012 (No 1).*

2 Commencement

This instrument commences on the day after notification.

3 Details of Instrument

The following Action Plans, as attached (Attachment A) have been prepared:

Action Plan No. 5 A subalpine herb (*Gentiana baeuerlenii*)

Action Plan No. 6 Northern Corroboree Frog (*Pseudophryne pengilleyi*)

Action Plan No. 22 Brush-tailed Rock Wallaby (*Petrogale penicillata*)

Action Plan No. 23 Smoky Mouse (*Pseudomys fumeus*)

Action Plan No. 30 Spotted-tailed Quoll (*Dasyurus maculatus*)

Action Plan No. 31 Canberra Spider Orchid (*Arachnorchis actensis*)

Action Plan No. 32 Brindabella Midge Orchid (*Corunastylis ectopa*)

Note: Action Plan No. 31 Canberra Spider Orchid is in the form which was adopted as a Commonwealth recovery plan for the Canberra Spider Orchid under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 as in force on commencement of this instrument with the following minor modifications:

- updated title page and publication details page;
- details regarding declaration of the species as endangered in the ACT;
- updated Directorate, branch and section names; and
- removal of Table 1 - estimated costs of implementing actions.

Note: Action Plan No. 32 Brindabella Midge Orchid is in the form which was adopted as a Commonwealth recovery plan for the Brindabella Midge Orchid under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 as in force on commencement of this instrument with the following minor modifications:

- updated title page and publication details page;
- details regarding declaration of the species as endangered in the ACT;
- updated Directorate, branch and section names;
- inclusion of additional data for 2011;
- minor changes to threats and management action details; and
- removal of Table 1 - estimated costs of implementing actions.

Note: Copies of the above Action Plans are available from http://www.environment.act.gov.au/cpr/conservation_and_ecological_communities/threatened_species_action_plans

4 Revocation

This instrument revokes the Nature Conservation (Threatened Ecological Communities and Species) Action Plan 2007 (No 2) DI2007-85.

Alan Traves
Acting Conservator of Flora and Fauna

30 May 2012

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.

ACT DEPARTMENT OF URBAN SERVICES
ENVIRONMENT ACT

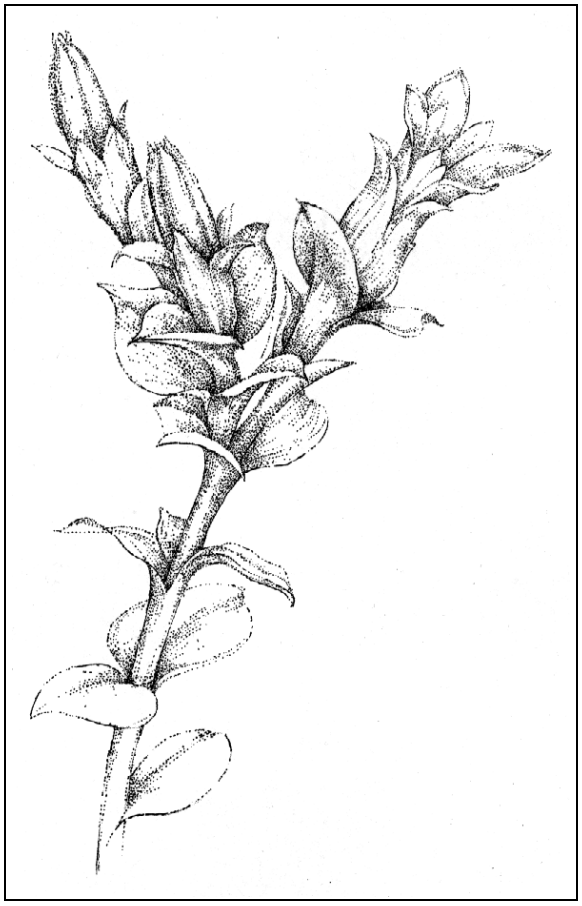

Figure 1: *Gentiana baeuerlenii*. Scale: shown approximately twice actual size.

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.

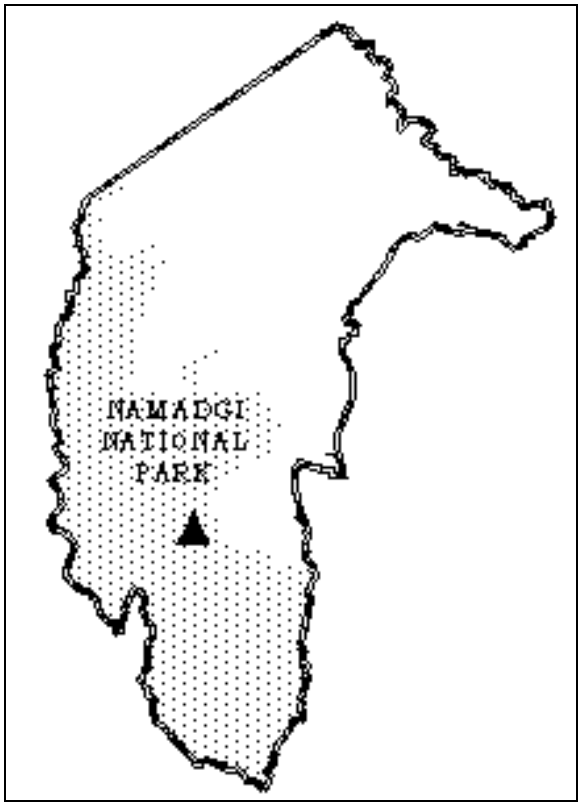

Figure 2: Map showing location (♦) of *G. baeuerlenii* within Namadgi National Park.

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

Second Edition

The **Northern Corroboree Frog (*Pseudophryne pengilleyi)*** was declared an endangered species on 8 December 2003 (Determination DI2003-319) in accordance with section 38 of the *Nature Conservation Act 1980*. Section 40 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:

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 ACT 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 in a regional context. They are guided by criteria set out in its publication *Threatened Species and Communities in the ACT: criteria for assessment, July 2008*.

In making its assessment of the northern corroboree frog, the Committee concluded that it satisfied the criteria indicated in Table 1. Accordingly, in 2003, the Committee recommended the northern corroboree frog be declared Endangered. This replaces earlier declarations for the species.

The species had previously been declared vulnerable in 1996 under the species name of *P. corroboree* (Determination DI1996-29 of 15 April 1996), which was subsequently revoked and replaced by a declaration of *P. pengilleyi* as a vulnerable species (Determination DI1998-7 of 12 January 1998) following taxonomic revision of corroboree frogs.

An Action Plan is required in response to each declaration. The Action Plan 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.

The first edition of this Action Plan was prepared in 1997 (ACT Government 1997). The first edition is superseded by this second edition in 2012.

Table 1 Criteria satisfied

1.1 Species is known or suspected to occur in the ACT region and is already recognised as endangered or presumed extinct in an authoritative international or national listing.

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 one or more of:

- 1.2.1 Current serious decline in population or distribution from evidence based on:
  - 1.2.1.1 Direct observation, including comparison of historical and current records.
- 1.2.3 Continuing reduction or unnaturally extreme fluctuations in population, or distribution, for a species currently occurring over a small range or having a small area of occupancy within its range.

Conservation status

The northern corroboree frog *Pseudophryne pengilleyi* is recognised as a threatened species in the following sources:

International
Endangered. IUCN Red List of Threatened Species. IUCN 2011.

National
Vulnerable. *Environment Protection and Biodiversity Conservation Act 1999*.

New South Wales
Critically Endangered. *Threatened Species Conservation Act 1995*.

Australian Capital Territory
Endangered. *Nature Conservation Act 1980*.
Special Protection Status Species. *Nature Conservation Act 198*0.

Species description and ecology

DESCRIPTION AND DISTRIBUTION

There are two closely related species of corroboree frog; the northern corroboree frog *Pseudophryne pengilleyi* (Wells & Wellington 1985), 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) (Figure 1).

Figure 1. Dorsal view of northern corroboree frog. The black and white illustration is two times actual frog size.

The northern corroboree frog occurs over an altitudinal range of 750 to 1800 m and is confined to the high country of the ACT and adjacent areas in NSW, including the northern Brindabella Range, Fiery Ranges, Bogong Mountains and Buccleuch State Forest (Figure 2). In the ACT, the species occupies a disjunct narrow strip that follows the summit of the Brindabella/Bimberi Range. The southern corroboree frog is found only in the Snowy Mountains of Kosciuszko National Park 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 the northern corroboree frog differ from the southern corroboree frog in having: (1) a pattern of dorsal stripes that are usually yellow with a green or lime-green tinge; (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). The two species also differ genetically (Roberts and Maxson 1989; Osborne and Norman 1991; Morgan et al. 2008) and in their skin biochemistry (Daly et al. 1990). Another difference, which is less obvious, is the longer first component in the advertisement call of the northern corroboree frog.

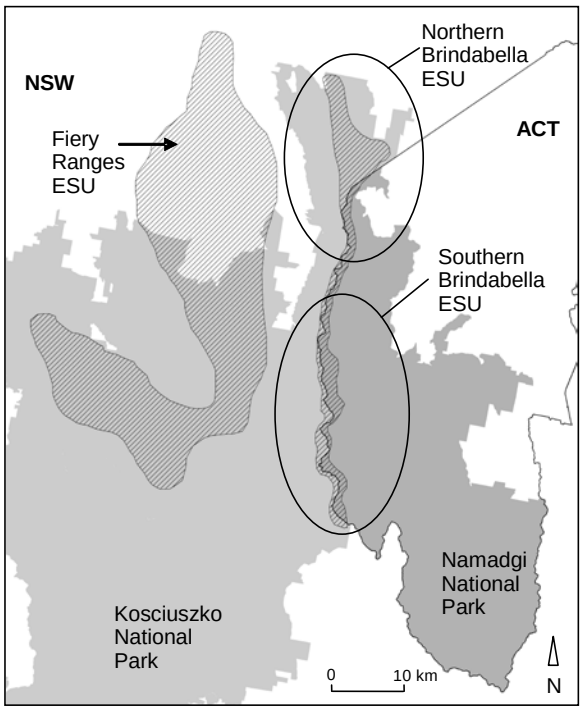

Figure 2. Distribution (hatched area) of the northern corroboree frog, from current and historic records.

Three Evolutionary Significant Units (ESU) have been identified for the northern corroboree frog each represented by populations of frogs that are genetically different (Morgan et al. 2008) (Figure 2). The southern Brindabella ESU occupies the highest elevation of the three ESUs, and is found in the subalpine zone between about 1400 m and 1850 m along the Bimberi Range between Mt Bimberi and Ginini Flats. This ESU occurs within Namadgi National Park (ACT) and to a lesser extent in the adjacent Bimberi Nature Reserve in NSW, with the largest numbers of frogs historically occurring at Ginini Flats and Snowy Flats in the ACT. The northern Brindabella ESU is characterised by frogs having greener stripes and occurs at lower elevations at the northern extent of the Brindabella Range between Bushrangers Creek in the ACT and California Flats in NSW. The Fiery Ranges ESU occurs in NSW and occupies lower elevation areas encompassing the Fiery Ranges, Bogong Mountains and Buccleuch State Forest.

HABITAT

The frogs use two distinct habitat types; a breeding season habitat associated with pools and seepages in *Sphagnum* moss (*Sphagnum cristatum*) 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; Osborne 1990). 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. Litter, logs and dense ground cover in the understorey of snow gum woodland and heathland provide over-wintering habitat for subadults and adults (Pengilley 1966).

The breeding pools are characteristically shallow and have relatively large surface areas and low water flow rates, which may allow the water in the preferred pools to become warmer during the day, possibly enhancing tadpole development (Osborne 1990). Pools range from semi-permanent to ephemeral, with the abundance and duration of pools related to amount and timing of rainfall or snowmelt.

LIFE-HISTORY AND ECOLOGY

Like most frogs, corroboree frogs have 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 damp, 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 terrestrial chambers in moss or other dense 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 to attract females. Males may have more than one clutch in their nest. 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 16–38) (Pengilley 1973). Whilst the number of eggs produced per female is relatively few, the eggs are amongst the largest in the genus (Tyler 1989), being about 3.5 mm in diameter when laid and later absorbing water to swell to about 9 mm diameter.

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 in autumn and winter during periods of high rainfall or snow-melt that cause pool levels to rise and flood nests. The pre-metamorphic period is critical for reproductive success, because the tadpoles and eggs are vulnerable to desiccation and pool-drying from insufficient rainfall or snow-melt. Corroboree frogs reach reproductive age about four years after metamorphosis and are known to survive for up to nine years in the wild (Hunter 2000). Adult survival is critical to enabling the species to persist through a series of dry years (drought) when there may be little or no recruitment to populations from breeding.

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, before moving 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 1971b), though to what extent this reflects relative food-type availability or dietary specialisation is unclear.

POPULATION DECLINE

During the 1960s and 1970s 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 Ginini Flats have been monitored regularly since the mid-1980s and other sites have been monitored since the mid-1990s (Osborne 1989; Osborne et al. 1999; M. Evans, ACT Conservation Planning and Research, unpubl. data). The results indicate that northern corroboree frog populations have suffered severe and widespread decline since the early 1980s, and that the decline is still occurring. In the western section of Ginini Flats (commonly referred to as Ginini West) there was estimated to be 500 to 1000 male northern corroboree frogs calling in 1986; three years later the figure had dropped to about 50 males calling (Osborne et al. 1999). At the time of writing there are estimated to be less than 100 adult northern corroboree frogs remaining in the wild across the species' range in the ACT. The actual number remaining is possibly as low as 50 individuals. The most severe decline has occurred in the Brindabella and Bimberi ranges in and near the ACT, though particularly within the higher elevation ACT Southern Brindabella ESU (M .Evans, ACT Conservation Planning and Research, unpubl. data). Numbers in the NSW Fiery Ranges ESU have also declined, though apparently not as severely as in the two Brindabella ESUs (R. Pietsch and D. Hunter, NSW Department of Climate Change and Water, unpubl. data). The southern corroboree frog has shown a similar catastrophic decline across its range in the Snowy Mountains (Hunter et al. 1999; Osborne et al. 1999).

Threats

Threats to corroboree frogs include disease, fire, drought, climate change, feral animals and weeds. Such threats rarely act in isolation and when more than one threat acts against a population the effects are often synergistic (magnifying) (Brook et al. 2008). For example, warmer temperatures and less rainfall due to climate change might modify corroboree frog breeding habitat. These conditions might also increase the frequency of fire in Alpine environments, which in turn will also modify breeding habitat. Drought causes failed recruitment, the effect of which may be compounded by fewer breeding adults due to amphibian chytrid fungus, and both threats might increase the species susceptibility to the inherent risks faced by small populations. Effective management of threats will require consideration of risks and potential synergies.

DISEASE

Recent evidence points to disease caused by an introduced fungal pathogen as the main reason for decline in corroboree frogs. The amphibian chytrid fungus *Batrachochytrium dendrobatidis* has only recently spread around the world and the disease it causes (Chytridiomycosis) has resulted in mass amphibian declines and extinctions (Berger et al. 1998; Skerratt et al. 2007). Frog species vary in their susceptibility to the disease; corroboree frogs are highly susceptible, whereas the sympatric common eastern froglet *Crinia signifera* is apparently relatively unaffected and can act as a reservoir host for the disease (Hunter 2007). Field sampling for chytrid fungus indicates that it is present in all key corroboree frog habitats in the ACT (Hunter 2007). Chytrid fungus can infect tadpole and frog stages but not eggs as they do not contain keratin, which is required by the fungus. The main method of disease transmission amongst populations of corroboree frogs is likely to be from adult-adult contact during breeding and by corroboree frog tadpoles contracting the disease from tadpoles or adults of common eastern froglets using the same pools.

Reducing the impact of the disease will require (a) eradicating or controlling amphibian chytrid fungus in the environment or (b) improving resistance of frog populations to the disease. Eradication of amphibian chytrid fungus from the Australian continent, or even the Australian Alps, appears unlikely given no introduced organism has been eradicated once it has become established in the Australian environment. There is no known method to control the pathogen on a broad geographic scale, though maintaining disease-free 'refuge' sites (particularly sites that are isolated by natural barriers to animal movement) might be achievable. However, there are no known disease-free sites for corroboree frogs in the ACT.

Improved disease resistance in wild populations may arise through attenuated virulence of the pathogen and/or increased defences of amphibian hosts. There is some evidence that populations of other frog species that have suffered declines from Chytridiomycosis have developed resistance to this pathogen (Retallick et al. 2004; McDonald

et al. 2005), probably through intense genetic selection. Corroboree frogs have persisted with amphibian chytrid fungus in their habitats for at least two decades (albeit at perilously low population levels) and thus the remaining individuals are likely to represent the most disease-resistant genes.

Corroboree frog populations might recover if given the opportunity for ongoing selection for disease resistance, as has apparently occurred for some other frog species. Selection for disease resistance could occur naturally in the wild or artificially in captive populations, though the latter will require research into the response of the frog immune system to infection with the amphibian chytrid fungus.

There have been significant recent developments in the effectiveness of treating frogs that have Chytridiomycosis, including the use of elevated temperatures and fungicides such as Chloramphenicol (Woodhams et al. 2003; Bishop et al. 2009). There is also some evidence to suggest that frogs exposed to Chytridiomycosis and then 'cured' may acquire lasting resistance to the disease (Woodhams et al. 2003), though such resistance is not conferred to offspring. This type of acquired resistance may be useful for managing disease outbreaks in captivity and for boosting survival rates of individuals released from captivity to the wild.

FIRE AND DROUGHT

Wildfires and planned (prescribed) fires have the potential to impact on the frogs by burning vegetation and peat in breeding and non-breeding areas (Clark 1986). Wildfire can severely damage peat and bog areas, causing erosion and decreasing the capacity of the bogs to hold water (Good 1973; Clark 1986). In January 2003, wildfires burnt most of Namadgi National Park (and much of the Australian Alps) and severely burnt corroboree frog breeding sites and their heath/woodland over-wintering habitat. All breeding sites were affected, with the proportion of each site burnt ranging from 70% to 95% (Carey et al. 2003). Corroboree frogs were killed in the fires (D. Hunter pers. com.), though breeding still occurred in unburnt areas. The recovery of breeding habitat has been variable, with some areas taking less than three years post-fire to provide suitable conditions (vegetation and pools), whereas other areas are still recovering after eight years. In some areas, sphagnum moss or wet heath have been converted to wet grassland (a less favourable breeding habitat for corroboree frogs). Some smaller bogs have not recovered their functionality due to the peat becoming hydrophobic and these areas are now dry grassland (M. Evans pers. obs.), which is unsuitable as breeding habitat. It is possible that these areas may not revert to bogs for decades, if ever. Most breeding sites, particularly the larger sites such as Ginini Flats and Snowy Flats, now appear to be suitable breeding habitat for corroboree frogs.

Whilst the short-term effects of fire are loss of habitat and potentially loss of frog individuals, the long-term effects on the ecology or abundance of corroboree frogs are not well understood. 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.

Drought presents a broader scale threat and has been observed to prevent breeding or to prevent recruitment when pools that contain developing tadpoles prematurely dry (Pengilley 1966; Osborne 1988, 1989). Prolonged drought that results in lack of recruitment for several years is likely to have widespread and significant impacts on corroboree frog populations.

FERAL ANIMALS AND WEEDS

Feral pigs (*Sus scrofa*) are a threat as they disturb breeding areas by rooting up sphagnum moss and other vegetation in their search for food (M. Evans, pers. obs.), which includes 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 (D. Hunter, W. Osborne, pers. obs.). However, the actual extent of impact on the ecology of the frogs requires further research.

Sambar deer (*Cervus unicolour*) and fallow deer (*Dama dama*) have the potential to damage corroboree frog habitat, and whilst their abundance in the ACT is low, there is some evidence that their numbers are increasing.

In NSW trampling by feral horses (*Equus equus*) has caused extensive damage to some breeding sites (W. Osborne and D. Hunter

pers. obs.) through incision of the bogs and altering drainage patterns (see comments by Dyring 1992). There is no known permanent population of feral horses in the ACT, and it is important for the protection of corroboree frog habitat that horses moving into the ACT from NSW continue to be trapped and removed.

Blackberry (*Rubus fruticosus*) is a serious threat to corroboree frog habitat. Breeding sites that have been invaded by this weed in NSW appear to be no longer suitable for corroboree frogs (W. Osborne, R. Pietsch, D. Hunter, pers. obs.). In the ACT, blackberries are present in Namagi National Park, including some of the smaller corroboree frog breeding sites, and ongoing control is required. Pine wildings are occasionally found and removed from corroboree frog breeding sites, particularly Snowy Flats where the source is the arboretum near Pryors Hut. Exotic grasses such as sweet vernal grass (*Anthoxanthum odoratum*) are present at the margins of some corroboree frog breeding sites, though what effect this might have on corroboree frog habitat is unknown.

HABITAT DISTURBANCE AND DEGRADATION

Localised human impacts are known to have had a deleterious effect on some breeding sites (Osborne 1991). Erosion from poorly maintained roads has 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).

Almost all habitat for the northern corroboree frog in the ACT is contained within Namadgi National Park, which is a relatively undisturbed environment. Nevertheless, activities that may pose a threat in catchments with corroboree frog habitat include earthworks and road construction, which may damage soil, peat or vegetation and alter flows of water into bogs and other wet areas. Road construction without adequate environmental safeguards risks sedimentation of corroboree frog habitat, especially during unforeseen storm events.

CLIMATE CHANGE

Global warming (IPCC 2007; Lawler 2009) has 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 (Osborne and Davis 1997). Climate change modelling suggests that higher elevation areas of the Australian Alps, including the Brindabella Range, will experience warmer temperatures and a decrease in precipitation (both as rainfall and snow) (Hennessey et al. 2003). Higher temperatures might be expected to result in a contraction of the lower altitudinal limit for the species, whereas higher temperatures and less precipitation, combined with an expected higher fire frequency, might result in a change in the hydrological functioning of wetlands and a reduction of suitable breeding habitat (such as sphagnum moss communities becoming wet sedgeland, grassland or heathland).

The most immediate effect on the species is likely to be less reliable annual recruitment to the population due to less frequent 'good' breeding seasons. The long development times for corroboree frogs as eggs and tadpoles (several months) means that both species of corroboree frog are particularly susceptible to low precipitation that results in ephemeral pools not forming (loss of eggs) or pools drying before tadpoles reach metamorphosis (Osborne 1990, Hunter et al. 2009).

Whilst climate change can be speculated to have some impact on corroboree frogs, it is still uncertain whether the magnitude of such changes will be sufficient to cause the extirpation of these species. In addition to sphagnum moss, corroboree frogs are able to use a range of other wet areas for breeding, including wet grassland and wet heathland. Depending on the rate and magnitude of climate change, it is possible that its effect on the species may be ameliorated to some extent though behavioural or genetic adaptation.

SMALL POPULATION SIZE

Whilst not often regarded as a threat *per se*, very small populations face a higher probability of extinction simply because of their small size (Caughley and Gunn 1996). For small populations, the effects of environmental stochasticity (random environmental disturbances such as drought and fire) are magnified. In addition, small populations risk genetic problems such as loss of genetic diversity and random genetic drift, which can result in individuals being less genetically 'fit' for their environment. Very small populations may also not be able to maintain a social

structure, such as calling aggregations in frogs that attract females and enable sexual selection. A key recovery action for species whose populations have been reduced to small size is to increase the size of the population to overcome the 'small population paradigm' (Caughley and Gunn 1996). This is particularly applicable to low fecundity species such as corroboree frogs. The use of a captive population to produce individuals for release back to the wild can be an effective (in some cases the only) method to increase the size of wild populations.

The northern corroboree frog faces considerable inherent risk due to its specialised life history. It has a very low clutch size, each female breeds only once each year, and the tadpoles are slow-growing, spending three months or more in the shallow pools. Whilst this life history has evolved in response to a relatively stable, cold, low nutrient environment, it also reduces the ability of the species to recover quickly during favourable seasons and places it at risk from any long-term disturbance or change that affects the breeding sites.

Captive population

In response to ongoing declines of corroboree frogs in the ACT, and in particular a sharp decline through 2001 and 2002, the decision was made to collect eggs to establish a captive assurance population in a biosecure (free of chytrid fungus) facility to safeguard against the loss of the Southern Brindabella ESU in the event that the species becomes extinct in the wild.

Northern corroboree frog eggs were collected from the wild in April 2003 to establish the captive population at Tidbinbilla Nature Reserve. The egg stage was collected because the eggs are naturally free of chytrid fungus, most eggs in the wild are unlikely to survive to become a frog and survivorship of eggs can be markedly increased under controlled (captive) conditions, enabling a rapid increase in the size of the captive, and potentially wild (through reintroduction), populations.

Around one-third of eggs in each nest were collected from all nests found at key monitoring sites, which is estimated to have been less than half of all nests in the ACT. The number taken was considered to be sufficient to establish a captive population yet not to have a major impact on recruitment in the wild.

A similar project had begun three years earlier for the southern corroboree frog, whose catastrophic declines preceded those of the northern corroboree frog. By 2007 the number of nests in the wild was insufficient to continue egg collections for northern corroboree frogs. Northern corroboree frogs take five years from eggs to reach breeding age, and were bred in captivity for the first time in 2008.

The captive population currently contains over 800 individuals, with around half of the population at breeding age. The establishment of this captive assurance population is consistent with the recommendations of the National Threat Abatement Plan for Chytrid Fungus (DEH 2006) and the draft National Recovery Plan for the Northern and Southern Corroboree Frog (NSW DECCW in prep.).

Major conservation objective

The objective of this Action Plan is to:

- Maximise the survival, in the long-term, of viable, natural populations of northern corroboree frogs 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:

Protection

- Protecting sites and vegetation communities that are critical to the survival of the species. This includes habitat that is listed as threatened under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (Alpine Sphagnum Bogs and Associated Fens), and the Ramsar-listed Ginini Flat Subalpine Bog Complex in the ACT.

- Managing activities in the catchments of breeding sites and surrounding woodlands to minimise or eliminate any threat to frog populations.

- Increasing community awareness of the need to protect the frogs and their habitat.

Monitoring, Research and Experimental Management

- Supporting and participating in monitoring, research and experimental management

aimed at understanding and mitigating the causes of population decline.

Captive Breeding and Release

- Establishing and maintaining captive assurance population(s) while the species is under immediate threat of extinction in the ACT.

- Reintroducing captive bred individuals to the wild to allow selection for disease resistance through maintenance of wild populations, either by increasing the size of small populations or re-establishing extirpated populations.

Conservation issues and intended management actions

MONITORING

Populations of corroboree frogs have declined to low numbers in the ACT (estimated to be less than 100 individuals remaining in the wild) and the decline is continuing. The species has become locally extinct at a number of breeding sites. The current monitoring program identified the sharp decline in 2001 and 2002, which triggered the establishment of the captive assurance population (located at Tidbinbilla Nature Reserve). Continued monitoring is essential to track the trend in the species population size and to evaluate the effectiveness of conservation, research and land management actions.

Annual monitoring will be expanded to include an assessment of pool and bog characteristics that may be impacted from climate change, fire and feral animals. 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 techniques across the region.

Monitoring Action 1

Objective
Trends in abundance are known for corroboree frogs in the ACT.

Action
Monitor corroboree frog abundance and habitat (bog and pool characteristics) at key sites the ACT.

Indicator
Annual monitoring of corroboree frog abundance is undertaken. Monitoring includes characteristics of pool and bog habitat.

RESEARCH AND EXPERIMENTAL MANAGEMENT

There is considerable existing information on the biology and ecology of corroboree frogs. Distribution (Osborne 1989), breeding biology and demography (Pengilley 1966, 1973; Hunter 2000), diet (Pengilley 1971a), population genetics (Osborne and Norman 1991; Morgan et al. 2008), habitat use (Osborne 1990) and causes of decline (Berger et al. 1998; Skerratt et al. 2007) are reasonably well known.

Amphibian chytrid fungus is a key factor causing the decline of corroboree frog populations and remains the most significant impediment to the species recovery. This pathogen is well established in the Australian environment and is likely to remain so. Facilitating greater resistance to this pathogen at the population level should be a major goal of research and experimental management. A key step will be to understand how the frog immune system responds to infection with the amphibian chytrid fungus. This knowledge would provide the basis for a captive breeding program to select for specific traits. Research investigating the immune response of corroboree frogs to this pathogen requires specialised laboratory facilities, and is currently being undertaken at James Cook University (Townsville) and Taronga Zoo (Sydney). The captive population of northern corroboree frogs at Tidbinbilla is likely to be an important (perhaps the only) source of northern corroboree frogs for such research.

Other key research aspects relate to the landscape processes that influence metapopulations, which is 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.

Climate change has the potential to alter the habitat of corroboree frogs, such as the hydrology (timing and persistence) of the

ephemeral breeding pools, and the growth and dynamics of vegetation in the breeding habitat.

Since 1996 the Corroboree Frog National Recovery Team has played an important role in coordinating, advising and obtaining funding for recovery actions (including research and habitat management) for both species of corroboree frog. The recovery team is composed of experts on corroboree frogs, representatives of all agencies responsible for management of land with corroboree frog habitat, and other stakeholders such as zoos and research agencies.

Research Action 1

Objective
The short-term objective is to attain a greater understand the ecology of corroboree frogs, particularly with respect to interaction with chytrid fungus and potential effects of climate change. The long-term objective is to mitigate threats to the species to enable viable, wild populations to survive.

Action
Support and participate in research and experimental management, including research by universities and other organisations.

Indicator
Research is undertaken and supported that provides a greater understanding of the ecology of corroboree frogs (especially in relation to chytrid fungus) and the mitigation of threats to the frogs and their habitat.

Research Action 2

Objective
The Corroboree Frog National Recovery Team continues to play a key role in the provision of expert advice and coordination of recovery actions for both species of corroboree frogs.

Action
Represent the ACT on the Corroboree Frog National Recovery Team and provide expert advice.

Indicator
Continued representation on the Corroboree Frog National Recovery Team and provision of expert advice and progress updates to the team on the conservation of the Northern Corroboree frog in the ACT.

CAPTIVE BREEDING AND RELEASE

Action 2.1.6 of the National Threat Abatement Plan (TAP) for Chytrid Fungus (DEH 2006) is to 'Restock species that are under severe threat from infection with Chytridiomycosis using captive-raised and captive-bred stock. Implement this under an adaptive management framework that heeds relevant state, national and international (IUCN) standards on translocations and monitor the outcome'. Other actions in the TAP relate to coordinating captive husbandry, breeding and restocking programs across states and territories (Action 2.1.1); expanding knowledge of, and infrastructure for, captive breeding of amphibians that are particularly vulnerable to Chytridiomycosis (Action 2.1.3); and assessing the value of reintroduction programs over significant timeframes in terms of increased abundance, range and prevalence of Chytridiomycosis (Action 3.4.3). A major goal of the draft National Recovery Plan for the Corroboree Frog (NSW DECCW 2010) is the establishment of captive assurance population(s) and undertaking reintroductions.

The aim of maintaining captive assurance population(s) is to provide a source of individuals for conservation research and re-establishment of the species in the wild, in the event that wild populations become unviable or extinct. A key aim of reintroduction is to maintain the species in the wild with a functional social structure to allow for ongoing selection of disease resistance in frog populations. Disease-resistant genes in wild populations will need to be incorporated back into the captive breeding program, otherwise the reintroduction of 'less fit' captive-bred individuals to the wild may act against the selection process. This can be achieved by regularly introducing wild-bred individuals (either as eggs, tadpoles or frogs) to the captive breeding program.

Captive breed/release Action 1

Objective
Prevent complete loss of northern corroboree frogs from the ACT if wild populations become extinct.

Action
Establish and maintain captive assurance population(s) of northern corroboree frogs whilst the species is under immediate threat of extinction in the wild.

Indicator
Captive assurance population(s) are maintained whilst the species is under immediate threat of extinction in the wild.

Captive breed/release Action 2

Objective
Augment existing, or re-establish extirpated, wild populations of northern corroboree frogs in the ACT.

Action
Develop a plan to captive breed and release corroboree frogs to the wild. Implement a breed/release program that is (a) within a scientific monitoring framework, (b) consistent with the National Recovery Plan for the species and (c) takes account of advice and direction provided by the National Recovery Team for corroboree frogs.

Indicator
A captive breeding and release plan is developed that is consistent with the National Recovery Plan for the species. Corroboree frogs are released to the wild and a scientific monitoring framework established.

Protection

Almost all of the known breeding sites for the northern corroboree frog in the ACT occur within Namadgi National Park. The largest populations occur in sub-catchments of the Cotter River above Bendora and Corin dams. Public access and camping are restricted and these areas 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 have been included in the *Namadgi National Park Plan of Management* (ACT Government 2010). Protection includes controlling activities such as construction of access tracks and fire management/suppression in the vicinity of corroboree frog habitat, controlling feral animals (horses, pigs, deer) and weeds (pine wildings, blackberry), and avoiding the spread of diseases that could affect frogs.

Fire can severely impact corroboree frog habitat, particularly S*phagnum* moss bogs where the effect of intense fire can be long-term. Planned and unplanned fire should be excluded from breeding habitat (bogs) and overwintering habitat (surrounding woodland). Fire suppression activities (such as use of heavy machinery and chemical retardants) can also cause impacts to habitat. Undertaking such activities in or near corroboree frog habitat should only be considered if habitat is under threat of severe impact from fire. Guidelines for fire management in areas where corroboree frog habitat is known or suspected to occur have been included in the Fuel and Fire Suppression Guidelines for ACT Declared Threatened Species and Endangered Ecological Communities (ACT Government 2008) and in Bushfire Operational Plans. Specifically the plans provide for:

- Preparation of maps of sensitive sites including all known corroboree frog breeding sites in the ACT. These maps are available for use in fire emergencies and prescribed burns.

- Excluding planned (prescribed) burns in the area within 300 metres of identified corroboree frog breeding habitat.

- Avoiding the use of heavy machinery in the immediate catchment of *Sphagnum* moss bogs and corroboree frog habitat where this is likely to result in sediment flows into the bogs.

- Avoiding the use of chemicals and fire retardants in and near bogs.

Protection Action 1

Objective
Corroboree frog habitat in Namadgi National Park is protected from the impacts of construction and maintenance of access tracks.

Action
New vehicle access tracks are not constructed in corroboree frog habitat. Measures are taken to avoid impacts (such as sediment movement into bogs) from tracks in the vicinity of habitat, both during and after construction.

Indicator
No impacts on corroboree frog habitat from construction and maintenance of access tracks. No new vehicle access tracks constructed in corroboree frog habitat.

Protection Action 2

Objective
Corroboree frog habitat is protected from fire and from impacts of fire management and suppression activities.

Action
Include guidelines for fire management in or near corroboree frog habitat in Bushfire Operational Plans and other relevant fire planning/management documentation.

Indicator
No planned fires in corroboree frog habitat or within 300 m of identified breeding habitat. No fire suppression activities undertaken in corroboree frog habitat (unless threat of severe impact by fire).

Protection Action 3

Objective
Corroboree frog habitat is protected from the impacts of feral animals and weeds.

Action
Manage feral animals and weeds so that their impacts do not threaten the viability of northern corroboree frog populations or their habitat.

Indicator
Impacts from feral animals and weeds do not pose a threat to the viability of northern corroboree frog populations or their habitat.

Protection Action 4

Objective
Prevent the spread of pathogens amongst wild corroboree frog populations.

Actions
- Promote and provide advice to researchers, land managers and the public on appropriate quarantine measures (such as sterilisation of footwear and equipment) to reduce the possibility of spreading pathogens between catchments and frog populations.
- Screening for pathogens in captive corroboree frogs prior to release to the wild is consistent with best practice risk assessment guidelines such as Pessier et al. (2010).

Indicators
- Advice on appropriate quarantine measures provided to persons intending to visit areas in or near corroboree frog habitat, including researchers, land managers and the public.
- Agency staff (including researchers and land managers) undertake appropriate quarantine measures when working in or near corroboree frog habitat.
- Appropriate quarantine measures included as a condition on relevant scientific licences issued by the ACT government.
- Screening for pathogens in captive corroboree frogs prior to release to the wild has been undertaken according to best practice risk assessment guidelines such as Pessier et al. (2010).

Legislative provisions

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

ACT Legislation

Nature Conservation Act 1980

The *Nature Conservation Act 1980* provides for 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 animals and plants may be declared in recognition of a particular conservation concern and increased controls and penalties apply. Species declared as endangered must be declared as having special protection status, which is the highest level of statutory protection under this Act.

Other Relevant Provisions

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.

Planning and Development Act 2007

The object of this Act is to provide a planning and land system that contributes to the orderly and sustainable development of the ACT. The Act establishes the Territory Plan; provides for the identification, reservation and management of Public Land; and outlines requirements for environmental impact assessment.

Heritage Act 2004

This Act establishes a system for the recognition, registration and conservation of natural and cultural heritage places and

objects. A list of these places is maintained on the ACT Heritage Register.

Commonwealth Legislation

Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the primary Commonwealth legislation for environment protection. Under the EPBC Act, an action will require approval from the (Commonwealth) Environment Minister if the action has, will have, or is likely to have a significant impact on a matter of national environmental significance and it is not subject to certain specified exceptions. Matters of national environmental significance are: World Heritage and National Heritage properties, Ramsar wetlands of international importance, nationally listed threatened species and ecological communities, migratory species protected under international agreements, Commonwealth marine environment and nuclear actions.

International Agreements

Ramsar Agreement

The Convention on Wetlands (Ramsar, Iran, 1971) is an intergovernmental treaty aimed at achieving the conservation and wise use of wetlands. The Ginini Flats Wetlands in Namadgi National Park, which provide important habitat for the northern corroboree frog, are listed as wetlands of international importance under the Ramsar Agreement. This Action Plan for the northern corroboree frog when read in association with the *Nimadgi National Park Plan of Management* (2010) and the *Ginini Flats Wetlands Ramsar Site Plan of Management* (2001) (ACT Government 2001) provides the basis for ongoing management of Ginini Flats. (At the time or writing the Ginini Flats plan was under review.)

Consultation and community participation

The Conservation, Planning and Research section within the ACT Government 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 Department of Climate Change and Water, State Forests of NSW, organisations involved in research on corroboree frogs (University of Canberra, Australian National University), and organisations involved in captive husbandry of corroboree frogs (Tidbinbilla Nature Reserve, Amphibian Research Centre (Melbourne), Taronga Zoo, Healesville Sanctuary).

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.

Implementation and review

The ACT Government (Land Management and Planning Division; Department of Climate Change Energy and Water) has responsibility for coordinating implementation of this Action Plan. Some actions will involve collaboration between government agencies, research organisations, zoos and the community.

The Flora and Fauna Committee will review implementation of this Action Plan after three years. The review will comprise an assessment of achievement of the objectives of the Action Plan. The timeframe for achieving some objectives (such as re-establishing wild populations from captive breeding and release) are necessarily longer than the duration of this Action Plan. Assessment of progress will be based on achieving the relevant indicator for each Action.

The review will provide an opportunity for both the Flora and Fauna Committee and relevant section(s) of the ACT Government to assess progress; take account of new knowledge of the species and threats; consider new developments in policy and administration; and review directions and priorities for future conservation actions.

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List of Action Plans

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.
No. 25: Ginninderra Peppercress (*Lepidium ginninderrense*—an endangered species.
No. 26: Silver Perch (*Bidyanus bidyanus*)—an endangered species.
No. 27: Woodlands for Wildlife. ACT Woodland Conservation Strategy.

Incorporating Action Plans for the following threatened species and communities:

- Yellow Box – Red Gum Grassy Woodland
- A Leek Orchid (*Prasophyllum petilum*)
- Small Purple Pea (*Swainsona recta*)
- Hooded Robin (*Melanodryas cucullata*)
- Swift Parrot (*Lathamus discolor*)
- Superb Parrot (*Polytelis swainsonii*)
- Brown Tree creeper (*Climacteris picumnus*)
- Painted Honeyeater (*Grantiella picta*)
- Regent Honeyeater (*Xanthomyza phrygia*)
- Varied Sitella (*Daphoenositta chrysoptera*)
- White-winged Triller (*Lalage sueurii*)

No. 28: A Vision of the Grassy Plains Extended. ACT Lowland Native Grassland Conservation Strategy.

Incorporating Action Plans for the following threatened species and communities:

- Natural Temperate Grassland
- Striped Legless Lizard (*Delma impar*)
- Grassland Earless Dragon (*Tympanocryptis pinguicolla*)
- Golden Sun Moth (*Synemon plana*)

- Perunga Grasshopper (*Perunga ochracea*)
- Button Wrinklewort (*Rutidosis leptorrhynchoides*)
- Ginninderra Peppercress (*Lepidium ginninderrense*)

No. 29: Ribbons of Life. ACT Aquatic Species and Riparian Zone Conservation Strategy.

Incorporating Action Plans for the following threatened species and communities:

- Two-spined Blackfish (*Gadopsis bispinosus*)
- Trout Cod (*Maccullochella macquariensis*)
- Macquarie Perch (*Macquaria australasica*)
- Murray River Crayfish (*Euastacus armatus*)
- Silver Perch (*Bidyanus bidyanus*)
- Tuggeranong Lignum (*Muehlenbeckia tuggeranong*)
- Pink-tailed Worm Lizard (*Aprasia parapulchella*)

No. 30: Spotted-tailed Quoll (*Dasyurus maculatus*)—a vulnerable species.

FURTHER INFORMATION

Further information on this Action Plan or other threatened species and ecological communities can be obtained from:
Environment and Sustainable Development Directorate
ACT Government
Phone: (02) 132281
Territory and Municipal Services Website:
http://www.tams.act.gov.au/

This document should be cited as:
ACT Government 2012. *Northern Corroboree Frog (*Pseudophryne pengilleyi*). Action Plan No. 6. Second edition.* ACT Government, 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).

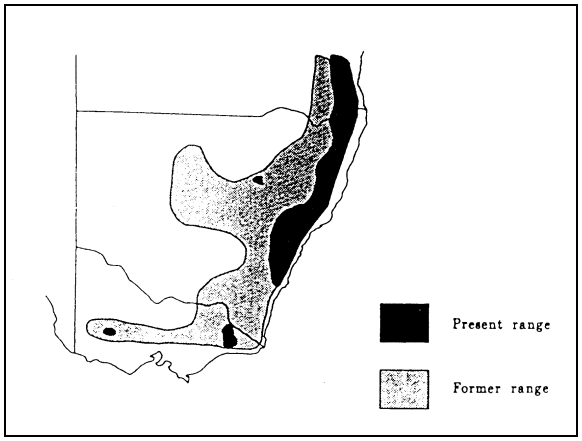

Figure 2: Map showing the present and former range of *P. penicillata* in south-eastern Australia (from Short and Milkovits 1994, cited by Connolly 1995).

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.

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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.

ACTION PLAN No. 23

In accordance with section 21 of the *Nature Conservation Act 1980*, the **Smoky Mouse *(Pseudomys fumeus)*** was declared an **endangered** species on 6 January 1998 (formerly Instrument No. 7 of 1998 of 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:

Smoky Mouse
Pseudomys fumeus

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 Smoky Mouse, 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:
	1.2.6 Extremely small population.

Species Description and Ecology

DESCRIPTION

The Smoky Mouse *Pseudomys fumeus* (Figure 1), is a native mouse, similar in size to a small rat (Watts and Aslin 1981). It is pale grey to blue-grey to black above, with a grey to white belly (Cockburn 1995) and a ring of dark hairs around each of its large, bulging eyes (Mayo pers. comm.). The feet are pink with white fur (Cockburn 1995). The species is distinguished by its bicoloured tail, which is blue-grey dorsally, white ventrally and lightly furred (Mayo pers. comm.). The species has a head and body length of 85-100 mm (average 90 mm), a tail length of 110-145 mm (average 140 mm) and weighs between 45-90 g (average 70 g) (Cockburn 1995).

Variability in size and colour has been noted between two forms found in Victoria. The western form, known only from the Grampians is larger and darker than the eastern form (east of Melbourne) (Cockburn 1995). It appears that the specimens found in NSW are similar to the eastern form and a male trapped in the Brindabella Ranges had a pink scrotum (Osborne and Preece 1986), whereas those from the Grampians were darkly pigmented (Cockburn pers. comm.).

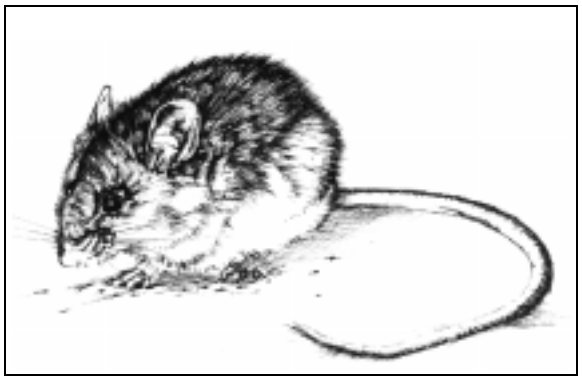

Figure 1: Smoky Mouse *Pseudomys fumeus.* Scale: approximately half natural size.

HABITAT

P. fumeus has been found in a range of vegetation types from coastal heath to heathy woodland. These range from the coast to subalpine heath and dry forest of Broad-leaved Peppermint *Eucalyptus dives* and Brittle Gum *E. mannifera*, or Mountain Gum *E. dalrympleana* and Silvertop Ash *E. delegatensis* forests, and Snow Gum (*E. pauciflora*) woodland in the subalpine regions. They also occur in fern gullies in wet forest in the Grampians (Menkhorst 1995). Surveys undertaken in eastern Victoria and south-eastern NSW (e.g. Jurskis *et al.* 1997; Ford 1998a,b; Broome *et al.* in prep.) indicate that the species' preferred habitat is ridge-top sclerophyll forest (Cockburn 1995) with a diverse understorey of heathy shrubs, especially from the families Fabaceae and Epacridaceae (Menkhorst and Seebeck 1981).

DISTRIBUTION

Former Distribution

Subfossil deposits indicate that *P. fumeus* was once widespread in south-eastern NSW, at Yarrangobilly, Marble Arch and London Bridge near Googong (Mayo pers. comm.) and in parts of eastern and western Victoria, including the Buchan district, the Grampians and near Nelson (Lee 1995).

Present Distribution

P. fumeus occurs mainly in Victoria as disjunct populations in the Grampians, coastal slopes of the Otway Ranges, Central Highlands, Barry Mountains, near Mt Cobberas and coastal east Gippsland between Marlo and Tamboon Inlet (Lee 1995). There are relatively few recent (post 1979) records from known sites in the Victorian highland areas, Mt William and coastal East Gippsland, despite extensive hair-tube surveys and carnivore scat analyses (J. Seebeck cited in Department of Conservation and Natural Resources 1996) and trapping at Mt William (A. Cockburn pers. comm.). However, a few recent (post 1995) records have been obtained from predator scats in the highland areas near West Buffalo and Mt Cobbler (N. Jones, pers. comm.) and Mt Stradbroke (Belcher 1995). One individual was found near Toombullup (January 1998), and possible hair records were obtained from Mt Beauty (April 1998) during surveys in NE Victoria (G. Newell pers. comm.).

Evidence for the species was found from hair sampling tubes in 1993 at Mt Poole in Nungatta State Forest in the Eden district of south-eastern NSW, (Broome *et al.* in prep.). In 1994, a NSW State Forests research team, trapping for potoroos in Nullica State Forest, caught the first *P. fumeus* to be trapped in NSW (Jurskis *et al.* 1997). The site is now included in South East Forests National Park (Nullica Section). More animals were trapped nearby in Nullica State Forest (C. Slade SFNSW, pers. comm.; Ford 1998a,b).

In Kosciuszko National Park hair records were obtained from the Pilot and Ravine areas, and three individuals were found dead near the Yarrangobilly Caves in October 1998 (Broome *et al.* in prep.; Ford 1998b).

In the ACT, two males have been trapped in the Brindabella Ranges in Namadgi National Park, one from Bulls Head (Osborne and Preece 1986) and one from Mt Kelly (Mayo 1987) (Figure 2). Repeated trapping surveys since this time have not resulted in any additional captures. However, further evidence has been obtained from one probable and one possible hair record from Mt Namadgi in 1994 (Broome *et al.* in prep.), and from an unconfirmed report of a trapping near Mt Coree in the 1970s (T. Macdonald pers. comm.). These findings suggest that it is highly likely that the species still occurs within and adjacent to the ACT, although probably in low densities (Broome *et al.* in prep.).

The broader distribution of records in subfossil remains indicates that the species' range has contracted significantly (DCNR 1996). Lee (1995) notes that the species probably declined prior to European settlement, and has declined further more recently due to habitat loss. The current distribution of *P. fumeus* is relictual and extremely difficult to interpret, thus it is not possible to identify any particular cause precipitating the declines (Cockburn pers. comm.).

BEHAVIOUR AND BIOLOGY

Studies undertaken on the summit of Mt William in the Grampians indicate that *P. fumeus* relies on three very distinct food sources, all of which are rich in nitrogen (Cockburn 1981a). *P. fumeus* forages for legume seeds and epacrid berries, as well as bogong moths, during summer. This was confirmed in the study of the population in the Nullica State Forest near Eden, which showed that habitat preference is directly related to a dietary preference for legume seed and epacrid fruits, also during summer months (Ford 1998a). In winter, the species switches to hypogeous (underground) truffle-like fungi that are common round the roots of certain shrubs and grasses, when few seeds are produced from the shrubs (Cockburn 1995). The spring diet of the Nullica population was shown to be dominated by fungi (Ford 1998a).

This reliance on seasonal food sources creates a nutritional crisis for *P. fumeus* during late spring. The fruiting bodies of the hypogeous fungi disappear through loss of soil moisture at a time when there are few alternative sources available until the mid-summer plant productivity flush (Cockburn 1995). Thus, the species can survive during this period only in restricted habitats where Bogong Moths are attracted to spring blossoms and new seeds are set (Cockburn 1995). However, studies on the Nullica population (Ford 1998a) indicate that decline does not appear to be linked with fungal decline, which suggests that decreased social factors or predation could well be a causal factor.

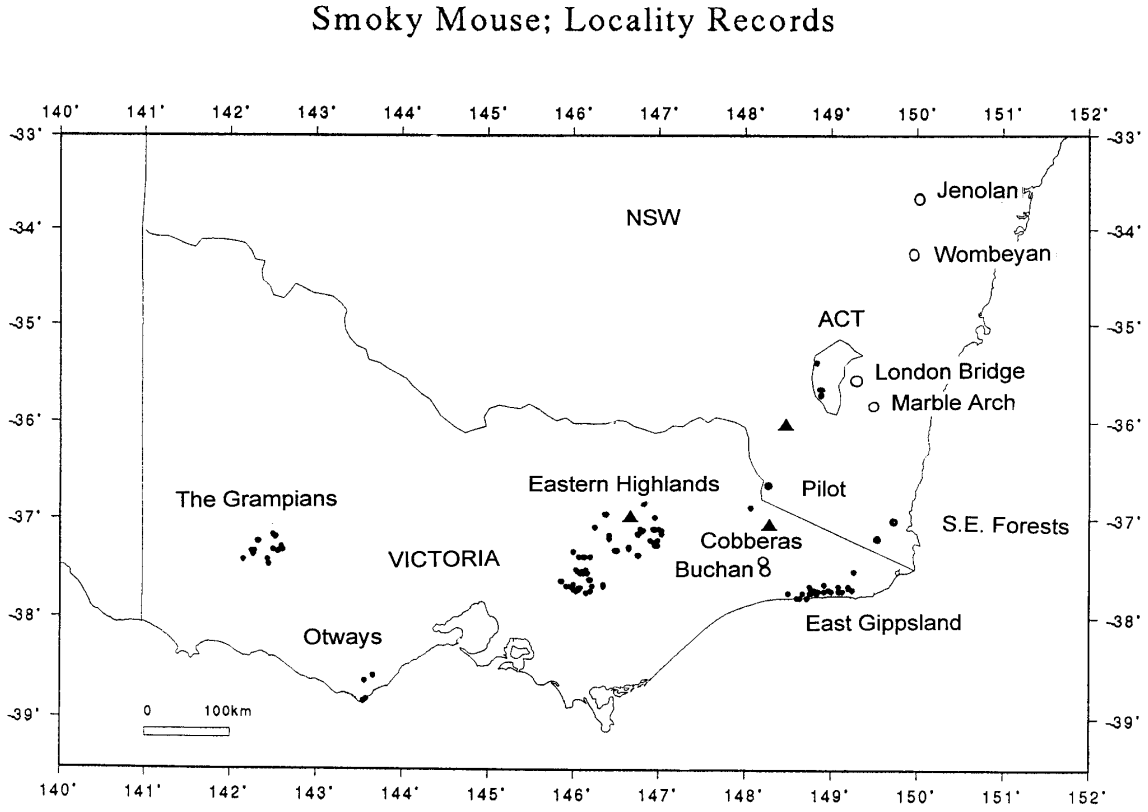

Figure 2: The distribution of *P. fumeus* in south-eastern Australia (Broome *et al.* in prep.).

- • Trapping and hair-sampling tube records.
- ▲ Predator scat records.
- o Subfossil remains.

Population Fluctuations

P. fumeus populations are subject to large annual fluctuations in abundance (Cockburn 1981b; Ford 1998a). Cockburn (1981b) attributes this to the decline in available food sources during late spring whereas Ford (1998a) indicates that the causes are unclear, but suggests that males may decline due to social conflict. Fluctuations for females are not so large because they tend to be more selective in their habitat choice and occur in higher densities in the preferred habitat which offers protection during the late spring nutritional crisis. Individuals with home ranges outside these favoured sites (more males than females) generally do not survive, although it has been suggested that they may perform an important exploratory role in colonising new areas (Cockburn 1981b).

Once breeding territories are established, breeding commences and females produce one to two litters, each of three to four young. The species has been recently discovered as being a communal plural breeder - up to five reproductive females were found co-habiting in burrows during the breeding season and a high degree of breeding synchrony was observed within nests (Ford 1998a). The females often live to breed in the second year with older ones breeding slightly earlier than the younger animals (Cockburn 1995).

This pattern of life of *P. fumeus* on Mt William in the Grampians is probably representative of the species throughout its range, given the overall similarity in habitat, which has a diverse understorey of heathy shrubs, especially legumes (Cockburn 1995). Cockburn (1995) notes that this vegetation complex is fire-generated, and suggests that the species is dependent upon post-fire succession for survival. However, the species' possible disappearance from its former stronghold in the Grampians is not, at first glance, associated with visible vegetation change, or with the disappearance or decline of any vascular plant species (Cockburn pers. comm.). This may suggest some effects on the ecology of the hypogeous fungi, which form such an important part of the species' diet (Cockburn pers. comm.).

Conservation Status

P. fumeus is recognised as a threatened species in the following sources:

International

Rare. - IUCN Red List of Threatened Animals 1994 (Groombridge 1993).

Australian Capital Territory

Endangered. - Section 21 of the *Nature Conservation Act 1980,* Instrument No. 192 of 1998 (formerly Instrument No. 7 of 1998).

Special Protection Status Species. - Schedule 7 of the *Nature Conservation Act 1980,* Instrument No. 197 of 1998.

New South Wales

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

Victoria

Vulnerable. - *Flora and Fauna Guarantee Act 1988.*

Threatening Processes

Since European settlement throughout the species' range, several major environmental changes have occurred that are likely to have seriously disadvantaged the species. These are (Lee 1995):

- **vegetation clearance**, resulting in loss of habitat and likely contraction of range;
- **inappropriate fire regimes**, resulting in changes to the floristic composition of ground and shrub vegetation - may have deleterious effects on food sources; and
- **predation** by the introduced European Red Fox (*Vulpes vulpes*) and Cat (*Felis catus*) - may be significant for small isolated populations, particularly in relation to the recent discovery of communal nesting (Ford 1998a).

When combined with the existing fragmentation of many of the remaining forest habitats, the effects of wildfires, inappropriate fire regimes and predation are all likely to exacerbate serious problems resulting from reduced dispersal, recolonisation ability and gene flow (Saunders *et al.* 1991; Fahrig and Merriam 1994). These combined effects are limiting populations to small, isolated, fire and predator refuges within the species' preferred heathy habitat (Broome *et al.* in prep.).

Major Conservation Objectives

The major conservation objective is to secure in the long term, viable, wild populations of *P. fumeus* as a component of the indigenous biological resources of the ACT region and contribute to the national conservation of the species.

This objective is to be achieved by:

- encouraging research aimed at identifying and managing the causes of population decline;
- co-operating with regional and national bodies to ensure coordination of research and monitoring programs;
- increasing awareness with land managers and the community of the need to protect the species and its habitat; and
- where appropriate, implementing any identified management action.

Conservation Issues and Intended Management Actions

Lack of knowledge on ecological requirements, particularly in relation to fire, prohibits specification of detailed management prescriptions. In the case of the Mt William population in the Grampians (which is relatively well studied), no management actions specifically aimed at the species have been undertaken (Lee 1995), although a fire management plan has been drawn up for the Otway Ranges (Lane 1997). Survey and research priorities can therefore be set (Lee 1995).

SURVEY

Following the two sightings in Namadgi National Park (NNP) in 1986 and 1987, intensive small mammal trapping efforts were directed at the two localities (Lawrence 1986; Lintermans 1988). However, no additional captures of *P. fumeus* were made. In the 1993-94 summer, an intensive hair-sampling tube survey was undertaken within predicted habitat areas in both Namadgi and Kosciuszko National Parks. From 1,354 tubes placed by the ACT Parks and Conservation Service in NNP, only one probable (from hair in a bird's nest) hair sample of *P. fumeus* was obtained at Mt Namadgi (Broome *et al.* in prep.). There were no positive identifications from hair analyses from numerous scats collected in various places throughout NNP (Mayo pers. comm.). From 1,490 tubes in Kosciuszko National Park (1994-95), one hair sample was obtained from a hair tube at The Pilot. Another was found in October 1996 from a Quoll scat at Ravine, at the northern end of the Park. Subsequent trapping surveys in the Ravine area were unsuccessful but three individuals were found dead at Yarrangobilly, most likely resulting from cat predation (Ford 1998b). Other potential sites will be surveyed as resources become available.

Research at the Nullica site in 1997-98 revealed 15 females and 13 males at the site, but numbers declined during the summer (Ford 1998a). Low numbers of individuals have been trapped at four other sites nearby in South East Forest National Park and three sites to the north in Nullica State Forest (Ford 1998b; C. Slade SFNSW, pers. comm.). These findings suggest that a metapopulation exists in the area.

Broome *et al.* (in prep.) describe the results of surveys conducted in south-eastern NSW between March 1993 and October 1998 and present predictive models of the potential distribution of the species, using all extant records from the species' entire known range until October 1998.

Due to apparent late spring die-offs (Cockburn 1981b; Ford 1998a), the optimal times for surveying populations is from late August to late September in the coastal forests and from September to November in the sub-alpine areas.

⇒ Environment ACT will follow up any new useful evidence of the species' presence within Namadgi National Park or neighbouring areas in the ACT.

⇒ Environment ACT will liaise with the NSW National Parks and Wildlife Service (NSW NPWS) to ensure coordination of efforts on a regional basis.

RESEARCH

Broome *et al.* (in prep.) have identified the urgent need for further ecological and genetic studies, and research on appropriate fire regimes. Ford (1998a) undertook a detailed study on the ecology and social organisation of the recently discovered population in south-eastern NSW to determine whether Cockburn's findings can be generalised across the range of the species. This highlighted the role of predation as a threat to the population, as does the recent find at Yarrangobilly.

⇒ Environment ACT will, through co-operation with regional efforts, support research programs which may have application for a recovery strategy for the species. Priority research projects are:

- survey of areas of known potential habitat;
- determination of appropriate fire regimes for the species' habitat; and
- effects of predation.

It is typical of the species that trap success has been very sporadic. However, ongoing monitoring through trapping, and in addition pitfall trapping at the Nullica site, will continue with an intensive predator control program by NSW agencies to see if populations do re-establish.

REQUIRED MANAGEMENT ACTIONS

- The inadequate knowledge of the habitat of this species in the ACT, and its apparent rarity, makes it difficult to specify actions other than ones already encompassed within the management of Namadgi National Park, including the Bimberi Wilderness Area. The following actions are based on the information available up to 1990 and should be reviewed as new information becomes available:
- to minimise the risk of increasing the predation pressure on the species, no fire trails or walking tracks to be constructed near areas most likely to comprise Smoky Mouse habitat, including none in the Bimberi Wilderness Area;
- continue to manage pig control programs involving poisoned wheat baits so as to avoid areas of likely Smoky Mouse habitat;
- consider the conservation requirements of this species in the preparation of the Bush Fire Fuel Management Plan covering Namadgi National Park. When, and if feasible, provide in that plan for regeneration of areas of heath. In the event of wild fires likely to burn into heath or dry sclerophyll forest on ridges, liaise with the appropriate ACT or NSW bush fire suppression authority so that heath and understorey conservation requirements are taken into account in deciding the management response to such wildfires;
- no fuel reduction burning in the Bimberi Wilderness Area. Any planned burning in possible Smoky Mouse habitat to involve monitoring of the vegetation in reference to the apparent habitat requirements of the species; and
- maintain the current level of effort to minimise the frequency of fires in Namadgi National Park that are caused by people.

Protection

All known areas of suitable and potential habitat for *P. fumeus* occur within Namadgi National Park. Therefore no further reserved areas are required.

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.

Any predator control programs implemented for the conservation of this species will be beneficial for other species and for neighbouring rural lessees. Any predator control program will be managed to minimise non-target risk, for example current baiting procedures for foxes involve burial of baits to maximise risk to the target species while minimising risk to the spotted-tailed quoll, *Dasyurus maculatus*.

⇒ Environment ACT will undertake a community consultation and public education program if its proposals for protection of the species involve land use changes.

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 (including fish and invertebrates), 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.

P. fumeus 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. 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. fumeus* is mandatory as the species has been listed as endangered. Predation by the European Red Fox (*Vulpes vulpes*) has been listed as a Key Threatening Process. The Final Determination was made in March 1998.

Consultation and Community Participation

It is appropriate that the conservation of *P. fumeus* and its associated heathy habitat be promoted through community liaison and public education, with the main objective being to foster protection of the species.

⇒ Environment ACT (ACT Parks and Conservation Service) will support national and regional recovery efforts.

⇒ Environment ACT (ACT Parks and Conservation Service) will encourage appropriate community participation in activities associated with the conservation of threatened species, including *P. fumeus*, in the ACT.

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 regional and national recovery efforts, 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

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:

⇒ undertaking further survey and research work to gain a greater understanding of the distribution of the species;

⇒ development of management prescriptions to enhance the conservation status of the species, especially in regard to preferred fire regimes and predator control; and

⇒ co-operation with regional and national recovery efforts.

Acknowledgments

Linda Broome (NSW NPWS) for providing advice and oversighting successive drafts of this Action Plan.

Professor Andrew Cockburn, Head of the Division of Botany and Zoology, Australian National University, who has studied *P. fumeus* in the Grampians in western Victoria.

N. Jones, Department of Natural Resources and Environment, Victoria, who has undertaken surveys and found predator scats containing remnants of Smoky Mouse.

Garry Mayo, Division of Botany and Zoology, Australian National University, who has provided information to the ACT Flora and Fauna Committee to assist in the assessment of the species' status.

Graham Newell, senior wildlife scientist, Victorian Department of Natural Resources and Environment, who is responsible for state wide fauna surveys conducted as part of the Comprehensive Regional Assessment process.

C. Slade, ecologist, State Forests of NSW, who has undertaken surveys of Smoky Mouse.

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

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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. *Smoky Mouse* (Pseudomys fumeus): *An endangered species*. Action Plan No. 23. Environment ACT, Canberra.

ACTION PLAN No. 30

In accordance with section 38 of the *Nature Conservation Act 1980*, the **Spotted-tailed Quoll *(Dasyurus maculatus)*** was declared a **vulnerable** species on 4 September 2003 (Instrument No. 265 of 2003). Section 40 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:

Spotted-tailed Quoll
Dasyurus maculatus

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 Spotted-tailed Quoll, 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 *Nature Conservation Act 1980*, in consultation with the Flora and Fauna Committee.

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 or suspected to occur in the ACT region and is already recognised as vulnerable in an authoritative international or national listing.

Species Description and Ecology

DESCRIPTION

The Spotted-tailed Quoll (or Spot-tailed Quoll, Tiger Quoll, Spotted-tailed Native Cat, Tiger Cat) *Dasyurus maculatus* is the largest of the six living quoll species (including subspecies) and the largest marsupial carnivore on mainland Australia. Other quoll species such as the Northern, Eastern and Western Quolls, have all declined on mainland Australia, and the related Tasmanian Devil and Thylacine have become extinct in the last few thousand years.

There are two described subspecies of the Spotted-tailed Quoll: *Dasyurus maculatus gracilis*, confined to northern Queensland, and *Dasyurus maculatus maculatus* described here. There is also a distinct Evolutionarily Significant Unit restricted to Tasmania that has been proposed for reclassification as another subspecies (Firestone *et al.* 1999 and Firestone *et al.* 2000).

Male quolls have a head and body length of 380–760 mm, a tail length of 370–550 mm and weigh up to 7 kg (average 3 kg). Females have a head and body length of 350–450 mm, a tail length of 340–420 mm and weigh up to 4 kg (average 2 kg). The fur ranges from rich rufous brown to dark above, pale below, with conspicuous white spots of varying size over the body and tail (Edgar and Belcher 1995).

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Website: www.cmd.act.gov.au (AHE 05/1501)

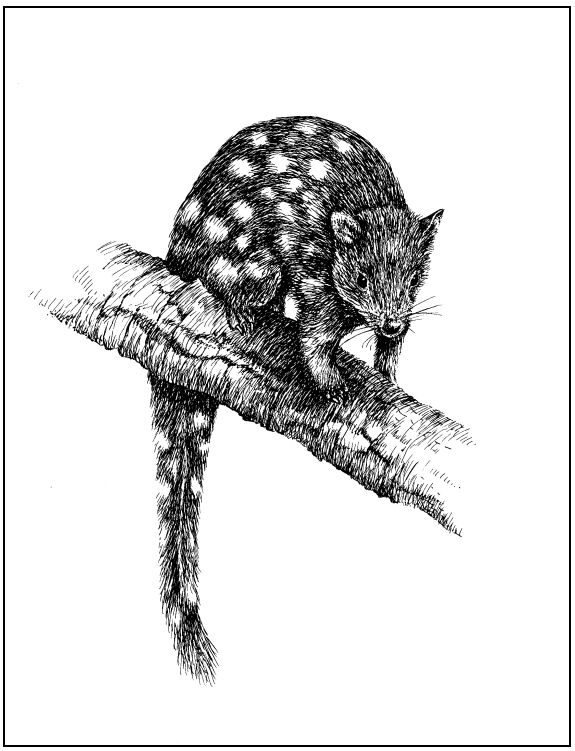

Figure 1: Spotted-tailed Quoll *Dasyurus maculatus maculatus*.

HABITAT

The Spotted-tailed Quoll is recorded from a wide range of forested habitats, including rainforests, wet sclerophyll forest, lowland forests, River Red Gum forests, dry 'rainshadow' woodland, sub-alpine woodlands, coastal heathlands and inland riparian forests (Edger and Belcher 1995; Green and Scarborough 1990; Jones and Rose 1996; Mansergh 1995).

The species appears to favour areas with a relatively complex understorey, often in association with complex rock formations, hollow-bearing trees, rocky escarpment and/or fallen logs or burrows for den sites.

BEHAVIOUR AND BIOLOGY

The Spotted-tailed Quoll is primarily a carnivore, that preys on medium-sized mammals including possums, gliders and rabbits. Other prey includes small mammals, birds, reptiles and invertebrates (Belcher 1995). It is also known to prey on domestic poultry and to scavenge on carrion (Edgar and Belcher 1995).

It is usually nocturnal, but will bask in the sun and on occasions has been known to be diurnally active (Edgar and Belcher 1995). The species is generally solitary and occupies large home ranges, in the order of many hundreds to a few thousand hectares (Belcher and Darrant 2004; Claridge *et al*. 2005). Within its home range, this species has 'latrines' where it defecates, which are likely to define territories (Edgar and Belcher 1995) and also act as places of 'advertisement' (Kruuk and Jarman 1995).

Mating takes place from April to July. The average litter size is five, and the young remain in the pouch for about seven weeks, becoming fully independent at around 18 weeks (Edgar and Belcher 1995).

DISTRIBUTION

The former distribution of the Spotted-tailed Quoll was south-eastern Queensland (Bundaberg to Chinchilla), eastern NSW (including the ACT), Victoria, South Australia and Tasmania (including some Bass Straight Islands), (Mansergh and Belcher 1992).

The current distribution includes:

- *Queensland*—south-eastern Queensland, restricted to Blackall/Conondale Ranges, southern Darling Downs (Stanthorpe to Wallangarra), Main Range (Goomburra to Spicer Gap), Lamington Plateau and McPherson/Border Ranges (Springbrook to Mt Lindsay) (Maxwell *et al.* 1996).
- *Victoria—s*everal disjunct populations including:
    - eastern Victoria (from the foothills and ranges north and east of Melbourne through to the NSW border);
    - north-eastern Victoria;
    - north-western Victoria;
    - south-western Victoria (centred on Mt Eccles National Park);
    - lowland East Gippsland and South Gippsland;
    - Otway Ranges; and
    - Central Victoria (including records from 1991 at Macedon Ranges) (NRE 2001).
- *New South Wales—s*everal disjunct populations occur between the Border Ranges and Blue Mountains/Illawarra; several populations between Grafton and Taree in north-east NSW through to the gorges and escarpments of the New England tablelands; numerous records in the coastal forests between Ulladulla and Bermagui. Intensive survey work has identified locally abundant populations in some areas of the Tallaganda and Badja State Forests and south-east forests, and forests of the coastal escarpment and the rainshadow woodland of Kosciuszko National Park (South East Forests Spotted-tailed Quoll Working Group 2003).

Isolated records also exist from near Hay in Southern NSW, near Brewarrina in Northern NSW and Walgett (Long and Nelson 2004).

- *Tasmania*—in wet forests and scrub in the west and north of the island, although absent from the Tasman Peninsula (Rounsevell *et al.* 1991). The Tasmanian populations apparently form a separate Evolutionarily Significant Unit and have been proposed to be reclassified as a separate subspecies (Firestone *et al.* 1999 and Firestone *et al.* 2000).

Distribution in the Australian Capital Territory

In the mid 1800s, both *D. maculatus* and *D. viverrinus* (Eastern Quoll) were present in the ACT region and quolls were regularly seen in the Tidbinbilla Valley.

The introduction of strychnine to the Canberra district in 1861 is believed to have led to quolls being widely poisoned (Allan Fox & Associates, 1987). By 1971, *D. viverrinus* was considered to be extinct in the district (National Parks Association of the ACT 1971) and on the mainland as a whole (Maxwell *et al*. 1996). At this time, *D. maculatus* was recorded as occurring mostly in the timbered ranges of the ACT, including Tidbinbilla Nature Reserve.

There have been ten specimen records (animal (live or dead), hair, scats or DNA (ACT Vertebrate Atlas)) of the Spotted-tailed Quoll in the ACT since the 1950s, the most recent in 2004. These records are widely distributed across the ACT and include three within the suburban area. A survey conducted in 1999 and 2000 by Environment ACT failed to record the species in the ACT (Nelson *et al.* 2001). The species was recorded in May 2002, as part of a regional survey in Kosciusko National Park, on the NSW-ACT border at Sentry Box mountain at the southern end of Namadgi National Park (James Dawson pers. comm.). In 2003 and 2004 a search for Quoll latrine sites confirmed the occurrence of the species at three locations in Namadgi National Park (two sites in the Gudgenby Valley and Orroral Valley) (Mark Dunford pers. comm.). Occasional sightings of the Spotted-tailed Quoll continue to occur across the ACT and surrounding region.

The limited confirmed records in the ACT probably reflect the elusive nature of the Spotted-tailed Quoll, rather than its actual distribution.

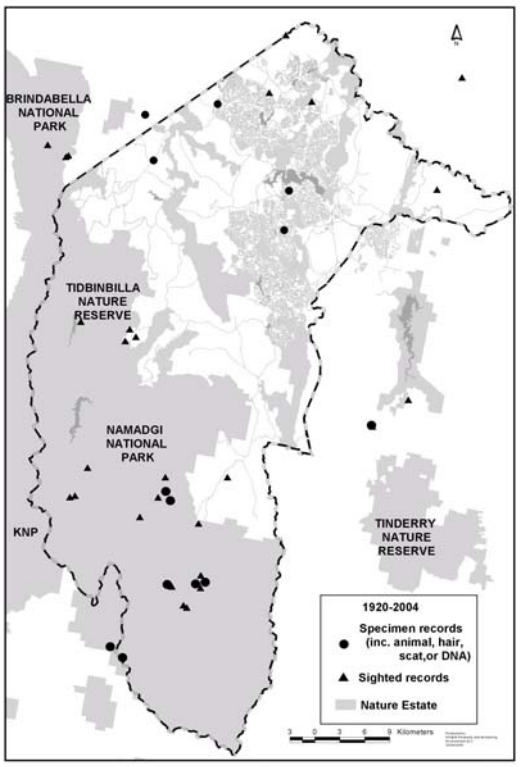

Figure 2: Records of the Spotted-tailed Quoll in the ACT region.

Conservation Status

Dasyurus maculatus maculatus is recognised as a threatened species in the following:

International
Vulnerable—IUCN (2000).

National
Endangered—Environment Protection and Biodiversity Conservation (EPBC) Act 1999.
Vulnerable—(Tasmanian population).

Australian Capital Territory
Vulnerable—Section 21 of the *Nature Conservation Act 1980*, Disallowable instrument No. 256 of 2003.

Queensland
Vulnerable—Threatened Species List 2000.

Victoria
Endangered—Schedule 2 of the Flora and Fauna Guarantee Act 1988.

New South Wales
Vulnerable—Schedule 2 of the NSW Threatened Species Conservation Act 1995.

South Australia
Endangered—Schedule 7 of the National Parks and Wildlife Act 1972 (although considered by state authorities to be extinct in SA).

Threats Across the Species Distribution

Habitat Loss, Fragmentation and Degradation
The loss, fragmentation, disturbance and degradation of habitat through clearing of native vegetation, timber harvesting and other forest management practices are probably the greatest threats to Spotted-tailed Quolls. It is not clear to what extent wildfires and prescribed burns are a threat to the species. It is likely that fire can have both a positive and negative influence, in that the availability of prey and refugia may be limited in the short term, but that in the longer term, fire may also accelerate the formation of tree hollows used by quolls and their prey (Long and Nelson 2004).

Competition and Predation
Competition and predation involving foxes, feral cats and wild dogs are suspected to suppress quoll populations (Edgar and Belcher 1995; Maxwell *et al.* 1996; Murray and Poore 2004), although the frequency or degree of impact on populations is unknown and it is possible that some interactions are positive for quoll populations. The distribution and abundance of foxes appears to be associated with patterns of land disturbance (Catling and Burt 1995), which combined, could have major impacts on quoll populations.

Poisoning
Spotted-tailed Quolls are carnivorous, and may be at risk during feral animal control programs through primary and secondary poisoning (Belcher 2000). However, there is currently considerable debate regarding the impact of these pest control programs on quoll populations (Department of Sustainability and Environment 2003). Belcher (1998), Glen and Dickman (2003) established that quolls could detect, remove and consume non-toxic FOXOFF baits. However, Körtner *et al*. (2003) demonstrated that while quolls regularly remove baits they rarely consume FOXOFF toxic baits. Murray and Poore (2004) showed that normal aerial baiting for dingoes and wild dogs with fresh meat baits resulted in high rates of bait uptake by Spotted-tailed Quolls. Control programs for all vertebrate pests must be managed to minimise risks of either primary or secondary poisoning to non target species.

Killing by Humans
Quolls have been known to be deliberately killed in rural areas due to their predation on domestic poultry (Maxwell *et al.* 1996). Road mortality is also a threat in some areas of the species range. However, it is not known to what extent these two threats affect quolls at the population level and it is unlikely that these play a significant role in the ACT.

Major Conservation Objectives

The major conservation objectives of this Action Plan are:

- to contribute to regional and national conservation of the species; and
- to maintain in the long-term, viable, wild population(s) of the Spotted-tailed Quoll *Dasyurus maculatus* as a component of the indigenous biological resources of the ACT.

This objective is to be achieved through the following strategies:

- co-operating with, and contributing to regional and national networks to ensure coordination of research, survey and monitoring programs;
- identifying and protecting habitat critical to the survival of the species in the ACT; and
- where appropriate, implementing management actions or methods required to protect the species and its habitat in the ACT.

Conservation Issues and Intended Management Actions

SURVEY/MONITORING/RESEARCH
Environment ACT has conducted surveys for Spotted-tailed Quolls in Namadgi National Park and a number of nature reserves (Tidbinbilla, Rob Roy Range and Googong Foreshores in NSW). A variety of techniques have been used during these surveys including searches for Quoll latrine sites and scats, searches for scats of other predators (which may contain Quoll remains) and the use of hair sampling tubes. Trapping has also been undertaken at a number of locations of likely Quoll habitat. Recent efforts have resulted in confirmation of the presence of the species, evidenced by scats, at two locations in Namadgi National Park.

⇒ Environment ACT will continue to co-operate with and contribute to regional and national networks to ensure coordination of research, survey and monitoring programs.

⇒ Environment ACT will conduct further surveys in likely Quoll habitat to gain an understanding of the species distribution in the ACT, and the feasibility of establishing monitoring programs for the species in the ACT.

⇒ Environment ACT will survey rural lease holders to gain information about Quoll sightings in rural areas adjoining potential Quoll habitat.

REQUIRED MANAGEMENT ACTIONS

Targeted feral animal control programs may benefit the Spotted-tailed Quoll through reduction of competition. However, due to the uncertainty about the uptake of poisoned baits by Quolls and the risk of secondary poisoning (and the degree to which individual animals are affected or killed) vertebrate pest control programs need to be implemented cautiously, with consideration of the possible effects on non-target species, including Quolls.

⇒ Environment ACT will ensure that all pest animal control activities in areas of known Quoll populations (or areas with high potential for Quoll occurrence) comply with current best practice prescriptions to minimise the risks of baiting programs on Quolls.

⇒ Environment ACT will incorporate into its Vertebrate Pest Management Strategies a consideration of the possible benefit to Quoll populations of control programs targeted at the Feral Cat and Fox.

Protection

Within the ACT, it is probable that most of the suitable habitat for this species exists in reserved areas such as Namadgi National Park, Tidbinbilla Nature Reserve, Googong Foreshores and the Murrumbidgee River Corridor. It is therefore unlikely that further areas will be required for the conservation of this species.

⇒ Environment ACT will manage or avoid habitat disturbance in reserved areas known to support Quoll populations. Particular care will be taken to protect areas around known latrine sites.

⇒ Environment ACT will incorporate the protection of rocky outcrops, riparian zones (and other critical habitat features) into fire management prescriptions within areas of known Spotted-tailed Quoll habitat.

Socio-economic Issues

Given that the species is most likely to occur mainly within nature reserves in the ACT, there are no foreseeable socio-economic issues associated with the protection of this species and its habitat.

⇒ Environment ACT will undertake a community consultation and public education program if its proposals for protection of the species involve land use changes.

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 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.

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 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, 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.

***Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Commonwealth)**

The endangered status of the species under the *EPBC Act* means that the species is recognised by the Commonwealth as a matter of national environmental significance. Any action that is likely to have a significant impact on the species will need to be referred to the Australian Government Environment Minister for a decision as to whether assessment and approval is required. It is an offence for any person to undertake an action that is likely to have a significant impact on the south-eastern mainland population of the Spotted–tailed Quoll without approval.

Consultation and Community Participation

It is appropriate that the conservation of the Spotted-tailed Quoll and its habitat be promoted through provision of information to the public.

⇒ Environment ACT will maintain links with regional and national conservation networks.

⇒ Environment ACT will encourage appropriate community participation in activities associated with the conservation of the Spotted-tailed Quoll.

Implementation, Evaluation and Review

RESPONSIBILITY FOR IMPLEMENTATION

Environment ACT will have responsibility for coordinating the implementation of this Action Plan subject to government priorities and resources.

EVALUATION

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 (eg. 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:

⇒ maintaining links with national and regional networks to ensure coordination of research, survey and monitoring programs;

⇒ supporting and contributing to national and regional recovery efforts;

⇒ undertaking surveys in the ACT to identify suitable quoll habitat and establishing the species presence in those habitats, thereby gaining an understanding of the species distribution;

⇒ ensuring that all pest animal control activities in areas of known or potential Quoll populations comply with current best practice prescriptions to minimise the risks of baiting programs on Quolls; and

⇒ where appropriate, implementing any other identified management actions or methods required to protect the species and its habitat.

Acknowledgments

The illustration of the Spotted-tailed Quoll was prepared for Environment ACT by Lesley Wallington.

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List of Action Plans—August 2005

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.

No.25: Ginninderra Peppercress (*Lepidium ginninderrense*)—an endangered species.

No. 26: Silver Perch *(Bidyanus bidyanus)*—an endangered species.

No. 27: ACT Lowland Woodland Conservation Strategy. *(Supersedes Action Plans 4, 9, 10, 15,16,17,18,19,20).*

No 28: ACT Lowland Native Grassland Conservation Strategy. *(Supersedes Action Plans 1, 2, 3, 7, 8, 21, and 25).*

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

Website: www.cmd.act.gov.au

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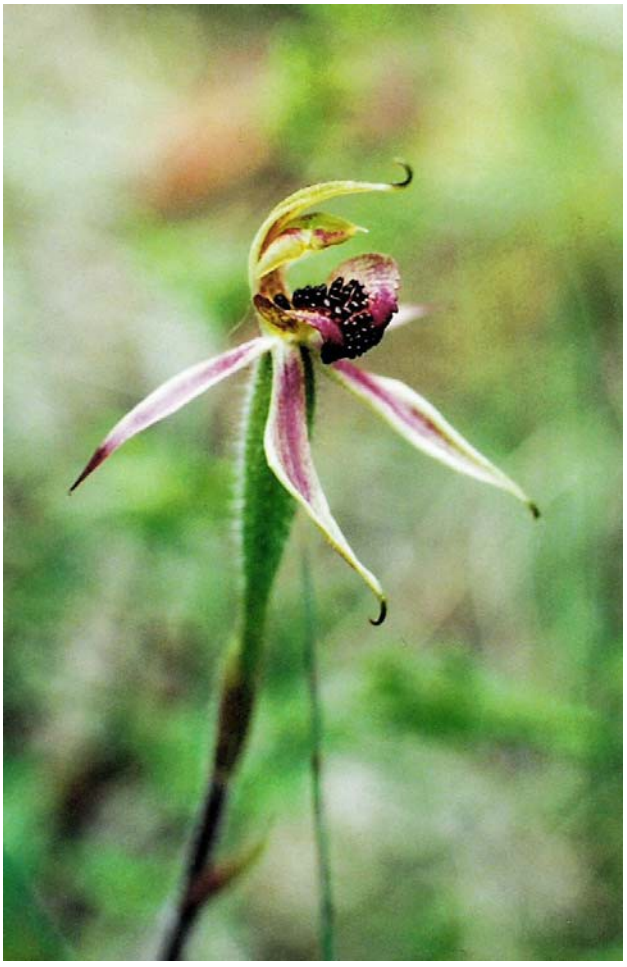
Action Plan 31
For
Canberra Spider Orchid
(*Arachnorchis actensis*)

Prepared under the provisions of the
***Nature Conservation Act 1980* (ACT)**



ACT Government
Environment and Sustainable Development

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Disclaimer:
The Australian Government, in partnership with the ACT Government, facilitates the publication of recovery plans to detail the actions needed for the conservation of threatened native wildlife. The attainment of objectives and the provision of funds may be subject to budgetary and other constraints affecting the parties involved, and may also be constrained by the need to address other conservation priorities.

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Funding for the preparation of this plan was provided by the Australian Government.

1. Species Information and General Requirements

1.1 Species Name and Description

Arachnorchis actensis (D.L.Jones & M.A.Clem.) (Canberra Spider Orchid) is endemic to the Australian Capital Territory and was originally described as *Caladenia actensis* (Jones and Clements 1999). A revision of the genus *Caladenia* has resulted in the species being renamed as *Arachnorchis actensis* (Jones *et al.* 2001).

Arachnorchis actensis is a terrestrial orchid that grows singly or in small groups to a height of 40 to 90 mm. The flowers are solitary (rarely two) 12–20 mm in diameter and the base colour is greenish, heavily marked with reddish crimson lines and suffusions. For a complete description refer to Jones and Clements (1999).

1.2 Conservation Status

The Canberra Spider Orchid is declared a Critically Endangered species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (6 June 2005). The species is also declared an Endangered species in the Australian Capital Territory under the *Nature Conservation Act 1980* (ACT) (11 April 2005). This recovery plan has been prepared under the provisions of the EPBC Act and Nature Conservation Act.

1.3 International Obligations

There are no international obligations in relation to this species.

1.4 Affected Interests

The known locations of the orchid were confined to the slopes of Mt Ainslie and Mt Majura (managed by the ACT Government). More recently, a population has been located in the Majura Valley (on land managed by the Department of Defence as Majura Field Firing Range). This recovery plan is focussed on the Mt Ainslie and Mt Majura populations; however, it would be relevant to any other populations in the ACT.

- **Mt Ainslie and Mt Majura**. Both these locations are Public Land (Nature Reserve) under the *Planning and Development Act 2007* (ACT). The areas are managed by the ACT Government as part of Canberra Nature Park. Prescribed management objectives for this land under the Act (Schedule 3) are: (a) to conserve the natural environment; and (b) to provide for public use of the area for recreation, education and research. Implementation of the recovery plan will involve Parks and Conservation Service (Territory and Municipal Services Directorate, ACT Government), but will have minimal impact on public recreational use of Canberra Nature Park.
- **Majura Field Firing Range**. This is National Land located in the Majura Valley and managed by the Department of Defence. National Land is defined in the *Australian Capital Territory (Planning and Land Management) Act 1988* (Cwlth) as land used by or on behalf of the Commonwealth and managed by the Commonwealth. Public access to Majura Field Firing Range is prohibited.

1.5 Role and Interests of Indigenous People

All Aboriginal signatories to the Agreement between the Territory Government and ACT Native Title Claim Groups were contacted and provided with a draft of the recovery plan (April 2007). None of the signatories made comment or expressed concern about the contents of the plan.

1.6 Benefits to Other Species/Ecological Communities

Actions to conserve the species will be undertaken in the context of the ecological community of which it is a part. Broader biodiversity benefits have not been identified at this stage. No adverse effects on other species or the ecological community as a whole are envisaged.

1.7 Social and Economic Impacts

No significant adverse social or economic impacts are envisaged from implementation of the recovery plan. The Mt Ainslie and Mt Majura populations are located in nature reserve areas in which nature conservation is a primary management objective (ACT Parks and Conservation Service 1999).

2. Distribution and Location of the Canberra Spider Orchid

2.1 Distribution and Importance

Currently, the species is known from two separate populations totalling approximately 250 plants (2003 data) in a combined area of about five hectares on the lower western slopes of Mt Ainslie (30 plants) and Mt Majura (220 plants), in Canberra Nature Park. More recently the species has been located also in the Majura Valley. *Arachnorchis actensis* was previously recorded from a second site on Mt Ainslie (in the suburb of Campbell), as well as in the suburb of Aranda prior to its development. Extensive surveys in other suitable habitat in the ACT in spring 2003 failed to locate any plants (Milburn and Rouse 2004).

Given that these are the only known locations of the species, they are considered to be important populations in terms of the EPBC Act.

2.2 Habitat Critical to the Survival of the Species

At Ainslie–Majura, the Canberra Spider Orchid grows in transitional vegetation zones between Yellow Box – Red Gum Tableland Grassy Woodland (dominated by *Eucalyptus blakelyi*, *E. melliodora* and *E. pauciflora*) and Red Stringybark Tableland Grass/Shrub Forest (dominated by *E. rossii*) at an altitude of 645 to 745 m. The soils are shallow gravelly brown clay loam of volcanic origin. The known extant populations of the orchid occur only on dacitic ignimbrite of the Mt Ainslie Formation. Plants occur amid a groundcover of grasses, forbs and low shrubs, often among rocks. The major population on Mt Majura grows in open areas among rocks with partial shade from the north, in association with *Allocasuarina verticillata* (Milburn and Rouse 2004).

As these sites are the only habitat where the species is known to occur, they are considered habitat critical for the maintenance and recovery of the species.

2.3 Mapping of Habitat Critical to the Survival of the Species

Locations of the populations of the Canberra Spider Orchid have been defined (GPS co-ordinates) and mapped (Milburn and Rouse 2004), but this information is not included in the recovery plan due to the need to protect the sites from unauthorised collection of plants.

3. Known and Potential Threats

3.1 Ecology (relevant to threats)

Arachnorchis actensis is a seasonal perennial, its leaf appearing from a dormant underground tuber in late autumn or early winter following good rains. Flower buds appear in late winter or early spring and plants flower from late September to mid-October. Plants are insect pollinated, probably by a thynnid wasp species. Plants die down post-flowering and remain dormant over summer. Seeds require interactions with a mycorrhizal fungal host for germination. Mature plants probably are reliant also on a mycorrhizal fungal host to receive an adequate carbon and nutrient supply (Milburn and Rouse 2004).

3.2 Identification of Threats

Arachnorchis actensis has an extremely small population. Over a ten year period to 2003, the Ainslie–Majura population has averaged about 100 plants. Of these, only about one-third has borne flowers. The number of plants recorded in spring 2003 (approximately 250, being 235 mature and 40 possible juvenile plants) is the highest for the species. Atypically, in 2003, a very high proportion of the plants observed were flowering. The 2003 population number should be considered to be close to an upper limit for the Ainslie–Majura populations (Milburn and Rouse 2004).

The effects of fire on *Arachnorchis actensis* and/or its adaptation to a particular fire regime are unknown. Throughout Australia, the most important habitats for terrestrial orchids are burnt regularly, and for some species summer bushfires have become an integral part of their life cycle. Summer fires are known to stimulate flowering in the following spring for a number of *Caladenia* species (Jones 1988).

Arachnorchis actensis is highly vulnerable to disturbance due to its restricted distribution, small population, and characteristics of its life cycle (period of dormancy when its presence is not evident, short flowering period and association with soil fungi).

The populations of *Arachnorchis actensis* at Ainslie–Majura are not under immediate threat; however, potential threats are:

(a) **Recreational use (trampling and mechanical injury)**: Mt Ainslie and Mt Majura units of Canberra Nature Park are popular for recreation including walking, cycling and horse riding. Management provisions related to these activities are set out in the *Canberra Nature Park Management Plan* (ACT Parks and Conservation Service 1999). *Arachnorchis actensis* populations may be susceptible to trampling by recreational users moving off existing tracks or to disturbance related to track maintenance.

(b) **Infrastructure establishment and maintenance (mechanical injury)**: Planning provisions in the ACT allow for the establishment of utilities and infrastructure in the 'Inner Hills' areas. As well as a network of management (vehicle) and walking tracks, the Mt Ainslie and Mt Majura areas contain major powerlines and water reservoirs for urban reticulation. The largest grouping of plants (Mt Majura) is located near a cleared powerline easement. A potential threat to the populations is disturbance associated with the maintenance of infrastructure or the establishment of new facilities.

(c) **Weed invasion**: Site conditions have probably contributed to a relatively low level of weed invasion of the existing *Arachnorchis actensis* populations. However, weed species are prevalent throughout the area, especially in the groundcover. Weed encroachment is a potential threat to the species and should be monitored and controlled.

(d) **Shading (tree and shrub cover)**: Some shrub cover is present at the sites of the *Arachnorchis actensis* populations. This comprises *Acacia* spp. (Mt Ainslie and the small population at Mt Majura) and *Allocasuarina verticillata* (the large population at Mt Majura). While this shrub cover results in sunny to part-shaded habitats, it is not known if increased shading due to shrub (or tree) growth is a threat to the species.

(e) **Herbicides**: Herbicides used to treat shrub regrowth or weeds at the *Arachnorchis actensis* sites should not come into contact with the orchid plants.

(f) **Illegal collection**: Though there is no evidence for this having occurred to date, it is a potential threat given the attractiveness of the plant, its limited numbers and proximity to urban Canberra.

(g) **Fire**: It is likely that *Arachnorchis actensis* evolved with a late summer to early autumn fire regime (the naturally fire-prone period in the ACT), which corresponds with its dormant period. Fires from late autumn to early spring may affect its life cycle and reproductive capability. This is a matter warranting further investigation.

(h) **Herbivore grazing**: High densities of eastern grey kangaroos and rabbits occur in the areas where *Arachnorchis actensis* occurs. Excessive grazing by rabbits, in particular, has been increasingly recognised as a threat to the remaining populations of the orchid. Rabbit proof fencing has been undertaken to protect both populations.

(i) **Soil pathogens**: Dieback of vegetation has occurred in the area surrounding the Mt Ainslie orchid site, which may be due to the presence of soil pathogens (PJ Milburn, pers. comm.). If present, such pathogens have the potential to impact directly on the orchid population or indirectly, by changing their habitat.

3.3 Areas and Populations under Threat

The potential threats outlined in s. 3.2 apply to all the known occurrences of *Arachnorchis actensis* at Mt Ainslie and Mt Majura.

4. Objectives, Performance Criteria and Actions

4.1 Conservation Objectives

The overall objective of this recovery plan is to preserve in perpetuity, in the wild, the only known populations of *Arachnorchis actensis*.

A supporting objective is that the habitat of *Arachnorchis actensis* is conserved and managed so that natural ecological processes continue to operate.

Conservation of habitat involves, in particular, management actions to deal with or avoid the potential threats outlined above e.g. ensuring that the sites are not deleteriously affected by recreational activity or infrastructure works, weeds and shrub growth are controlled, and the sites are protected from potentially damaging fires.

While these objectives relate to the five year term of this recovery plan, they are long-term and ongoing.

4.2 Performance Criteria

The following Performance Criteria are pertinent to the objectives in s. 4.1:

(a) Populations of *Arachnorchis actensis* are monitored annually (see below) and are maintained. (Annual/ongoing)
(b) Habitat conditions are monitored annually and are maintained or improved by management actions and avoidance of potential threats. (Annual/ongoing)

The species is monitored during the flowering season with counts of the numbers of plants occurring in the known population areas. Survey pegs have been placed at the sites for replication of the surveys in subsequent years. At the site of the largest population (Mt Majura), counting is conducted in defined one square metre quadrats.

The primary criterion for the success or failure of this recovery plan is the maintenance *in situ* of the populations of *Arachnorchis actensis* in the ACT.

4.3 Recovery and Threat Abatement Actions (including Management Practices)

Parks and Conservation Service, ACT Territory and Municipal Services Directorate has responsibility on ACT Government managed land for all the actions listed below.

Information: Survey, Monitoring, Research

1. Maintain alertness to the possible presence of the species while conducting woodland surveys in appropriate habitat.
2. Continue to monitor flowering of the orchid to provide information and guidance for management.
3. Encourage and support research into the biology and ecology of the species, its optimum fire regime, the potential for the propagation of *ex situ* populations, and the effects of potential threats e.g. presence of soil pathogens.

Protection and Management

1. Ensure that the orchid populations are protected from the impacts of recreation, infrastructure works and maintenance, and any other potentially damaging activity (e.g. fire fuel hazard reduction).
2. Prepare a management plan for the species based on accurate mapping of the location of the plants.
3. Coordinate management actions undertaken by Parks and Conservation Service.
4. Undertake shrub and weed control in the orchid habitats as required. Provide advice to contractors and park staff on appropriate herbicide use at the sites. Herbicides should not come into contact with the orchid plants.
5. Where herbivore grazing pressure is a threat, fence orchid sites. Otherwise, maintain a 'low profile' for the sites to avoid drawing attention to the orchid populations.
6. Implement an appropriate fire regime for the species and its habitat, once the optimum fire regime has been determined.
7. Based on the results of research, evaluate and, if feasible, undertake the establishment of *ex situ* populations of the species.

5. Duration of the Recovery Plan and Estimated Costs

The recovery plan is for a period of five years.

6. References

ACT Parks and Conservation Service 1999. *Canberra Nature Park Management Plan* (Environment ACT, Canberra).

Jones DL 1988. *Native Orchids of Australia* (Reed Books, Frenchs Forest, NSW).

Jones DL and Clements MA 1999. *Caladenia actensis* (Orchidaceae), a new species from the Australian Capital Territory, *The Orchadian* 12(11): 522–525.

Jones DL, Clements MA, Sharma IK and Mackenzie AM 2001. A new classification of *Caladenia* R.Br. (Orchidaceae), *The Orchadian* 13(9): 389–419.

Milburn PJ and Rouse DT 2004. Nomination of *Arachnorchis actensis* (D.L. Jones *et* M.A. Clements) D.L. Jones *et* M.A. Clements for consideration as an endangered species in the Australian Capital Territory under the *Nature Conservation Act 1980* (A1980–20) (Unpublished, nomination to ACT Flora and Fauna Committee, Environment ACT, Canberra).

Action Plan 32
For
Brindabella Midge Orchid
(*Corunastylis ectopa*)

Prepared under the provisions of the
***Nature Conservation Act 1980* (ACT)**

ACT Government
Environment and Sustainable Development

Prepared by Kevin Frawley for the AGT Government.

Published by the Environment and Sustainable Development Directorate, Canberra.

Adopted under the EPBC Act in 2010

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Disclaimer:
Funding for the preparation of this plan was provided by the Australian Government.
The Australian Government, in partnership with the ACT Government, facilitates the publication of recovery plans to detail the actions needed for the conservation of threatened native wildlife. The attainment of objectives and the provision of funds may be subject to budgetary and other constraints affecting the parties involved, and may also be constrained by the need to address other conservation priorities.

1. Species Information and General Requirements

1.1 Species Name and Description

Corunastylis ectopa (D.L.Jones) D.L.Jones & M.A.Clem. (Brindabella Midge Orchid, also known as the Ectopic Midge Orchid) is endemic to the Australian Capital Territory and was originally described as *Genoplesium ectopum* (Jones 1999). A revision of the genus *Genoplesium* has resulted in the species being renamed as *Corunastylis ectopa* (Jones *et al.* 2002). It was first collected in 1992.

Corunastylis ectopa is a terrestrial orchid that grows to a height of 10 to 25 cm from an underground tuber. The flowers (15–35) are densely crowded, 5–5.5 mm in diameter and are either green and reddish-purple or wholly reddish-purple. For a complete description refer to Jones (1999).

1.2 Conservation Status

The Brindabella Midge Orchid is declared a Critically Endangered species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (6 June 2005). The species is also declared an Endangered species in the Australian Capital Territory under the *Nature Conservation Act 1980* (ACT). This recovery plan has been prepared under the provisions of the EPBC Act and the Nature Conservation Act taking into account the objects of each Act.

1.3 International Obligations

There are no international obligations in relation to this species.

1.4 Affected Interests

The known location of the orchid is on Public Land (National Park) under the *Planning and Development Act 2007* (ACT) in an area declared as Namadgi National Park. Prescribed management objectives for this land under the Act (Schedule 3) are: (a) to conserve the natural environment; and (b) to provide for public use of the area for recreation, education and research. Implementation of the recovery plan will be the responsibility of Parks and Conservation Service (Territory and Municipal Services Directorate). The plan will have minimal impact on public recreational use of the national park. The recovery plan has implications for ACT Roads, the agency responsible for maintaining the unsealed road adjacent to the orchid population.

1.5 Role and Interests of Indigenous People

Aboriginal association with the area now included in Namadgi National Park is recognised in the Agreement between the Territory Government and ACT Native Title Claim Groups (April 2001). This provides for co-operative management of the park. Involvement of the Ngunnawal Aboriginal community in the management of the park is outlined in section 1.7 of the *Namadgi National Park Plan of Management 2010* (ACT Government 2010).

All Aboriginal signatories to the Agreement between the Territory Government and ACT Native Title Claim Groups were contacted and provided with a draft of the recovery plan (April 2007). None of the signatories made comment or expressed concern about the contents of the plan.

1.6 Benefits to Other Species/Ecological Communities

Actions to conserve the species will be undertaken in the context of the ecological community of which it is a part; however, little is currently known about its relationship with the surrounding forest. Broader biodiversity benefits have not been identified at this stage. No adverse effects on other species or the ecological community as a whole are envisaged.

1.7 Social and Economic Impacts

No significant adverse social or economic impacts are envisaged from implementation of the recovery plan. The species is located in a national park in which biodiversity conservation is a primary management objective (ACT Government 2010).

2. Distribution and Location of the Brindabella Midge Orchid.

2.1 Distribution and Importance

Currently, *Corunastylis ectopa* is known from a single site of less than one hectare in the Brindabella Range in the ACT at an altitude of 980 m. No other plants were located in a search of nearby suitable habitat in 2004 and the species is unknown from outside the ACT (Milburn and Rouse 2004).

Given that this is the only known location of the species, it is considered to be an important population in terms of the EPBC Act and Nature Conservation Act.

2.2 Habitat Critical to the Survival of the Species

The Brindabella Midge Orchid grows on a steep slope with a northerly aspect in tall *Eucalyptus robertsonii – Eucalyptus viminalis* Montane Forest. The plants grow in an open area with sparse shrub cover. The soil is stony brown loam over shale derived from the Nungar Beds (Milburn and Rouse 2004). The site is subject to erosion.

As this site is the only habitat where the species is known to occur, it is considered habitat critical for the maintenance and recovery of the species.

2.3 Mapping of Habitat Critical to the Survival of the Species

The location of the only known population of the Brindabella Midge Orchid has been defined (GPS coordinates) and mapped (Milburn and Rouse 2004), but this information is not included in the recovery plan due to the need to protect the site from unauthorised collection of plants.

3. Known and Potential Threats

3.1 Ecology (relevant to threats)

Corunastylis ectopa is a seasonal perennial, shooting from a dormant underground tuber after summer rain. In the absence of rain at the appropriate season the plants remain dormant. The buds develop rapidly and flowering is in progress about six weeks after the initialising rain event, typically from late January to March. The details of pollination are not known, but small flies pollinate other members of the genus. Seeds require interaction with a mycorrhizal fungal host for germination and this requirement probably persists in order for mature plants to receive an adequate carbon and nutrient supply. After setting seed, the aerial portion of the plant withers, and the tubers remain dormant over the subsequent seasons until the next substantial summer rainfall (Milburn and Rouse 2004).

3.2 Identification of Threats

Corunastylis ectopa has an extremely small population located at one site. The population occurs within 10 m of a road embankment on which plants have been dislodged and lost due to small landslides. The species was discovered in 1992 and the type specimen collected in 1993. No data are available on the population number prior to 1999 when Jones (1999) described a population of about 70 plants and noted that several searches in adjacent areas of the Brindabella Range had failed to locate any other populations. Flowering appears to be highly variable, related to seasonal conditions. The site was examined in February 2004 to determine whether the population had been impacted by the high intensity fire of January 2003. Thirty-five plants were located and the site appeared to have been undisturbed by erosion following the fire and subsequent rainfall. Given the relatively dry season, the total of 35 plants suggests that the population has continued to survive since its discovery in 1992 (Milburn and Rouse 2004). Numbers of plants recorded in monitoring from 2008 to 2011 are: 2008 (14 plants); 2009 (nil); 2010 (78 plants); 2011 (76 plants) (100 individuals cumulative total 2010 to 2011) (Environment and Sustainable Development Directorate, unpubl. data). The 2010 and 2011 flowering followed late summer rain.

The effects of fire on *Corunastylis ectopa* and/or its adaptation to a particular fire regime are unknown. Throughout Australia, the most important habitats for terrestrial orchids are burnt regularly, and for some species summer bushfires have become an integral part of their life cycle (Jones 1988). The population count of *Corunastylis ectopa* in 2004 suggests that the species is able to withstand high intensity bushfire.

There has been little weed invasion of the *Corunastylis ectopa* site to date; however, it has been necessary to control shrub growth. This has been undertaken using carefully targeted herbicide application and physical removal.

Because of its restricted distribution, location near an eroding road embankment, small population, characteristics of its life cycle (period of dormancy when its presence is not evident, short flowering period, and association with soil fungi) the species is highly vulnerable to disturbance.

Threats to the population of *Corunastylis ectopa* are:

(a) **Erosion**: The embankment near where the population is located has eroded in the past with the loss of plants (Jones 1999). The embankment appears to have been relatively stable following the bushfire of 2003 and subsequent rainfall (Milburn and Rouse 2004).
(b) **Roadworks**: The site of the orchid is close to a road. Roadworks such as widening, realignment, new drainage, regrading of the embankment and bulldozing of firebreaks could have serious impacts on the population or even result in its destruction.
(c) **Shrub growth, weed invasion**: The orchid grows in a disturbed roadside area subject to shrub regrowth. Weed invasion has not been significant to date (careful use of herbicides and physical removal to control shrub growth has been undertaken at the site).
(d) **Herbicides**: Herbicides used to treat shrub regrowth (and potentially roadside weeds) at the *Corunastylis ectopa* site should not come into contact with the orchid plants.
(e) **Illegal collection**: Though there is no evidence for this having occurred to date, it is a potential threat.

3.3 Areas and Populations under Threat

The threats outlined in s. 3.2 apply to the only known population of *Corunastylis ectopa*.

4. Objectives, Performance Criteria and Actions

4.1 Conservation Objectives

The overall objective of this recovery plan is to preserve in perpetuity, in the wild, the only known population of *Corunastylis ectopa*.

A supporting objective is that the habitat of *Corunastylis ectopa* is conserved and managed so that natural ecological processes continue to operate.

Conservation of habitat involves, in particular, management actions to deal with or avoid the potential threats outlined above e.g. ensuring that the site is not deleteriously affected by road works.

While these objectives relate to the five year term of this recovery plan, they are long-term and ongoing.

4.2 Performance Criteria

The following performance criteria are pertinent to the objectives in s. 4.1:

(a) The population of *Corunastylis ectopa* is monitored annually (see below) and is maintained. (Long-term monitoring is required, as the flowering population fluctuates with seasonal conditions.) (Annual/ongoing)
(b) Habitat conditions are monitored annually and are maintained or improved by management or avoidance of potential threats. (Annual/ongoing)

The site of the Brindabella Orchid has been monitored annually since 2008. Monitoring has been a systematic search of the full area where the orchid has been found and counts made of plants observed. The monitoring system was expanded in 2010 into a more systematic transect method. A tape measure was used along the full location of the orchid site and any plants found were recorded along with their life stage. The life stage is the current observation of the plant as: shoot only, with buds, flowers or old flowers. This method will be used again each year.

The survey in 2010 found the highest number of plants ever recorded, and the 2011 survey brought the cumulative number of individual plants recorded to 110. This is due to the high rainfalls in the area during the summers of 2010 and 2011. The number of plants that flower each year is highly seasonally variable.

The Environment and Sustainable Development Directorate has primary responsibility for implementation of the recovery plan and will review progress of the plan initially after three years, using the Performance Criteria above. The review will be reported to the ACT Flora and Fauna Committee.

The primary criterion for the success or failure of this recovery plan is the maintenance *in situ* of the population of *Corunastylis ectopa* in the ACT.

4.3 Recovery and Threat Abatement Actions (including Management Practices)

Management of the site of the population of *Corunastylis ectopa* will be undertaken in the context of the *Namadgi National Park Plan of Management 2010* (ACT Government 2010), in particular, its native vegetation objective and strategies (Chapter 5, Objective 5.9: *Vegetation is managed to retain a high level of ecological integrity across representative communities, successional stages and age classes*).

With regard to vegetation management, the plan of management gives the highest priority to vegetation communities of regional significance, especially threatened communities and species. The plan notes that Action Plans (ACT) and Recovery Plans (Commonwealth) for threatened species provide authoritative guidelines. Actions for vegetation management include: (a) the use of environmental assessment to manage development activities that have a potential to affect native vegetation; (b) undertaking a systematic research and monitoring program to identify specific management requirements for species and communities; and (c) avoidance of disturbance to sensitive vegetation communities and species by visitors and management activities.

Actions in this recovery plan will provide guidance as to the requirements for the conservation management of *Corunastylis ectopa*.

The Environment and Sustainable Development Directorate has overall responsibility for implementing and reporting of this action plan. It is also responsible for research, monitoring and the initiatives relating to *ex situ* conservation.

Parks and Conservation Service in the Territory and Municipal Services Directorate, ACT Government, has responsibility for many of the actions listed below. The involvement of ACT Roads is noted for specific actions.

Information: Survey, Monitoring, Research

1. Maintain alertness to the possible presence of *Corunastylis ectopa* while conducting vegetation surveys in appropriate habitat (ESDD).
2. Continue to monitor flowering of the orchid to provide information and guidance for management (ESDD).
3. Encourage and support research into the biology and ecology of the species, the potential for the propagation of *ex situ* populations, and potential for translocations (ESDD).

Protection and Management

1. Ensure that the orchid population is protected from the impacts of roadworks such as widening, realignment, new drainage, regrading of the embankment and bulldozing of firebreaks. (ESDD, PCS and ACT Roads)
2. Prepare a management plan for the species based on accurate mapping of the location of the plants (ESDD).
3. Investigate and, if desirable and practicable, undertake appropriate works to stabilise the embankment near the *Corunastylis ectopa* population. (ESDD< PCS and ACT Roads)
4. Coordinate, and provide guidance for management actions undertaken as part of the management of Namadgi National Park (ESDD, PCS).
5. Undertake shrub and weed control in the orchid habitat, as required. Provide advice to contractors and park staff on appropriate herbicide use at the site. Herbicides should not come into contact with the orchid plants (PCS).
6. As the area is located on a roadside, maintain and update, as required, existing 'Roadside Conservation Area' signs, without identifying specific details about the site (PCS).
7. Based on the results of research, evaluate and, if feasible, undertake the establishment of *ex situ* populations of the species (ESDD).

5. Duration of the Recovery Plan and Estimated Costs

The recovery plan is for a period of five years.

6. References

ACT Government 2010. *Namadgi National Park Plan of Management 2010* (Department of Territory and Municipal Services, Canberra).

Jones DL 1988. *Native Orchids of Australia* (Reed Books, Frenchs Forest, NSW).

Jones DL 1999. *Genoplesium ectopum* (Orchidaceae), an Endangered New Species from the Australian Capital Territory, *The Orchadian* 12(12): 570–573.

Jones DL, Clements MA, Sharma IK, Mackenzie AM and Molloy BPJ 2002. Nomenclatural Notes Arising from Studies into the Tribe Diurideae (Orchidaceae), *The Orchadian* 13(10): 437–468.

Milburn PJ and Rouse DT 2004. Nomination of *Corunastylis ectopa* (D.L. Jones) D.L. Jones *et* M.A. Clements for consideration as an endangered species in the Australian Capital Territory under the *Nature Conservation Act 1980* (A1980–20) (Unpublished, nomination to ACT Flora and Fauna Committee, Environment ACT, Canberra).