



# Recovery Plan for the Long-footed Potoroo (*Potorous longipes*)



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**Cover:** The Long-footed Potoroo *Potorous longipes*  
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# Recovery Plan for the Long-footed Potoroo (*Potorous longipes*)

## Executive Summary

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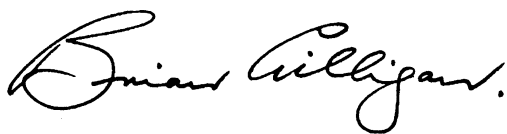
This document constitutes the formal New South Wales Recovery Plan for the Long-footed Potoroo *Potorous longipes*, and as such considers the conservation requirements of the species across its known range within the State. It identifies the actions that will be undertaken to attempt to ensure the long-term viability of the species in nature and the parties who will carry these out.

The Long-footed Potoroo is listed as Endangered (Schedule 1, Part 1) on the NSW *Threatened Species Conservation Act 1995* and Endangered on the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*. The species is a medium-sized (1.5 to 2.3 kg body weight) ground-dwelling marsupial, with grey-brown fur above and grey fur underneath. It is larger than the related Long-nosed Potoroo (*P. tridactylus*), with proportionately longer hind feet, and moves with a bi-pedal hop. A specialist mycophagist (fungus-feeder), the Long-footed Potoroo consumes a large quantity and diversity of hypogeous (underground-fruited) fungal fruit-bodies throughout the year.

The species has an extremely limited range in New South Wales. It is apparently restricted to damp and wet sclerophyll forest communities within South East Forests National Park in the south of the State. While no animals have ever been live-captured, intensive hair-sampling tube and predator-scat based surveys have recorded the Long-footed Potoroo in a small number of discrete localities. Collectively, these records do not allow for even a crude estimate to be made of total population numbers. The species may also occur in adjacent State Forest and private land, but this remains to be determined.

Perceived short-term threats to survival of the Long-footed Potoroo in New South Wales include predation by dogs and foxes, inappropriate disturbance to the small amount of habitat in which it is known to occupy, and competition for fungal food resources with the feral pig. Over and beyond these immediate threats, the long-term viability of the species in the wild is still doubtful given the extremely limited area over which it is found and the consequent potential for population extinction. In view of these combined factors, the current recovery plan maintains a pragmatic approach to conservation of the Long-footed Potoroo in the wild. Over the next five years, key recovery actions will include: (i) expansion of an existing intensive introduced predator control program over the entire known range of the species, (ii) development of a monitoring program to assess the efficacy of the introduced predator control program in terms of impact on target animals and benefit to non-target species such as the Long-footed Potoroo, (iii) creation of a spatial database which identifies the mosaic of key micro-habitats for the species across its known range, leading to more refined approaches to future protection, maintenance and enhancement of those areas (ie. primarily through development of a targeted prescribed burning strategy), and (iv) investigation of land adjacent to the known distribution to determine its value as habitat for the species, and if required, negotiation for a sympathetic management regime on such land. In addition to these key actions, the plan advocates a number of research activities that may lead to better understanding of the ecology and conservation requirements of the Long-footed Potoroo and its food resources.

It is intended that this recovery plan be implemented over a five-year period, by which time the success (or otherwise) of the intensive introduced predator control, habitat enhancement, research and survey programs will be known. Actions identified in this recovery plan will be undertaken by the New South Wales National Parks and Wildlife Service and consultants as necessary, using existing resources.



**BRIAN GILLIGAN**  
Director-General



**BOB DEBUS MP**  
Minister for the Environment

## **Acknowledgments**

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The authors would like to thank all current and previous members of the State Recovery Team from the NPWS, State Forests of NSW, Harris-Daishowa Pty Ltd, the South East Forests Alliance and Environment Australia. Stuart Cohen, Senior Public Affairs Officer with NSW NPWS Southern Directorate, provided information on previous media activities relating to conservation and management of the Long-footed Potoroo. Lorraine Oliver, Threatened Species Education Officer with the same organisation, prepared Figure 1.

## 1 Introduction

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Of the ground-dwelling mammals in Australia, members of the rat-kangaroo family (Marsupialia: Potoroidae) are among the poorest known (Claridge and Barry 2000). This is of increasing concern since, like many of the small to medium-sized marsupials on the continent, representatives of the taxonomic group have undergone several species extinctions, and contractions in species distribution since European human settlement. This effect has been apparent Australia-wide, but particularly evident in southern New South Wales where three species of rat-kangaroos have become extinct within the last century (Brush-tailed Bettong, *Bettongia penicillata*; Rufous Bettong, *Aepyprymnus rufescens*; Tasmanian Bettong, *Bettongia gaimardi*; see Lunney 1989 and Dickman 1994). Today, only two rat-kangaroo species remain extant in this geographic area, the critically endangered Long-footed Potoroo, *Potorous longipes*, and its congener, the relatively more common Long-nosed Potoroo (*P. tridactylus*).

Despite intensive survey over much forested land, no live captures of Long-footed Potoroo have ever been made in New South Wales. Instead, the only evidence of the species has come from hairs of live animals left in hair-sampling tubes (see Scotts and Craig 1988), or from hair and bone remains of animals found in the scats (droppings) of introduced dogs and foxes. Given this information, it is difficult to make any firm statement about the exact conservation status of the species in the State, let alone estimate the size of extant populations. Regardless, the overall paucity of records reinforces the notion that the Long-footed Potoroo has both a severely restricted distribution and occurs at a very low density. Given these attributes, the species may be prone to (at least) localised extinction when faced with unfavourable changes to habitat. Elsewhere, relatively secure populations of the species occur in two regions of Victoria, but even there little is known about how populations are changing over time (see Saxon *et al.* 1994; Jones and Johnson 1997).

This document constitutes the formal New South Wales State Recovery Plan for the Long-footed Potoroo and as such considers the conservation requirements of the species across its known range in the State. It identifies the actions to be taken to attempt to ensure the long-term viability of the species in nature and the parties who will carry these out. The attainment of this Recovery Plan's objectives is subject to budgetary and other constraints affecting the parties involved. It may also be necessary to amend the plan in the event of new information or following recommended changes to the Recovery Program by

the associated Recovery Team. The information contained within is accurate to May 2002.

## 2 Legislative Context

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### 2.1 Legal Status

In view of its extremely limited distribution within the State, the Long-footed Potoroo is considered endangered and is listed on Schedule 1 of the *Threatened Species Conservation Act 1995* (the TSC Act).

In Victoria, the species is considered Threatened under the *Flora and Fauna Guarantee Act 1988* (Scientific Advisory Committee 1991). At a National level it is listed as Endangered under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

A recent revised assessment of the conservation status of the Long-footed Potoroo according to IUCN (1994) criteria listed the species as Endangered (ANZECC 1999). The species is considered a Priority A Vertebrate on the Priority Lists prepared by the Endangered Species Advisory Committee (ESAC) for the Biodiversity Group of Environment Australia.

Among the consequences of listing as a threatened species on the TSC Act are that a recovery plan must be prepared, that consideration be given to the species in assessing the impacts of developments and activities with the aim of minimising adverse impacts, and that actions that are likely to result in the harming or picking of that species or damage to its habitat are licensed.

### 2.2 Recovery Plan Preparation

The TSC Act requires that the Director-General of National Parks and Wildlife prepare recovery plans for all species, populations and ecological communities listed as endangered or vulnerable on the TSC Act schedules. Similarly, the EPBC Act requires the Commonwealth Minister for the Environment to ensure the preparation of a recovery plan for nationally listed species and communities or adopt plans prepared by others including those developed by State agencies. Both Acts include specific requirements for matters to be addressed by recovery plans and the process for preparing recovery plans.

This recovery plan has been prepared to satisfy the requirements of the TSC Act, but since it does not cover the full range of the species within Australia it may not meet all the requirements of the EPBC Act. To that latter end a National Recovery Plan for the species has already been drafted and is currently

awaiting adoption by the Commonwealth Minister for the Environment (Natural Resources and Environment 2000).

### 2.3 Recovery Plan Implementation

The TSC Act requires that a public authority must take any appropriate measures available to implement actions included in a recovery plan for which they are responsible. Public authorities and councils identified as responsible for the implementation of Recovery Plan actions are required by the TSC Act to report on measures taken to implement those actions. In addition the TSC Act specifies that public authorities must not make decisions that are inconsistent with the provisions of the plan. The only public authority responsible for the implementation of this recovery plan is the New South Wales National Parks and Wildlife Service (NPWS).

The EPBC Act specifies that a Commonwealth agency must not take any action that contravenes a recovery plan.

### 2.4 Relationship to other legislation

The lands on which the Long-footed Potoroo is known to occur include those that are owned or managed by the NPWS. Relevant legislation includes:

- *National Parks and Wildlife Act 1974* (NSW)
- *Environmental Planning and Assessment Act 1979* (NSW)
- *Rural Fires Act 1997* (NSW)
- *Environmental Protection and Biodiversity Conservation Act 1999* (Commonwealth).

The interaction of these Acts with the TSC legislation is varied. The most significant implications are described in Section 2.5 below.

If, at a later time, the species is located on State Forest or private lands the provisions of other Acts may become relevant. These Acts include the *Forestry Act 1912*, the *Native Vegetation Conservation Act 1997* and the *Plantations and Reafforestation Act 1999*.

### 2.5 Environmental Assessment

The TSC Act amendments to the environmental assessment provisions of the *Environmental Planning and Assessment Act 1979* (EP&A Act) require that consent and determining authorities (the Director-General of the National Parks and Wildlife in the case of NPWS estate) consider relevant recovery plans when exercising a decision making function under Parts 4 and 5 of the EP&A Act. Decision makers must consider known and potential habitat, biological and ecological factors, and regional significance of

individual populations. In New South Wales, the only public authority that has a decision-making function in relation to the Long-footed Potoroo is the NPWS. Activities as defined under the EP&A Act require the approval of the Director-General. Any other action not requiring approval under the EP&A Act, and which is likely to have a significant impact on the species, requires a Section 91 licence from the NPWS under the provisions of the TSC Act. Such a licence can be issued with or without conditions, or can be refused. Additional public authorities may have a decision-making function if the species is located in other areas (land tenures) in the future.

As the Long-footed Potoroo is listed nationally under the EPBC Act, any person proposing to undertake actions likely to have a significant impact on the species should refer the action to the Commonwealth Minister for the Environment for consideration. The Minister will then decide whether the action requires EPBC Act approval. This is in addition to any State or Local Government approval requirements specified above for the New South Wales EP&A Act. Administrative guidelines are available, from Environment Australia, to assist proponents in determining whether their action is likely to have a significant impact.

In cases where the action does not require EPBC Act approval, but will result in the death or injury of a Long-footed Potoroo and the animal is in, or on a Commonwealth area, a permit issued by the Commonwealth Minister for the Environment under the EPBC Act, will be required. The Commonwealth Minister for the Environment can also delegate the role of assessment and approval to other Commonwealth Ministers under a Ministerial Declaration and to the States and Territories under bilateral agreements. At the time of writing the bilateral agreement between NSW and the Commonwealth has not been completed, but when in place the agreement will avoid the need for duplication of environmental assessment.

### 2.6 Critical Habitat

The TSC Act makes provision for the identification and declaration of Critical Habitat. Under the TSC Act, Critical Habitat may be identified for any endangered species, population or ecological community. Once declared, it becomes an offence to damage Critical Habitat (unless the TSC Act specifically exempts the action) and a Species Impact Statement is mandatory for all developments and activities proposed within Critical Habitat. To date, Critical Habitat has not been declared for this species under the TSC Act. The declaration of critical habitat is not considered to be a priority for the Long-footed Potoroo, as other mechanisms provide for the protection of this species. As the habitat of the species is only currently known to occur on land managed by the NPWS, the type of developments or activities

which are likely to occur are limited by the provisions of the *National Parks and Wildlife Act 1974* (NP&W Act) and subsequent amendments to that Act.

Under the EPBC Act Critical Habitat may be registered for any nationally listed threatened species or ecological community. When adopting a Recovery Plan the Commonwealth Minister for the Environment must consider whether to list habitat identified in the Recovery Plan as being critical to the survival of the species or ecological community. It is an offence under the EPBC Act for a person to knowingly take an action that will significantly damage critical habitat (unless the EPBC Act specifically exempts the action). This offence only applies to Commonwealth areas. However, an action that is likely to have a significant impact on a listed species is still subject to referral and approval under the EPBC Act. This recovery plan identifies those habitat features currently known to be critical to the survival of the Long-footed Potoroo in New South Wales, as required by the EPBC Act.

### 3 Species Information

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#### 3.1 Description

The Long-footed Potoroo is a medium-sized (1.5 to 2.3 kg body weight) ground-dwelling marsupial, with grey-brown fur above and grey fur underneath. It is larger than the related Long-nosed Potoroo (*P. tridactylus*), with proportionately longer hind feet. Like the Long-nosed Potoroo, the Long-footed Potoroo moves with a bi-pedal hop. Of particular note, the species has 24 chromosomes, which differs markedly from the 12 (female) and 13 (male) chromosomes found in its closest extant relative (Sinclair and Westerman 1997).

#### 3.2 Distribution

The Long-footed Potoroo was first described as recently as 1980, from specimens collected in East Gippsland, Victoria (Seebeck and Johnston 1980). There are currently three known disjunct sub-populations of the species; one in East Gippsland north-east of Orbost, another in south-eastern New South Wales and a third centred on the Barry Mountains in north-eastern Victoria. A fourth sub-population may exist near Mount Drummer in far eastern Victoria, where part of a potoroo skull was discovered in a predator scat in 1990. A fossil skull has also been found at Yarrangobilly Caves, south-west of Canberra (Seebeck 1992a), and a museum specimen collected last century has its location as 'near Rosedale', which is in central Gippsland (Seebeck and Johnston 1980). These latter records indicate that the species was probably more widespread in the recent (geological) past.

The East Gippsland sub-population appears to be the most extensive, with 45 separate sites known from an area of about 1120 square kilometres in the catchments of the Brodribb, Bemm, Rodger and Yalmy Rivers. These sites may be grouped into approximately twenty discrete colonies. The continuity between these colonies is currently unclear.

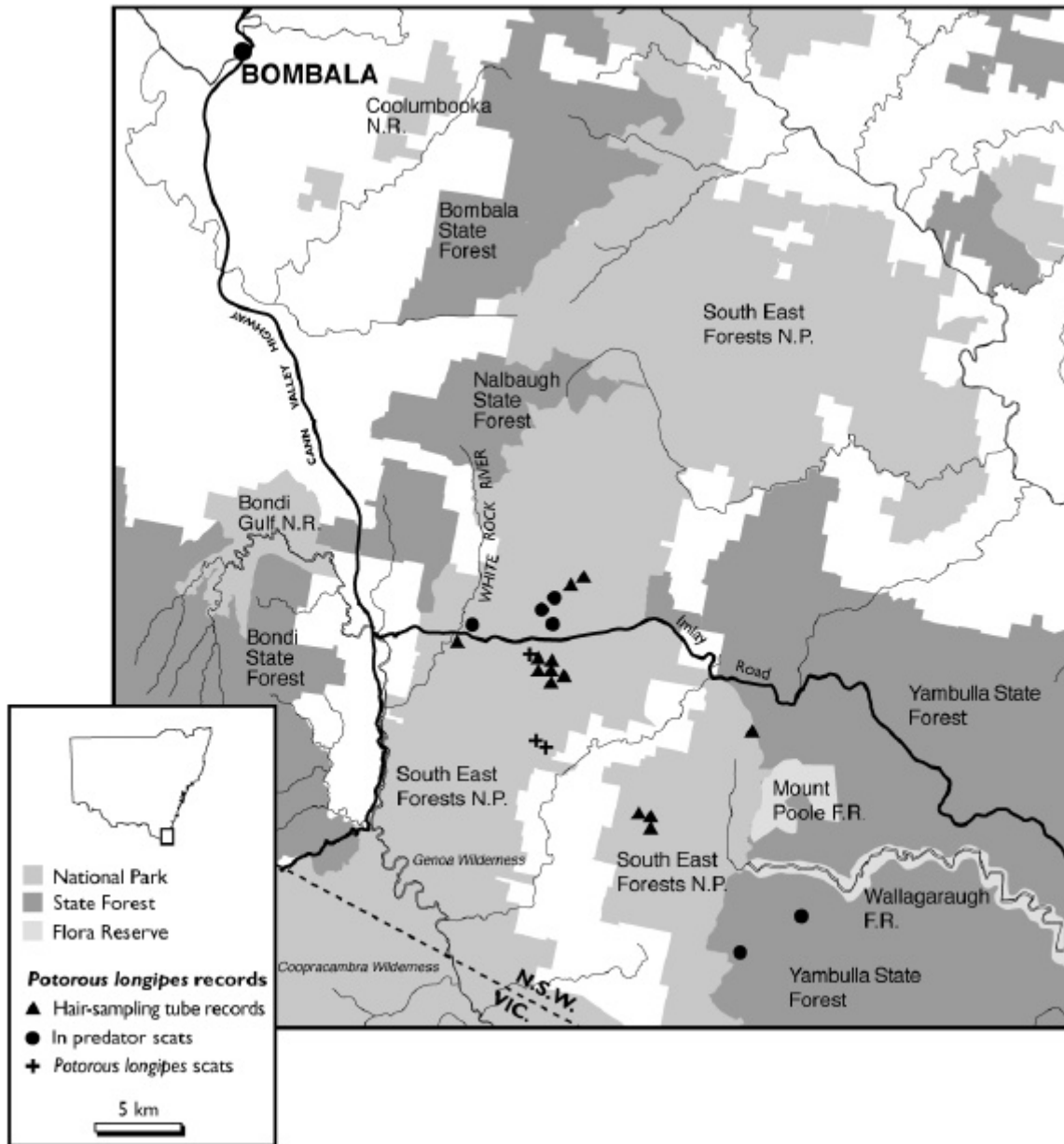
The north-eastern Victorian sub-population, only discovered in 1995, currently comprises 35 sites concentrated in the West Buffalo, East Riley and Tea Tree Range areas of the Barry Mountains. The current known range of the species in north-eastern Victoria is approximately 510 square kilometres (Jones and Johnson 1997; Jones 1999).

No animals have been live-captured in south-eastern New South Wales, with only 17 definite records obtained from a combination of introduced predator scats and (mainly) hairs from hair-sampling tubes (Scotts and Craig 1988; Broome *et al.* 1996; Figure 1). These records are mostly distributed across the Genoa and Waalimma sections of South East Forests National Park in the south-eastern corner of the State, with the exception of two records of the species obtained from remains in introduced predator scats collected in adjacent Yambulla State Forest. The apparent range of this sub-population is approximately 200 square kilometres. Within this range, the sub-population appears to be at very low density, presumably reflecting habitat which is more marginal than in Victoria (Broome *et al.* 1996).

#### 3.3 Current Conservation Status

To-date, live Long-footed Potoroos have only been detected in New South Wales using hair-tube sampling (Saxon and Pascoe 1989; Saxon and Noble 1993; Broome 1994, 1995). While this technique has proven useful in recording the species at a small number of discrete localities, as yet it provides no indications on the number of individual animals encountered. During the period 1990-1994, several major attempts to live-trap the species were made (see Broome 1994, 1995; Broome *et al.* 1996), but despite this effort no individuals were caught. As such, the total number of animals in the State cannot be determined with any degree of accuracy.

However, based on the low encounter rate of the species in intensive hair-tube surveys, it is clear that the Long-footed Potoroo is extremely rare, probably numbering less than a few hundred individuals (Saxon and Claridge 1995). This figure is well below the minimum number suggested for the long-term viability of animal populations (Soulé 1987).



**Figure 1.** Map of southern New South Wales illustrating sites at which the Long-footed Potoroo has been recorded.

The unsuccessful re-surveying of sites where the species was originally detected in hair-tubes (see Broome *et al.* 1996) is of greatest concern. These results may be interpreted in several ways. The simplest interpretation is that hair-sampling tubes do not reliably census animals, and there is some recent data to support this notion (Mills 2001). On the other hand, if hair-sampling tubes are effective censusing tools, then the lack of success in the repeat surveys might reflect either the extremely low density of animals, their mobility or non-fidelity to a given area, or given a worse-case scenario the recent extinction of populations.

Whatever the true situation, it is clear that as a specialist mycophagist, habitat for the Long-footed Potoroo is, and presumably always has been (in recent geological times), limited. This is reflected in the Potoroo is, and presumably always has been (in recent geological times), limited. This is reflected in the patchiness with which populations occur across the south-eastern Australian mainland.

### 3.4 Land Tenure

All known records of live Long-footed Potoroos in New South Wales occur within the boundaries of the South East Forests National Park. The security of this



National Park tenure is governed by the provisions of the NP&W Act. The land is zoned 8a - National Park. Remains of the species have also been obtained from scats of introduced predators in adjacent Yambulla State Forest, but to-date follow-up survey has revealed no live specimens.

### 3.5 Habitat

Across its Australian geographic range, the Long-footed Potoroo has been recorded in a variety of forest types, from dry sclerophyll forest interspersed with warm temperate rainforest at altitudes as low as 150 m (ASL) in East Gippsland, to montane forest at altitudes greater than 1200 m (ASL) in north-eastern Victoria (Saxon *et al.* 1994; Jones and Johnson 1997).

Robinson (1991) described the floristic diversity at 10 forest sites where the Long-footed Potoroo had been previously recorded in East Gippsland: this analysis indicated that the species occurred in a range of floristically heterogeneous plant associations, predominantly within 'wetter' vegetation communities. These vegetation communities were considered widespread in south-eastern mainland Australia (Robinson 1991). However, they are more restricted within the known range of the species in New South Wales, predominantly occurring in riparian areas (Saxon and Claridge 1995). Overstorey plant species in known Long-footed Potoroo localities in the State include Lilly Pilly (*Acmena smithii*), Messmate (*Eucalyptus obliqua*), Mountain Grey Gum (*E. cypellocarpa*), Brown Barrel (*E. fastigata*) and Blackwood (*Acacia melanoxylon*). Plant species commonly comprising the understorey at these sites include Forest Wire-grass (*Tetrarrhena juncea*), Red-fruit Saw-sedge (*Gahnia sieberiana*), other sedges (*Carex* and *Cyperus* spp.) and various ground ferns.

A more recent analysis of factors influencing the distribution of the Long-footed Potoroo across its East Gippsland range failed to identify any clear patterns in relation to occurrence of animals (Lewis and Thulin 1995). Instead, the work merely reaffirmed the notion that the species is found across a broad array of vegetation types. Part of the difficulty in making any rigorous attempt at modelling habitat of the Long-footed Potoroo, as has been recently done for other critical-weight-range ground-dwelling mammals (Claridge and Barry 2000), is the lack of surveys which have sampled the range of environmental gradients across the broader landscape; instead, such surveys have been largely targeted toward perceived favoured habitat types.

In north-eastern Victoria, the pattern of habitat preference among animals is perhaps more clearly defined, although the species has been recorded across a broad range of vegetation types (Jones 2000). During surveys conducted in 1998 and stratified by vegetation type, the Long-footed Potoroo was recorded

in riparian forest, wet forest, damp forest, herb-rich foothill forest, shrubby dry forest, montane damp forest, montane dry woodland. Notably, all positive localities for the species occurred in close proximity to damp forest types, supporting earlier suggestions by Jones and Johnson (1997) that such vegetation may form an integral component of habitat for the Long-footed Potoroo.

Too few records of the Long-footed Potoroo in New South Wales exist to attempt any form of rigorous habitat modelling. In any case, the biased approach to surveying for the species in that State (Norton and Saxon 1991), in keeping with the history of survey in East Gippsland, means that the results of any such analysis would be clouded by the relatively limited array of habitats in which sampling took place.

Details on micro-habitat usage by the species come from studies undertaken in Victoria. There, within a given forest catchment site, the Long-footed Potoroo appears to forage over a range of aspects and topographies (Hill and Triggs 1985; Scotts and Seebeck 1989; Green *et al.* 1998). From limited radio-tracking data recorded near Bellbird, East Gippsland, Hill and Triggs (1985) established that a single adult male animal ranged between drainage lines, slopes and ridges. However, they were unable to determine what proportion of time the animal spent foraging in each topographic location. In a more intensive study nearby (Bellbird Track), Scotts and Seebeck (1989) determined, from trapping records, seasonal differences in microhabitat use by the species. In the drier spring and summer months, individuals were caught more frequently in the relatively moister gully environments dominated by warm temperate rainforest. In contrast, in the wetter autumn and winter months, individual Long-footed Potoroos were caught more frequently in mid-slopes and lower slopes in habitats dominated by wet and damp sclerophyll forest. In upper-slope areas, dominated by dry sclerophyll forest, few individual were trapped all year round. Without supportive data, Scotts and Seebeck (1989) hypothesised that the differential seasonal use of microhabitat by the Long-footed Potoroo population was in some way related to the differential seasonal abundance of fruit-bodies of hypogeous fungi.

More recent studies at Bellbird Track by Green *et al.* (1998) have revealed a different pattern of microhabitat usage by the Long-footed Potoroo. Using a combination of live-trapping and radio-tracking, these researchers found that individual animals utilised habitat across the catchment, with most captures being made in dry habitats on upper slopes. Furthermore, unlike Scotts and Seebeck (1989) they did not find a seasonal movement of animals from moist to wet habitats from spring to summer. The higher use of drier, more open microhabitats on-site was attributed

to a reduction in introduced predators through an ongoing 1080-poison baiting program.

Green *et al.* (1998) also examined microhabitat use by the Long-footed Potoroo at an old growth forest site in north-eastern Victoria. In keeping with previous findings, they found that animals utilised a wide variety of microhabitats in different parts of the topographic sequence. Dry microhabitats were consistently under-utilised and wet microhabitats over-utilised relative to their overall availability.

Claridge *et al.* (1993a,b,c) provide further supportive evidence that rat-kangaroos and their fungal food resources require habitat across all parts of the topographic sequence. In this series of studies, the seasonal distribution and abundance of forage-diggings of the Long-nosed Potoroo were recorded in relation to the seasonal abundance of hypogeous fungal sporocarps in a forest catchment site near the township of Cabbage Tree, East Gippsland. There, the potoroo population generally foraged about the landscape in response to major fruiting events of certain suites of hypogeous fungi: for example, in one wet winter there was a 'bloom' of fungi in gully sites and the number of diggings of animals increased correspondingly (Claridge *et al.* 1993b,c).

### 3.6 Life History and Ecology

Much of the knowledge about the life history and ecology of the Long-footed Potoroo has been gleaned from studies undertaken at two sites, Bellbird Track and Riley Creek, in East Gippsland and north-eastern Victoria, respectively. While animals at both sites show large similarities in their various behaviours, there are also some noticeable differences. For example, although adult female potoroos at Bellbird Track may give birth to young at any time of the year, there is some evidence to indicate that the percentage of such births peak in the July-September quarter. In contrast, at Riley Creek births are spread more evenly across the seasons (Green and Mitchell 1997). Higher rainfall, with deeper soil and litter layer, may create a more stable fungal food supply at this site, accounting for aseasonal reproduction.

Pouch life is estimated to be between 140-150 days (Seebeck 1992b). The earliest age at which a pouch young was recorded out of the pouch is 113 days. Young remain at-heel until they become independent at about 20 weeks of age. Thereafter, they may remain within their natal territory for at least 12 months before dispersing (Green and Mitchell 1997). Sexual maturity is reached at about two years of age (Seebeck 1992b). Expected life span in the wild is not known, although both male and female individuals have been known to live beyond 14 years in captivity.

At Bellbird Track, home range of adult animals vary from 22 to 60 ha, with home ranges of males being larger than females, while at Riley Creek home ranges

vary from 14 to 23 ha (Scotts and Seebeck 1989; Seebeck *et al.* 1989; Green *et al.* 1998). Home ranges of juveniles lay within those of their parents. Long-footed Potoroos show territorial behaviour and appear to be monogamous (Scotts and Seebeck 1989). Males and females may forage in pairs, with the female's home range generally being within the boundary of the male's (Green *et al.* 1998). Little overlap occurs between pairs or between individual adult males. At the apparently more productive Riley Creek site, home ranges for both sexes are smaller and time spent foraging during the night is also less (Green *et al.* 1998). In New South Wales where apparently preferred habitat is far more limited, it could be that home ranges are far larger than those recorded at the two study sites in Victoria. This hypothesis remains to be tested.

The Long-footed Potoroo may depend on fungi as a food source more than any other mammal in Australia (Claridge and May 1994). Over a three-year study at Bellbird Track, fungi comprised an average of 91% of the diet of animals, with invertebrates and plant material making up the remainder. When the fungal component was lower, the proportion of invertebrates in the diet increased (Green *et al.* 1999). Together with other mycophagous (fungus-feeding) mammals, the Long-footed Potoroo may play a significant role in maintaining the health of the forest by dispersing viable spores from the fungal fruit-bodies they eat. These spores pass through the digestive tract of the animals intact, then are voided in the faecal pellets back on to the forest floor, from which they can re-enter the soil and establish mycorrhizal associations with host eucalypt roots. Such associations may benefit plant vigour and development (Claridge *et al.* 1992; Scotts and Seebeck 1989).

While the proportion of fungi to plants and invertebrates in the diet varies little, it is apparent that the spore classes making up the fungal component differ in their contribution over some seasons, years and localities. Climatic patterns have been shown to influence the abundance of fungal fruit-bodies, as well as the occurrence of individual species of hypogeous fungi (Claridge *et al.* 2000a,b). Logging and fire may also influence the diversity of fungi at a site, leading to the dominance of fungal species which may more easily survive desiccation and alteration of the soil/litter layer. The diversity of fungal species in relation to land management practices is an important issue which requires more attention (Claridge *et al.* 1993a).

### 3.7 Ability of Species to Recover

The apparent extreme rarity and limited distribution of the Long-footed Potoroo in New South Wales, coupled with its low fecundity, suggests that recovery of any extant populations to a position of viability in nature is doubtful. Successful recovery of this species, to meet

the criteria of the TSC Act for down-listing, may be dependent on assisted expansion of extant populations, together with the identification and protection of other (as yet unknown) populations.

## 4 Management Issues

As mentioned previously, surveys conducted thus far in New South Wales indicate that the Long-footed Potoroo is extremely rare and has a very restricted distribution, apparently being confined to wet and damp forest types within the South East Forests National Park in the far south-east of the State. Considerable survey for the species has been conducted in adjoining State Forests and, to a lesser degree, on private lands immediately to the east of the Genoa Wilderness. No evidence of an extant population has been collected from these areas although their presence cannot be totally ruled out. Existing threats to the remaining extant population include:

- Predation by foxes and dogs and perhaps cats;
- inappropriate disturbance to habitat resulting in loss of ground cover or diminished food resources;
- competition for food resources with the feral pig;
- extinction of smaller colonies through lack of breeding opportunity or success.

One or more of these factors may have contributed to the apparent rarity of the Long-footed Potoroo in New South Wales, although there is no evidence to suggest that the species was ever common and few data to suspect it was ever widely distributed elsewhere across the State.

### 4.1 Introduced Predators

The Red Fox (*Vulpes vulpes*), Wild Dog (*Canis familiaris*) and Dingo (*Canis lupus dingo*) are recognised predators of the Long-footed Potoroo (Saxon and Pascoe 1989; Scotts and Seebeck 1989; Brown and Triggs 1990; Broome 1996; Jones and Johnson 1997; Jones 1999) and the feral Cat (*Felis catus*) is considered a potential predator (Saxon *et al.* 1994). Of concern, all three predators are common to the environments inhabited by the species. To ensure the persistence and enhancement of populations of the Long-footed Potoroo across its range, the implementation of predator control programs is an essential long-term management strategy. Control of foxes and dogs is most readily achieved by poisoning with 1080 (sodium monofluoroacetate) using the buried-bait technique (Saxon *et al.* 1994). Reducing cat numbers is more problematic, because they rarely take 1080-laced baits. Instead, trapping is commonly utilised.

### 4.2 Inappropriate Disturbance to Habitat

Disturbance events such as logging and fire have the potential to either destroy or detrimentally affect habitat of the Long-footed Potoroo, be that through loss of ground cover vital for nesting and shelter from predators, or through loss of fungal food resources (Saxon and Claridge 1995).

Prior to the establishment of the South East Forests National Park in 1999, the main causes of habitat disturbance within the New South Wales distribution of the Long-footed Potoroo was logging, prescribed fire, and roading associated with those activities. Also, further into the past, there is evidence to suggest that some habitat for the species was subject to grazing (eg. Sheep Station Creek) and alluvial gold-mining (eg. Golden Gully). Just how these disturbance events may have affected the species is unknown.

In Victoria, a number of the sites at which the Long-footed Potoroo occurs have been previously logged (Saxon *et al.* 1994), including the long-term population study site at Bellbird Track. While this suggests that Long-footed Potoroos do utilise regrowth forest, it is unclear whether such areas will support the species throughout the longer-term regeneration process, or whether colonies have declined or increased after logging.

Other data suggest that the species may benefit from absence of logging disturbance. At Riley Creek in north-eastern Victoria, where the forest structure mainly includes mature, multi-aged and old-growth elements, Long-footed Potoroo colonies reach their highest known densities. Animals within these colonies are more fecund, forage for shorter periods of time and have smaller home ranges (Green and Mitchell 1997; Green *et al.* 1998). Moreover, elsewhere there is some evidence to suggest that regrowth forests provide a lesser diversity and abundance of hypogeous fungi, the primary food resource of the species (Claridge *et al.* 1993a, 2000a). However, to facilitate informed forestry management planning, it is clearly important that the effects of logging on the Long-footed Potoroo and its habitat are better clarified.

The impact of fire regime (the frequency and intensity of fires) may also be very important to conserving the species. A given fire regime will have both an impact on habitat structure and food availability. Additionally, severe fire events have the potential to kill individual potoroos and destroy colonies. Few of the currently known localities for the species have experienced extensive wildfire within the last 15 years, though all the known sites in regrowth forest in East Gippsland were subject to intensive slash burns after harvesting. Current policy is to avoid prescribed burning at known sites, but the necessity to do this, or

the way in which fire should be applied to maintain and possibly enhance habitat, is largely unexplored.

### 4.3 Competition for Food Resources

Dietary studies have indicated that the feral Pig (*Sus scrofa*) consumes a wide diversity and large quantity of fruit-bodies of hypogeous fungi (see Claridge and May 1994). This species is common across much of the forest in which the Long-footed Potoroo occurs in New South Wales, and could therefore be viewed as a competitor for a (sometimes) limited food resource. In addition, in foraging for this and other food resources, pigs cause much damage to the surrounding ground cover and leaf litter/soil layer. Reducing the number of these animals in the South East Forests National Park is a priority for NPWS, as it is for SFNSW and landholders on adjacent State Forests and private tenures, respectively.

### 4.4 Population Extinction Processes

Available data suggests that the Long-footed Potoroo occurs at extremely low densities across its limited New South Wales distribution. Currently, there is no evidence to suggest that sufficient habitat linkages exist to ensure interbreeding between colonies of animals, if they still exist. Such a metapopulation structure is suspected to occur among sub-populations in both north-eastern Victoria and East Gippsland, although evidence to show true interbreeding links between colonies does not exist (Natural Resources and Environment 2000). In the long-term, isolated colonies are presumably prone to extinction if opportunities for successful breeding are limited and as the age structure of the population shifts predominantly to older animals. This effect may be exacerbated given the (relatively) low fecundity of the species in marginal or less productive habitat types (Green and Mitchell 1997). Over and beyond this problem, the scarcity of records of the Long-footed Potoroo in South East Forests National Park indicates that the overall sub-population number may be well below that considered to be viable over evolutionary timescales (Soulé 1987). Understanding how preferred habitats are linked across the landscape in space and time is key to conservation management of the species over the medium- to long-term.

## 5 Previous Recovery Actions

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### 5.1 Survey

In New South Wales four major survey efforts for the Long-footed Potoroo have been conducted, each focussed in southern New South Wales close to the Victorian border. This broad geographic area is thought to contain all of the potentially suitable habitat for the species within the State.

The first targeted survey for the species in the State was conducted by Dovey (1987). This survey took place during 1986 within the catchment of Sheep Station Creek, Bondi State Forest, south-east of the township of Bombala. This area was the focus of the survey because it was predicted by the computer-based program BIOCLIM to be climatically suitable for the species, on the basis of known site records from adjacent East Gippsland. The methodology behind BIOCLIM is described in detail by various authors (ie. Busby 1986; Nix 1986). At the time, Dovey (1987) conducted live-trapping and predator scat-based surveys across the small area of predicted habitat in New South Wales. Positive evidence of the species' presence came in the form of jaw and teeth remains in a fox scat.

In July 1989, wildlife researchers from the (then) Victorian Department of Conservation, Forests and Lands recorded the first evidence of 'live' animals in New South Wales, from hairs obtained in two hair-sampling tubes, again in Sheep Station Creek. These researchers also surveyed adjacent State Forests (Coolangubra and Nungatta). Despite intensive hair-sampling tube and additional live-trapping effort, no further records of the species were obtained (Saxon and Pascoe 1989).

The most extensive survey effort for the Long-footed Potoroo in New South Wales was conducted during the period 1991-1995. This survey, which mainly relied again on hair-sampling tubes to detect animals, was principally funded, co-ordinated and conducted by NPWS, with various forms of assistance from SFNSW (documented in Saxon and Noble 1993; Broome 1994, 1995). The area over which surveys took place was defined, largely, by a revised BIOCLIM prediction of the climate envelope of the species based on all records from East Gippsland, plus the two records from New South Wales obtained earlier by Saxon and Pascoe (1989). Within this envelope, the area sampled was further delimited by vegetation type, with focus being given to wet and damp vegetation types. All major drainage lines within this latter area were then censused, at least once and on up to five separate occasions, by hair-sampling tubes. The survey also included apparently (visually) suitable habitat approximately 50 km to the south-east in Bruces Creek State Forest Nadgee State Forest and Nadgee Nature Reserve. This intensive effort resulted in hairs from the species being recorded from an additional nine discrete localities. Further evidence of the species was obtained as remains in predator (dog and fox) scats in the same general area.

In 1997 the NPWS undertook a live-trapping survey for the species within Kosciuszko National Park, well to the west of earlier survey efforts. The survey focussed on 'visually suitable' habitat types on the

western side of the main range, falling within the latest BIOCLIM predicted envelope (Ken Green, Fauna Conservation Officer, NPWS, pers. comm.). Despite considerable effort, no captures of the target species were made although many forage-diggings attributed to the Long-nosed Bandicoot were observed.

Recently, NPWS in collaboration with SFNSW and local residents, conducted an intensive hair-tube sampling survey for the Long-footed Potoroo in the southern portion of Yurammie State Forest. The impetus for this survey was provided by a sighting of an unidentified 'rat-kangaroo' in early January 1999. Despite a major localised sampling effort that March (Saxon 1999), and a repeat survey in October of the same year (Mills 2001), no physical (diagnostic hairs) evidence of the species was recorded. However, hair and bone remains of the related Long-nosed Potoroo were recorded from within a single fox scat collected from the general survey area at the same time. At this stage no further targeted survey in this area, which lies to the north-east of the current known distribution of the species, is planned.

SFNSW also have an ongoing obligation to undertake pre-logging survey for the species on State Forest tenures within the previously determined Long-footed Potoroo Management Zone (as defined by Saxon and Claridge 1995). The conditions of survey are outlined in the Integrated Forestry Operations Approval for the Eden Region (New South Wales Government 1999 – see Appendix B 'Terms of Licence under the *Threatened Species Conservation Act 1995*'). Where the species is found, SFNSW and NPWS must then develop a joint management strategy. As the compartments within the previously determined Potoroo Management Zone were logged during 2001, pre-logging surveys are not required during the first lifetime of this recovery plan.

## 5.2 Research and Monitoring

As stated elsewhere in this plan, much that is known about the biology of the Long-footed Potoroo has come from studies conducted at two sites in Victoria (see Section 3 and 4 above). These various studies have provided valuable information on the general life history, population dynamics, social and home range behaviour, and dietary ecology of the species.

In New South Wales, the absence of 'live-captures' of the Long-footed Potoroo has prohibited similar information being obtained. Instead, that which is known about the species from within the State comes from interpretation of survey data, mainly in the form of point locality records of the species from hair-sampling tubes or from remains in predator scats. For example, Neave *et al.* (1994) attempted to identify factors of habitat influencing the occurrence of hair-tube records of Long-footed Potoroos obtained during broadscale surveys in the early 1990s (Saxon and

Noble 1993; Broome 1994, 1995). Unfortunately, too few records of the species were obtained to analyse the data in any meaningful way. In any case, the survey effort was biased in such a way as to not equitably sample the full range of habitats present across the broader landscape.

Attempts have been made to try and improve the rate at which the species is detected in surveys by testing variously modified hair-sampling tubes. In captivity (penned animals in Healesville Sanctuary), certain types of hair-sampling tubes were found to better capture hair samples from potoroos (Broome 1994, 1995). However, the extremely low detection rate of animals in the field made it impossible to quantify measurable differences in success between hair-sampling tube types in the field. Research on this issue is continuing.

To-date, no systematic monitoring of the species in New South Wales has been undertaken, given the inability to trap animals. Instead, repeat hair-tube sampling surveys have been conducted variously at sites where the species had been previously detected. These repeat surveys have been undertaken at differing intervals over time (Broome 1994, 1995). Collectively, they demonstrate how difficult it is to re-census animals at previously known sites. Why this should be the case is unknown.

## 5.3 Genetic Studies

Recent research undertaken at the University of New South Wales, using hair-samples from Victorian animals either captured in traps or in hair-sampling tubes, has led to better understanding of the genetics of the species (Bill Sherwin, Department of Zoology, University of New South Wales, pers. comm.). Techniques now exist to amplify DNA in such hairs, allowing for more accurate identification of the species than is currently possible using more traditional microscopy techniques (Brunner and Coman 1974). This is particularly the case where the quality and/or quantity of a given hair sample is poor.

DNA amplification from hairs collected in hair-sampling tubes is limited by the field conditions to which those tubes are exposed, as these conditions are conducive to the breakdown of DNA. Currently, DNA amplification is still possible after four days of simulated field conditions. Sex determination from DNA in hair is still being developed, because the type of genes that readily allow sex determination in other marsupials are difficult to amplify reliably in potoroos.

Pending available funding and a representative set of samples, at a National-level there are further plans to better define; (i) the nature of genetic variation within and between the three known sub-populations of Long-footed Potoroo on the south-eastern Australian mainland, as well as (ii) the genetic variation between

individuals within those sub-populations. The latter will guide the development of appropriate geographic units of management, based on measured levels of gene flow. The former will produce important baseline data for checking the success of (future) genetic management, if and when conducted.

#### 5.4 Management

With limited knowledge of the impacts resulting from fire, logging and other disturbances, a conservative approach to management has been taken across all three sub-populations of the Long-footed Potoroo. In East Gippsland and north-eastern Victoria, Special Management Areas (SMAs) are set aside around all positive localities. These SMAs range in size (minimum 150-200 ha) depending on the nature and perceived quality of habitat, but are designed such that they enclose complete sub-catchment units within boundaries on ridges and spurs and crossings of drainage lines at drainage line junctions (see Saxon *et al.* 1994 for description). In doing so, they are presumed to include the full range of micro-habitats utilised by animals at any given site. Within these special management areas, any new roading, prescribed burning and logging activities are prohibited, unless carried out for scientific research purposes. For select SMAs, introduced predator (canid) control work is undertaken on a routine basis. Depending on their juxtaposition to one other, SMAs may be merged to create larger management units, otherwise they are linked by other forms of wildlife protection zones such as riparian buffers. The total area of SMAs in both East Gippsland and north-eastern Victoria is not to exceed 17,500 ha, respectively.

A similarly conservative approach has been taken to management of habitat for the Long-footed Potoroo in south-eastern New South Wales, since the first evidence of live animals was documented in 1989. At that time the land the species was recorded on was State Forest. Extensive hair-tube sampling across other land tenures failed to yield any other records. During the early 1990s an interim management strategy was jointly developed by NPWS and SFNSW, which protected core areas of habitat for the species within the State in a special Potoroo Management Zone (PMZ). The derivation of the boundaries of the PMZ, outlined in Saxon and Claridge (1995), was designed around eight design principles, including: (i) known movement capabilities of the Long-footed Potoroo (including where individuals forage); (ii) perceived population sizes; (iii) apparent habitat connectivity; (iv) preferred home-range of animals, based on Victorian radio-tracking studies; (v) information on dietary ecology of the species; and (vi) anticipated response of the species to habitat disturbance. In keeping with the Victorian approach, management aims of the PMZ included protection from severe wildfire, reduction in the number of introduced

predators, and no logging, fuel-reduction burning or roading activities.

Introduced predator control has been undertaken on an annual basis across the entire PMZ since 1994. This work has been primarily conducted by NPWS, with some assistance from SFNSW (outlined in Broome 1996). The effectiveness of this once-a-year approach is difficult to assess in the absence of any associated monitoring work, although of concern is that the rate at which new records of the Long-footed Potoroo were obtained within the PMZ declined during the mid-1990s, despite increased efforts to try and locate animals (Broome 1994, 1995). Other management activities of benefit to the Long-footed Potoroo during the lifetime of the PMZ included control of feral pig populations, by NPWS and SFNSW.

In 1998 the South East Forests National Park was created. The boundaries of the southern section of this National Park were selected specifically to encompass all areas considered important to the Long-footed Potoroo that were previously within the PMZ. Within this area, NPWS has continued to implement all management activities indicated immediately above.

#### 5.5 Captive Breeding

Husbandry techniques have been developed by the Healesville Sanctuary, where a captive colony of Long-footed Potoroos has been established from East Gippsland founder stock since 1980. Since then, the Sanctuary has assisted with numerous captive-based research projects and the colony has been invaluable for developing and refining radio-tracking, baiting and hair-tube sampling techniques. The colony has also served a critical information and public educational tool.

While the captive program at Healesville has allowed for successful breeding and rearing of progeny in the past, its future existence is tenuous. At present there is only one adult female and one adult male animal. Unfortunately, the female is inbred and both individuals have had significant levels of exposure to Avian Tuberculosis (Rosie Booth, former Head Veterinarian, Healesville Sanctuary, *pers. comm.*). The current objective for the colony, as outlined in the current Draft National Recovery Plan for the species, is to maintain the colony through opportunistic acquisition or injured or orphaned Long-footed Potoroos from the wild (Natural Resources and Environment 2000). Into the future, however, it may be necessary to establish a second captive colony elsewhere. The primary purpose of a such a colony would be to provide a source of animals for re-introduction into suitable habitat in New South Wales, should it become clearer that current wild populations there are no longer viable.

### 5.6 National and State Recovery Processes

A National Recovery Team was established in 1990 to oversee and direct research and management of the Long-footed Potoroo across its entire range. Representatives from the Victorian Department of Natural Resources and Environment (NRE), NPWS, SFNSW, Parks Victoria, Environment Australia (EA), Healesville Sanctuary, University of New South Wales and the Zoological Parks and Garden Board of Victoria are currently represented. The Team has guided the implementation of the National Recovery Plan, a draft version of which has been written according to guidelines specified in the Commonwealth's *Endangered Species Protection Act 1992* (Natural Resources and Environment 2000; note the Act was recently replaced by the EPBC Act). The National Plan broadly outlines the survey, research, monitoring and management actions necessary to improve the conservation status of the species in New South Wales and Victoria. It is yet to be officially approved by the Commonwealth.

A New South Wales State Recovery Team for the Long-footed Potoroo was created in 1996, following gazettal of the TSC Act the year before. Unlike the National Recovery Team, the State team deals specifically with issues relating to conservation and management of the species in New South Wales. Current representatives on the team include NPWS, SFNSW, EA, the South East Forest Alliance and Harris-Daishowa Pty Ltd. The State team has also been involved in the preparation of the current recovery plan.

### 5.7 Public Education and Awareness

In 1986, when the Long-footed Potoroo was discovered in New South Wales, media coverage was initially fairly intense for several reasons. Firstly, it was a newly recorded species for the State, and secondly the habitat in which it was recorded conflicted directly with key timber harvesting areas in (then) State forest. During this initial period, discovery of the Long-footed Potoroo was reported by most metropolitan dailies and electronic news outlets. From 1991-93, when a major survey of the species was underway in the South East Forests, the NSW NPWS sought to develop a higher public profile for the species and used the survey to gain further media coverage – this strategy was largely successful.

News of the survey, the unusual technique of using hair-tube sampling, and the occasional success at locating the species in particular areas, led to extensive publicity regionally and numerous news features in papers such as the *Sydney Morning Herald*, *The Australian* and *GEO Magazine*, as well as a considerable number of television and radio news features over a couple of years.

From this combined media effort, the Long-footed Potoroo gradually developed a public profile which in a way strengthened efforts to ensure its protection.

Since the early 1990s, the level of media publicity for the species has gradually declined, although during 1994 a number of related 'live-to-air' radio interviews were conducted by NSW NPWS officers co-ordinating survey work at that time. Despite this dwindling of publicity, one could reasonably say that many more people now know of the existence and status of the Long-footed Potoroo as a consequence of the considerable mass of earlier media coverage. Most recently, an information profile on the species has been produced and released as part of the NPWS' Threatened Species Information Program (New South Wales National Parks and Wildlife Service 1999). A copy is also available on the NPWS website. The Threatened Species Network has similarly produced a website with a profile of the species

## 6 Proposed Recovery Objectives, Actions and Performance Criteria for 2001-2006

The overall objective of this recovery plan is to improve the conservation status of the Long-footed Potoroo and maximise the opportunity for viability of this species in the wild in New South Wales. This will be done, primarily, by maintaining and (where necessary) enhancing habitat for species across its apparently limited range in the south-eastern corner of the State. In order to achieve this objective a number of actions will need to be carried out. Each of these actions is described immediately below.

### **Specific Objective 1: Control Introduced Predators through Intensive 1080 Poison-Baiting Program.**

Recovery of the Long-footed Potoroo within South East Forests National Park from *in situ* recruitment is extremely unlikely without better control of introduced predator populations. To minimise chances for extinction of the species in the short- to medium-term, an intensive 1080 poison-baiting program will be instigated by NPWS. The primary purpose of the program will be to reduce numbers of dogs and foxes to a level which promotes populations of native ground-dwelling mammals, hopefully including the Long-footed Potoroo. To attempt to measure this latter effect, a monitoring program will be implemented simultaneously, with assistance from wildlife consultants.

While cats are recognised as potential predators of the Long-footed Potoroo, existing techniques for controlling them are inefficient across the broader landscape. Until such techniques are derived, NPWS will continue to control feral cat populations across the range of the Long-footed Potoroo through opportunistic trapping and other appropriate means, as resources permit.

*Action 1.1: Undertake intensive 1080 poison-baiting program across the range of Long-footed Potoroo in South East Forests National Park.*

From 2001 onwards the existing 1080 poison-baiting program for introduced predators will be modified and expanded by the NPWS across the known range of the Long-footed Potoroo within South East Forests National Park. This program will be conducted for the current lifetime of this recovery plan. The method of baiting and its spatial extent will be similar to that already conducted by NPWS during the past six years. The frequency of baiting, however, will be increased in accordance with perceived best-practice methods. Finally, cats will be trapped opportunistically, as resources permit, until such time as more efficient

techniques to control them are derived and can be implemented across the broader landscape.

### *Performance Criterion 1.1*

Within one year, an intensive 1080 poison-baiting program for introduced predators is established across the known range of the Long-footed Potoroo in New South Wales. This program will be documented and then continue for the lifetime of the current plan. Also, within five years, the incidence of introduced predators throughout the range of the Long-footed Potoroo in New South Wales, as indicated by activity on monitoring sand-plots, is negligible.

### *Action 1.2: Monitor response of native-ground dwelling mammals to control of introduced predators.*

A monitoring program will be established across the same area as that where the 1080 poison-baiting program is being conducted for control of introduced predators. The purpose of this program will be twofold: (i) to establish whether the poison-baiting program is reducing the prevalence of introduced predators across the range of the Long-footed Potoroo, and (ii) to determine if native ground-dwelling mammal populations, including that of the Long-footed Potoroo, are increasing in abundance. The primary means of monitoring these responses will be through establishment of a series of sand-plots across various tracks and trails throughout the area where baiting occurs, using the methodology described in Newsome and Catling (1979). The activity of all ground-dwelling mammals (as indicated by diagnostic foot-tracks) will be monitored on these plots twice yearly. These systematic surveys will occur prior to and immediately after each respective poison-baiting session and will be conducted by wildlife consultants in conjunction with NPWS. Sand-plots will be monitored in this fashion throughout the current lifetime of this recovery plan.

Where indicated by results from sand-plot monitoring, additional live-trapping activities will be undertaken to better define which native species are responding to introduced predator control. In instances where such trapping can be shown to accurately define the level of population increase, longer-term monitoring grids may then be established.

### *Performance Criterion 1.2*

Within one year, a monitoring program based largely on the sand-plot technique is established across the known range of the Long-footed Potoroo in New South Wales. This program will be documented and



carried out for the lifetime of the current plan. Also, within five years, the incidence of native ground-dwelling mammals is increased. Additional live-trapping surveys will then be conducted in areas where native ground-dwelling mammals are shown to respond positively to introduced predator control to determine exactly which species are responding.

### **Specific Objective 2: Control Introduced Pigs through Trapping Program.**

Dietary studies reveal that pigs sometimes consume a large diversity and quantity of fruit-bodies of hypogeous fungi. In doing so, they potentially compete with the Long-footed Potoroo for a critical food resource. In addition, when foraging, pigs destroy the soil-litter layer and associated understorey vegetation. At a localised scale, this may also be detrimental to the Long-footed Potoroo because of ground cover (shelter) loss. Minimising the number of pigs across the range of the species may therefore be an important management goal.

Thus far, trapping of pigs by NPWS has proven an efficient means of reducing their incidence at sites with suitable habitat for the Long-footed Potoroo. As such, no alternative means of controlling them is proposed for the first lifetime of this plan, unless the current situation changes.

*Action 2: Implement trapping program for pigs across range of Long-footed Potoroo in South East Forests National Park.*

The current trapping program conducted by NPWS for pigs across the range of the Long-footed Potoroo within the South East Forests National Park will be continued throughout the current lifetime of this recovery plan. Trapping will occur as needed, as indicated by the incidence of activity of these animals. This work will complement similar trapping activities conducted by SFNSW in adjacent State Forest.

#### *Performance Criterion 2*

Within five years, the incidence of pigs across the range of the Long-footed Potoroo within South East Forests National Park is reduced.

### **Specific Objective 3: Define Extent of Suitable Habitat Across Known Distribution of Species and Put in Place Management Activities that Promote Such Habitat.**

At a micro-scale, forested habitat with a well developed understorey is key to the survival of populations of the Long-footed Potoroo. Such ground cover affords shelter and protection from introduced predators. The spatial extent of suitably complex

ground cover across the presumed range of the Long-footed Potoroo in South East Forests National Park is not accurately mapped. Recent technological advances in the use of airborne videography enable such complex habitat to be defined and spatially represented within a GIS-mapping framework (see Catling and Coops 1999). Doing this analysis would allow for a clearer spatial appreciation of the extent of suitable habitat for the species, and identify the juxtaposition of patches of such habitat to one another. Above and beyond this appreciation, the mapping exercise would also provide guidance on how best to protect, maintain and enhance patches of key habitat (high complexity), the manipulation of which could be undertaken through management tools such as prescribed burning. In this regard, a detailed fire management plan for the area over which Long-footed Potoroo habitat occurs needs to be developed. This plan will not only need to take account of the particular needs of that species, but also other responsibilities of the NPWS such as protecting neighbouring properties from the risk of major wildfire.

*Action 3.1: Develop a habitat complexity map across range of Long-footed Potoroo in South East Forests National Park, identifying key habitat for the species.*

A habitat complexity map will be derived for the entire known range of the Long-footed Potoroo within the South East Forests National Park (methodology as detailed in Catling and Coops 1999). This task will be funded by NPWS and conducted by appropriate consultants.

#### *Performance Criterion 3.1*

Within two years, a habitat complexity map covering the known range of the Long-footed Potoroo in South East Forests National Park is produced.

*Action 3.2: Develop and implement a fire management strategy which benefits the protection, maintenance and enhancement of Long-footed Potoroo habitat, while meeting other NPWS obligations in relation to reducing risk of major wildfire events.*

Using the habitat complexity map developed as part of Action 3.1 described above, a fire management strategy will be developed to protect, maintain and enhance key habitat for the Long-footed Potoroo within South East Forests National Park. Where indicated by that map, prescribed burning may then be utilised to: (i) better manage for that habitat, and (ii) help reduce the risk of major wildfire, thereby protecting other values on neighbouring lands.

*Performance Criterion 3.2*

Within three years, a fire management strategy is established which protects, maintains and enhances key habitat for the Long-footed Potoroo within the South East Forests National Park, while reducing the risk of severe wildfire.

**Specific Objective 4: Investigate Potential Values of Adjacent Land Tenures as Habitat for the Long-footed Potoroo.**

Although the known distribution of the Long-footed Potoroo in New South Wales is largely contained within South East Forests National Park, some Crown Leasehold and Private land immediately adjacent to that area may have value as habitat for the species. For example, non-reserved lands may well provide a vital link between patches of occupied habitat to the north and south-east of the overall distribution of the species, respectively. This may particularly be the case where that land is mainly timbered or contains suitably dense ground cover, particularly along drainage lines. Closer inspection and suitable management of these lands may well be integral to future conservation management of the Long-footed Potoroo within the State.

*Action 4.1: Liaise with adjacent landholders and examine potential value of land as habitat for Long-footed Potoroo.*

NPWS will liaise with relevant adjacent landholders and undertake an assessment of the potential value of those lands as habitat for the Long-footed Potoroo. This assessment may involve a combination of on-ground and desktop-type activities (the latter linked in with the habitat complexity modelling described in Action 3.1 above).

*Performance Criterion 4.1*

Within two years, the potential value of adjacent crown leasehold and freehold lands as habitat for the Long-footed Potoroo is evaluated.

*Action 4.2: Where valuable habitat identified, attempt to negotiate a management outcome sympathetic to the conservation requirements of the Long-footed Potoroo.*

In situations where potentially valuable habitat for the Long-footed Potoroo is identified, NPWS will negotiate with relevant landholders to attempt to put in place measures that protect, maintain and enhance such habitat. The mechanisms to do this are varied, but might include negotiation for Voluntary Conservation Agreements, provision of materials for fencing or on-ground support for undertaking useful

management activities (e.g. prescribed burning). Regardless, NPWS will maintain its statutory responsibility (as defined in the TSC Act) to ensure that any other activities proposed on such land are consistent with the conservation requirements for the Long-footed Potoroo.

*Performance Criterion 4.2*

Where valuable habitat is identified, the NPWS will have made all reasonable attempts to negotiate with relevant landholders for best possible outcome in terms of conservation management of the Long-footed Potoroo.

**Specific Objective 5: Identify Other Populations of the Species.**

Despite intensive survey for the Long-footed Potoroo over a large area of the South East Forests, the possibility exists that the species may occur outside of the currently known range. In the past the computer-based climate prediction system BIOCLIM has proven useful in directing survey effort for the species (Dovey 1987). A BIOCLIM-derived prediction for the Long-footed Potoroo has not been conducted for several years, during which time the population in north-eastern Victoria was discovered. A revised prediction, containing these new localities, may well expand the area over which the species might be predicted in New South Wales. If this is the case then further survey may be required to better determine the actual distributional limits. Where the species is then detected, appropriate management regimes may need to put in place.

*Action 5.1: Undertake revised BIOCLIM prediction of the Long-footed Potoroo, using all recorded (Australia-wide) localities of the species.*

Using BIOCLIM, NPWS will develop a revised prediction of the climatic envelope of the Long-footed Potoroo in New South Wales.

*Performance Criterion 5.1*

Within one year, a revised BIOCLIM prediction of the Long-footed Potoroo is developed.

*Action 5.2: Survey all currently non-sampled BIOCLIM predicted areas for the Long-footed Potoroo in New South Wales using appropriate methods.*

NPWS will conduct/coordinate surveys for the Long-footed Potoroo in any BIOCLIM-predicted areas that

have not yet been sampled. Survey techniques will likely involve a combination of live-trapping and hair-tube sampling.

*Performance Criterion 5.2*

Within two years, all non-sampled BIOCLIM predicted areas for the Long-footed Potoroo in New South Wales are surveyed using appropriate methods.

**Specific Objective 6: Undertake Ecological Investigations on Primary Food Resource of Long-footed Potoroo.**

Little is known about the ecology of hypogeous fungi, the fruit-bodies of which form the primary food resource of the Long-footed Potoroo across its south-eastern mainland Australian range (Scotts and Seebeck 1989; Green *et al.* 1999). In particular, the response of these fungi to disturbance such as logging is poorly documented (Claridge *et al.* 2000a,b). Since at least part of the range of the species in New South Wales has been previously logged it would be useful to determine the potential value, as a food resource provider, of stands of various regeneration ages. Documenting the diversity and relative abundance of hypogeous fungi in such stands would enable better understanding of the role of disturbance in creating habitat for the Long-footed Potoroo. This is vital given that such habitats will age in the absence of any further planned disturbance events.

*Action 6: Evaluate diversity and relative abundance of fruit-bodies of hypogeous fungi in stands of different regeneration ages post-logging.*

The diversity and relative abundance of fruit-bodies of hypogeous fungi will be evaluated in previously logged stands of various regeneration ages. To best gauge these responses, any such survey will need to be conducted over at least a three-year period. All sites will be selected within the known range of the Long-footed Potoroo within South East Forests National Park. This work will be conducted by appropriate consultants, but coordinated by NPWS.

*Performance Criterion 6*

Within three years, the diversity and relative abundance of hypogeous fungi within stands of various regeneration ages is measured. Results from this work are then used to implement appropriate on-ground management activities.

**Specific Objective 7: Improve Community Awareness of Conservation Significance of the Long-footed Potoroo.**

To raise community awareness of the conservation significance of the Long-footed Potoroo, this plan recommends that promotion of the species be undertaken through high profile media avenues, and also through the development of an interpretive display at a local NPWS Visitor Information Centre.

*Action 7.1: Instigate a publicity campaign.*

High profile media publicity will be sought as recovery program is implemented.

*Performance Criterion 7.1*

Within two years, at least three high profile media-related activities are undertaken.

*Action 7.2: Develop local interpretive display.*

An interpretive display featuring aspects of the ecology and conservation management of the Long-footed Potoroo will be developed. The most suitable location for this display would be at the NPWS Visitor Information Centre at Merimbula, on the far south-east coast of New South Wales.

*Performance Criterion 7.2*

Within two years, an interpretive display featuring aspects of the ecology and conservation management of the Long-footed Potoroo is installed at the NPWS Information Centre in Merimbula.

**Specific Objective 8: Continuation of Existing State Recovery Team and Interaction with National Recovery Team Where Necessary.**

To facilitate the State-wide recovery effort of the Long-footed Potoroo, the current plan advocates continuation of the existing New South Wales Recovery Team. This team should meet, on an as needs basis, into the future. Otherwise, NPWS will be responsible for administrative issues relating to the New South Wales State-wide recovery effort, including the issue and management of contracts for components of the program and obtaining permits to enable work to proceed. The major cost for management of the program will also be met by NPWS. Other participating agencies will be responsible for their own costs. In addition, members of the State Recovery Team will also contribute to the National Recovery Team and associated process where necessary. This will be relatively straightforward since some members of the State Team are also current members of the National Team.

*Action 8: Maintain State Recovery Team and associated planning processes, and contribute toward National Recovery Team efforts where required.*

The existing State Recovery Team will meet on an as needs basis, and likewise contribute to National Recovery Team meetings/processes where required.

#### *Recovery Criterion 8*

The State Recovery Team meets on an as needs basis, with members contributing to the National recovery process where required.

## **7 Implementation**

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Table 1 allocates responsibility for the implementation of recovery actions specified in this plan to relevant government agencies and/or parties for a period of five years from the time this recovery plan is adopted, and identifies costs associated with each recovery action. The total estimated cost for the implementation of these actions is \$253,500. These funds will be largely provided from externally-funded sources, together with in-kind contributions from NPWS.

## **8 Social and Economic Consequences**

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Since the Long-footed Potoroo is currently only known to occur within South East Forests National Park and no physical changes are proposed, the social and economic impacts of the recovery plan are expected to be few. If, in the future, the species is discovered in adjacent State Forests and/or Private Land, then there may be some economic consequences depending on the management approach taken to these additional localities.

The recovery plan could have social benefits for the general public, increasing awareness of the natural heritage values of South East Forests National Park. This would particularly be the case for recreational users of the Park and adjacent local communities.

## **9 Biodiversity Benefits**

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The widely publicised decline and extinction of a number of medium-sized ground-dwelling mammals in Australia is a cause of serious concern for biodiversity conservation. Better understanding of factors limiting populations of Long-footed Potoroos, together with protection and appropriate management of habitat for the species, will assist in the conservation of other fauna with similar requirements.

Such species include the Long-nosed Bandicoot (*Perameles nasuta*), Long-nosed Potoroo and the Southern Brown Bandicoot (*Isodon obesulus*).

Hypogeous fungi, the primary food resource of the Long-footed Potoroo, are thought to form mycorrhizal associations on the roots of a variety of forest trees and shrubs. Within this symbiosis the fungus takes nutrients and water from the soil, and transfers these to the plant host. Thus, hypogeous fungi are integral to the establishment and growth of forest plants. As a specialist mycophagist, the Long-footed Potoroo is probably the key vector for these fungi in habitats where it forages, and moreover may play a vital role in both regenerating (disturbed) and mature (undisturbed) eucalypt forests (see Claridge *et al.* 1992). Thus, the conservation management of this species and other mycophagous (fungus-feeding) fauna in the areas may help maintain critical ecosystem processes.

Finally, through awareness of the fate of the Long-footed Potoroo the profile of all threatened species will be raised in the general community. This in turn will lead to greater opportunities for the conservation of threatened species and increased protection of biodiversity.

## **10 Preparation Details**

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This Recovery Plan was prepared by Andrew Claridge, Senior Threatened Species Officer, and Michael Saxon, Manager Threatened Species Unit, Southern Directorate (NPWS). This plan is consistent with the National Recovery Plan for the Long-footed Potoroo.

## **11 Review Date**

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Any major changes to this Recovery Plan will require the revised Plan to be placed on public exhibition in NSW and re-approval by the NSW Minister for the Environment. The NPWS or other Recovery Team members should be contacted if it is believed any change to the Recovery Plan or to the Recovery Program should be considered.

A major review of this recovery plan will occur within five years of the date of its publication, at which time the success (or otherwise) of the introduced animal control, habitat enhancement and research programs will be known.

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### **13 Acronyms Used in this Document**

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EA – Environment Australia  
 NRE – Department of Natural Resources and Environment, Victoria  
 NPWS - NSW National Parks and Wildlife Service  
 SFNSW - State Forests of NSW

**Table 1:** Implementation and Costing Table.

Allocation of responsibility for implementation of recovery actions specified in this plan to relevant agencies. Costing for each action are also identified. Priority is categorised as 1 (Essential), 2 (Highly Desirable) or 3 (Desirable). In the fund source column 'in kind' indicates the value of contributions offered in various forms by government agencies and/or other groups to implement recovery actions.

| Action No.       | Action Title  | Priority | Estimated Cost/yr |        |        |        |        | Total Cost (\$) | Responsibility           | Funding Source      |
|------------------|---|----------|-------------------|--------|--------|--------|--------|-----------------|--------------------------|---------------------|
|                  |   |          | Year 1            | Year 2 | Year 3 | Year 4 | Year 5 |                 |                          |                     |
| 1.1              | High intensity 1080 poison-baiting program for introduced predators   | 1        | 10,000            | 11,000 | 12,000 | 13,000 | 14,000 | 60,000          | NPWS                     | SEFRAC*<br>/in kind |
| 1.2              | Twice-yearly monitoring of response of ground-dwelling mammals to 1080 poison-baiting program                   | 1        | 12,500            | 13,000 | 13,500 | 14,000 | 14,500 | 67,500          | NPWS/Consultant          | SEFRAC              |
| 2                | Control feral pigs through trapping campaign as necessary   | 1        | 7,500             | 7,500  | 7,500  | 7,500  | 7,500  | 37,500          | NPWS                     | in kind             |
| 3.1              | Develop spatial model of Long-footed Potoroo habitat  | 1        | -                 | 30,000 | -      | -      | -      | 30,000          | NPWS/Consultant          | SEFRAC              |
| 3.2              | Develop and implement fire management strategy that promotes key Long-footed Potoroo habitat                    | 1        | -                 | -      | ψ      | ψ      | ψ      | ψ               | NPWS                     | N/A                 |
| 4.1              | Investigate value as habitat for Long-footed Potoroo of adjacent leasehold and freehold lands                   | 2        | 3,500             | -      | -      | -      | -      | 3,500           | NPWS                     | in kind             |
| 4.2              | Enter into sympathetic management regime on high value lands if possible  | 2        | -                 | -      | ψ      | ψ      | ψ      | ψ               | NPWS/Relevant Landholder | N/A                 |
| 5.1              | Undertake revised BIOCLIM prediction based on all Long-footed Potoroo records                                   | 2        | 2,000             | -      | -      | -      | -      | 2,000           | NPWS/Consultant          | NPF**               |
| 5.2              | Conduct survey on remaining predicted lands   | 2        | -                 | 10,000 | -      | -      | -      | 10,000          | NPWS                     | NPF*<br>/SEFRAC     |
| 6                | Undertake ecological investigation on hypogeous fungi in relation to logging disturbance and implement findings | 2        | 10,000            | 12,000 | 14,000 | -      | -      | 36,000          | NPWS/Consultant          | SEFRAC              |
| 7.1              | Media awareness campaign  | 3        | 300               | 300    | 300    | 300    | 300    | 1,500           | NPWS                     | in kind             |
| 7.2              | Develop interpretive display  | 3        | -                 | 2000   | -      | -      | -      | 2,000           | NPWS                     | in kind             |
| 8                | Maintain existing recovery teams and attend meetings as necessary   | 2        | 700               | 700    | 700    | 700    | 700    | 3,500           | NPWS                     | in kind             |
| <b>Sub-Total</b> |   |          | 27,500            | 67,500 | 33,500 | 20,500 | 21,500 | 170,500         |                          | SEFRAC              |
| <b>Sub-Total</b> |   |          | 2,000             | 3,000  | -      | -      | -      | 5,000           |                          | NPF                 |
| <b>Sub-Total</b> |   |          | 17,000            | 16,000 | 14,500 | 15,000 | 15,500 | 78,000          |                          | in kind             |
| <b>Total</b>     |   |          | 46,500            | 86,500 | 48,000 | 35,500 | 37,000 | 253,500         |                          | All Sources         |

Key: \* Cost for this action via grant administered through the South East Forests Regional Advisory Council. \*\* Cost for this action via grant provided through the New South Wales National Parks Foundation. \*\*\* This action will not be conducted during the first lifetime of this plan. ψ No direct cost; however, action must be considered by relevant authorities.





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