Department of Sustainability and Environment

National Recovery Plan for the Smoky Mouse *Pseudomys fumeus*

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Territory and Municipal Services ACT Government

Department of Environment & Climate Change NSW

Victoria The Place To Be

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This Recovery Plan has been developed with the involvement and cooperation of a range of stakeholders, but individual stakeholders have not necessarily committed to undertaking specific actions. The attainment of objectives and the provision of funds may be subject to budgetary and other constraints affecting the parties involved. Proposed actions may be subject to modification over the life of the plan due to changes in knowledge.

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Detailed background information on the Smoky Mouse and implementation detail of this Recovery Plan can be found in the document 'Background and Implementation Information for the Smoky Mouse Pseudomys fumeus *National Recovery Plan' available at www.dse.vic.gov.au, www.threatenedspecies.environment.nsw.gov.au, and www.environment.gov.au*

Cover photograph: Linda Broome

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Summary

The Smoky Mouse *Pseudomys fumeus* is a small native rodent endemic to mainland south-eastern Australia, where it occurs in Victoria, New South Wales and the Australian Capital Territory. The species has a relatively wide but disjunct distribution, populations are small and fragmented, and there appear to have been local extinctions in several areas. The Smoky Mouse is listed as Endangered under the Australian Government *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Major threats to the species include predation by introduced carnivores, habitat changes due to altered fire regimes and dieback caused by the Cinnamon Fungus *Phytophthora cinnamomi*, and loss, modification and fragmentation of habitat due to road construction and intensive timber harvesting. This national Recovery Plan for the Smoky Mouse is the first recovery plan prepared for the species. The plan details the species' distribution, habitat, conservation status, threats, and recovery objectives and actions necessary to ensure the long-term survival of the Smoky Mouse. It is intended that local plans and actions for recovery will conform to this national plan.

Species Information

Description

The Smoky Mouse *Pseudomys fumeus* is a small native rodent about 2–3 times the size of the introduced House Mouse *Mus musculus*. Total length ranges from 180 mm to 250 mm, with the tail accounting for more than half of this. The ears are 18–22 mm long and the hind feet 25–29 mm long. Adult weight varies widely, from 25 g to 86 g. The fur is pale smoky grey above and whitish below. The tail is long, thin, flexible, and covered with short, fine hairs which are white to pale pinkish grey underneath and brown-grey in a narrow stripe along the upper surface. The ears and feet are pinkish, with sparse white hair. Animals from western Victoria tend to be larger and darker than those from east of Melbourne (Menkhorst & Knight 2004; Menkhorst & Seebeck unpubl. data).

Distribution

The Smoky Mouse is endemic to mainland south-eastern Australia (Figure 1), where it occurs in Victoria, New South Wales and the Australian Capital Territory and in four IBRA regions (South East Highlands, South East Corner, Australian Alps and Victorian Midlands). Capture sites range from near sea level to at least 1800 m altitude.

For the purposes of recovery planning a finer resolution regionalisation is necessary. Accordingly, in this plan five distinct biogeographic regions are used as the basic units of management for Smoky Mouse recovery: The Grampians, Otway Range, South Eastern Highlands, coastal East Gippsland and Eden Hinterland.

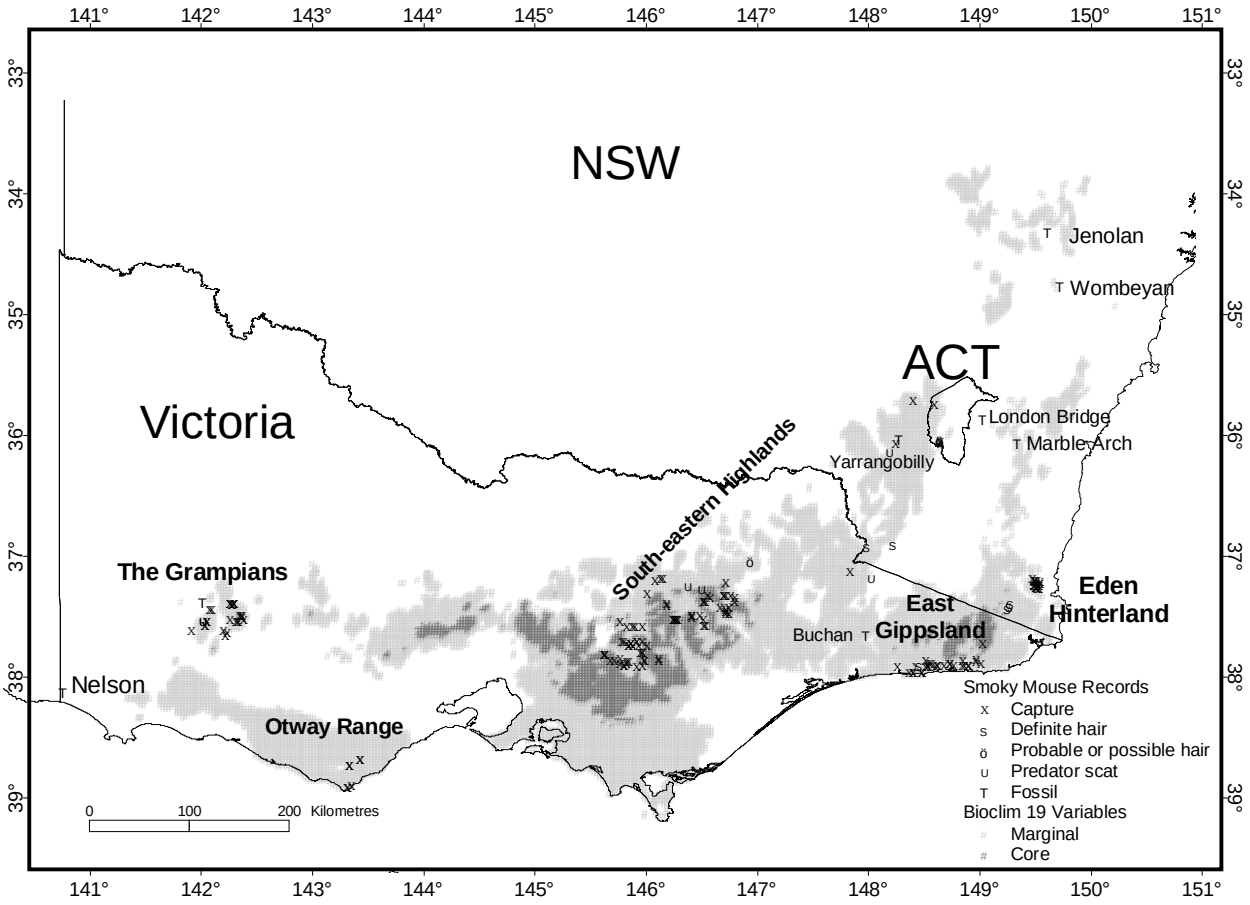

Figure 1. Distribution of the Smoky Mouse *Pseudomys fumeus*. The map shows all records from the Atlas of Victorian Wildlife and NSW Wildlife Atlas. A predicted distribution using the BIOCLIM climatic model is also shown. The Bioclim analysis is modelled on 19 temperature and precipitation variables, with the core bioclimatic domain based on the 10-90% levels in the bioclimatic envelope; the marginal bioclimatic domain is the remainder (see Lindenmayer *et al.* 1996 for explanations).

Population Information

The Smoky Mouse is an enigmatic species about which little is known (Menkhorst and Seebeck 1981). There are no data on which to base population estimates or to estimate trends, but some studied populations have clearly declined. Prior to 1985, the species was thought restricted to Victoria (Menkhorst and Seebeck 1981), but since then records from NSW and the ACT have substantially expanded the known range. It is possible that additional populations occur elsewhere within the total predicted range (Fig. 1).

Within this range, populations are fragmented and generally low in number, but can fluctuate in size. There is also evidence of apparent local extinctions. In the last two decades the Smoky Mouse appears to have disappeared from the Otway Range and coastal East Gippsland (Vic), and probably from Namadgi National Park (ACT). There have been no records from the vicinity of the type locality in the Otway Range

since 1937, despite considerable survey effort (Emison *et al.* 1975; Seebeck unpublished; Menkhorst & Homan unpublished). Further, there have been very few records in coastal heath or lowland forest in the Otway Range, and none since 1985, despite intensive search efforts by several workers (Emison *et al.* 1975; Conole & Baverstock 1983; Moro 1991; Westbrooke & Prevett 2002; Menkhorst & Homan unpublished). In coastal East Gippsland the species was readily captured during the 1970s (DSE unpublished data), but recent searches have failed to locate any animals, and the last capture came from south of Cabbage Tree Creek in 1990. The two largest studied populations, at Mt William (The Grampians) (Cockburn 1981a, 1981b) and Nullica (Eden Hinterland) (Ford 1998; Ford *et al.* 2003) also appear to have declined. While records in new areas are still being obtained, the apparent instability of Smoky Mouse populations is of concern.

Table 1. Conservation reserves in which the Smoky Mouse has been recorded.

Region	Conservation reserve with Smoky Mouse record	Year of last record
The Grampians	Grampians NP	2005
Otway Range	Great Otway NP	1985
South Eastern Highlands	Alpine NP	2007
	Baw Baw NP	1978
	Lake Eildon NP	1989
	Yarra Ranges NP	1988
	Mt Terrible NFSR	1989
	Kosciuszko NP	2004
	Namadgi NP	1986
East Gippsland	Cape Conran CP	1979
	Croajingalong NP	1979
Eden Hinterland	South East Forests NP	2004

CP – coastal park, FFR – flora and fauna reserve, NFSR – natural features scenic reserve, NP – national park.

Habitat

The Smoky Mouse occurs in a variety of vegetation communities, ranging from coastal heath to dry ridgeline forest, sub-alpine heath and, occasionally, wetter gullies (Menkhorst and Seebeck 1981). Except for the wetter sites, a consistent feature of Smoky Mouse habitats is the diversity of heath and bush-pea species present, combined with potential shelter sites in the form of woody debris or rocks. The vegetation at capture sites varies widely in age post-fire.

Knowledge of the habitat requirements of the Smoky Mouse is inadequate to allow a meaningful description of habitat critical to survival, as required under the EPBC Act. However, the actions included in the plan (particularly actions under objectives 2, 6 and 7) should result in the capacity to determine habitat that is critical to the survival of the Smoky Mouse.

Decline and Threats

There are several potential causes of the apparent decline in Smoky Mouse populations. Predation by introduced carnivores is likely to be a significant constraint

to population growth and a major cause of local population declines. Loss, modification and fragmentation of habitat are occurring in some areas due to road construction, intensive timber harvesting and altered fire regimes. Dieback of susceptible heath species caused by the Cinnamon Fungus *Phytophthora cinnamomi* is a threat in some areas due to the substantial habitat changes that result in infected patches of vegetation. Predation and changed fire regimes are likely to be acting throughout the species distribution. Timber harvesting, roading and habitat fragmentation are all potential threats in areas of State Forest that are available for timber harvesting.

Threatening processes listed under State or Commonwealth legislation that are likely to impact on Smoky Mice are listed in Table 2. Apparent major threats are further elucidated below.

Table 2. Potentially threatening processes listed under State and Commonwealth legislation that are likely to affect the Smoky Mouse.

Threatening Process	Legislation
Predation by the feral Cat *Felis catus*	EPBC, TSC, FFG
Predation by the European Red Fox *Vulpes vulpes*	EPBC, TSC, FFG
Infection of native plants by *Phytophthora cinnamomi*	EPBC, TSC, FFG
High frequency fire resulting in the disruption of life cycle processes in plants and animal and loss of vegetation structure and composition.	TSC, FFG
Land clearance / Clearing of native vegetation	EPBC, TSC
Habitat fragmentation	FFG
Inappropriate fire regimes causing disruption to sustainable ecosystem processes and loss of biodiversity	FFG
Loss of coarse woody debris from Victorian forests and woodlands	FFG
Invasion of native vegetation by native weeds	FFG

EPBC: Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

TSC: NSW *Threatened Species Conservation Act 1995*

FFG: Victorian *Flora and Fauna Guarantee Act 1988*

Introduced Predators

The review of Smith and Quin (1996) provides a helpful framework within which to assess the impact of introduced predators on the Smoky Mouse. They suggest that, in areas where predator abundance has been greatly elevated and sustained by the introduction and spread of the European Rabbit *Oryctolagus cuniculus* and the House Mouse, the primary cause of decline in native rodents such as the Smoky Mouse is direct predation by the introduced Red Fox *Vulpes vulpes* and Cat *Felis catus*. There is evidence that predation by the Cat is a particular threat to *Pseudomys* species, with cats able to 'stake out' communal nests and potentially eliminate small breeding populations within a very short time (Risby *et al.* 2000; Ford *et al.* 2003). Predator control aimed only at the Red Fox could result in increased populations of rabbits, and stimulate an increase in other predators such as the Dingo *Canis lupus dingo* and Cat (Risby *et al.* 2000).

The Smoky Mouse is particularly susceptible to predation because it has a relatively low reproductive rate, frequently uses vegetation with an open ground layer, and uses communal burrows with well-defined entrances that can be staked out by 'sit and wait' predators. These factors leave it more exposed to predators than species that have dispersed burrows or inhabit dense vegetation. Thus, even in areas where exotic prey species are scarce, predation by foxes and cats could still result in a decline in Smoky Mouse numbers. Native predators including quolls, pythons and owls could also be a threat to some colonies of Smoky Mice.

Inappropriate fire regimes

The floristic composition and structure of heath and heathy forest plant communities are strongly influenced by fire regimes. Too frequent burns, such as repeated prescribed burns, are likely to simplify the heath understorey in dry forests towards early successional species, depleting floristic diversity and encouraging ingress of predators, and may result in loss of *Pseudomys* species (Catling 1986, 1991). Frequent burning is also likely to result in a low abundance and diversity of hypogeal fungi, an important food resource, most of which prefer developed litter layers (Claridge & Cork 1997; Andrew Claridge pers. comm. August 2002). Repeated burning can also remove hollow logs, which were used as bolt holes by radio-tracked Smoky Mice (Ford 1998), and may help provide protection from predators. Lack of burning can result in senescence of heathy vegetation and lead to intense, large-scale wildfires that are likely to eliminate metapopulations. Smoky Mice have been trapped in vegetation ranging from early to senescent seral stages following fire (2-40 years). Insufficient data exist to determine the optimal successional stage(s), which are likely to differ between vegetation communities. However, it has been suggested that the understorey floristics and density at most Smoky Mouse sites in heath and dry forests can be maintained by fire regimes of moderate frequency (15–20 but up to 40 year intervals) and moderate intensity (Lane 1997; P. Catling & D. Keith pers comm. 2000; Ford *et al.* 2003).

Timber harvesting

Intensive logging, and the associated soil disturbance and regeneration burn, removes the heathy understorey in the short-term on a logged coupe and is likely to damage or destroy Smoky Mouse nest sites. However, Jurskis *et al.* (1997) suggested that disturbance such as fire or logging temporarily creates conditions suitable for exploitation by the Smoky Mouse. A flush of regenerating heath species is evident on some areas following removal of the canopy, some soil disturbance and burning. However, the time required for these plants to provide a food source and the suitability of post-logging vegetation to the Smoky Mouse in the medium- to long-term is unknown. Thick stands of regrowth *Eucalyptus* species and *Acacia* species are typical of regenerating, intensively logged areas in the medium-term, and the Smoky Mouse has not been shown to occupy this type of vegetation. It is possible that forest regeneration will eventually allow Smoky Mice to re-establish on logged areas, but this may require a time-frame longer than many current logging cycles.

Roads and tracks

Roads and tracks associated with timber harvesting or fire control are often constructed along ridgelines in dry forest. In some areas there are few substantial ridges that do not have roads or tracks constructed on them. This is potentially a substantial threat to a ridge-dependant species such as the Smoky Mouse because the ridgeline habitat is often narrow and is greatly reduced and fragmented by road construction. Roads can effectively fragment habitat by interrupting movement patterns of small mammals

(Andrews 1990; Goosem 2001). Roads and tracks are also likely to facilitate movement of foxes (Catling & Burt 1995) and cats within an area, creating further predator pressure on local populations of the Smoky Mouse. Even small trails created along trap lines in patches of previously dense vegetation can facilitate ingress of foxes and cats, and may pose a significant threat to study populations of small mammals (Claridge 1998).

Habitat fragmentation

The Smoky Mouse occurs in small, isolated populations that are probably restricted to patches of quality habitat that combine a rich and diverse range of food items with adequate shelter from wildfire and predators. There is probably now little opportunity for gene flow between these populations, and the effect of this isolation on population viability is unknown. Further habitat fragmentation within populations, by timber harvesting and road construction, is likely to disrupt metapopulation dynamics and result in increased predation.

Proximity to cleared freehold land and intensive logging was associated with increased abundance of Red Foxes in forest areas in eastern NSW (Catling & Burt 1995), and this was an important variable in determining the likelihood of locating the Hastings River Mouse *Pseudomys oralis* in the forests of northern NSW (Smith *et al.* 1996). Hastings River Mouse populations are generally absent from potential habitat where areas with more than 10% clearing occur within a 2 km radius, and this was attributed to penetration of the forest edge by foxes and rabbits (Smith *et al.* 1996). In Nullica State Forest (Eden Hinterland) approximately 75% of the total area within the known distribution of the Smoky Mouse has been logged, most of it since the Smoky Mouse was discovered in the region in 1994. However, the remainder, about 80% of the identified high quality Smoky Mouse habitat, has now been placed in an exclusion zone where timber harvesting and associated activities are not permitted. Some areas of potential habitat in the adjoining South East Forests National Park were logged prior to its gazettal. These areas are vegetated by thick *Eucalyptus* species regrowth and currently do not provide suitable habitat for Smoky Mouse. The Park also adjoins agricultural land and very little of the potential Smoky Mouse habitat is more than 2km from disturbed land. This degree of fragmentation may be contributing to the instability of Smoky Mouse sub-populations in the region.

Dieback caused by Cinnamon Fungus *Phytophthora cinnamomi*

Many of the plant families and genera characteristic of Smoky Mouse habitat are particularly susceptible to the root-rot Cinnamon Fungus *Phytophthora cinnamomi*. These include the Epacridaceae (*Epacris*, *Monotoca*, *Leucopogon*), Fabaceae (*Daviesia*, *Pultanaea*), Dillenaceae (*Hibbertia*), Tremandraceae (*Tetratheca*) and Xanthorrhoeacae (*Xanthorrhoea*, *Lomandra*) (McDougall & Summerell, pers. comm. 2002). In heathlands and heathy woodlands in The Grampians and Brisbane Ranges (Vic), the local extinction of susceptible shrubs and *Xanthorrhoea* species has led to substantial changes in the floristic structure and composition of plant communities (Weste 1981, 1986, Newell 1998). There has been a decline in species richness in these communities following infestation, with up to 60% of understorey plant species eliminated after infection (Kennedy & Weste 1986). There is evidence that the percentage of vegetation modified by Cinnamon Fungus is a significant variable affecting small mammal diversity and density (Newell and Wilson 1993, Wilson *et al.* 1994).

Cinnamon Fungus is more active in low fertility soils, and where there is little leaf litter, perhaps due to antagonistic actions of other microflora in the litter layer. In some circumstances, Cinnamon Fungus may contribute to plant death where there are other stresses present, such as wildfire. In addition to natural spread of spores by water or mycelial growth and root to root contact, Cinnamon Fungus propagules may be dispersed by cars and earth-moving equipment containing infected soil and root material, and by animals such as feral Pigs.

Cinnamon Fungus has the potential to have a very large impact on populations of the Smoky Mouse. It is evident that Smoky Mouse habitat in some areas of infestation has already been degraded or eliminated. Spread of the disease is a particular concern where it is widespread and the likelihood of soil movement is high, for example due to forestry activities. In Victoria, it is present in East Gippsland at known Smoky Mouse sites, and in areas of known and predicted habitat subject to timber harvesting in the South Eastern Highlands. In NSW, the pathogen is present at some sites occupied by the Smoky Mouse in the Eden Hinterland and is causing death of *Xanthorrhoea* species and heathy shrubs. The extent of its occurrence in the Kosciuszko, Ingebyra and Tumut regions is not known (McDougall, pers. comm. September 2002).

Recovery Information

Strategy for Recovery

The strategy for recovery of the Smoky Mouse will be to secure the habitat and stabilise population numbers of the Smoky Mouse in a majority of known populations in each of five Smoky Mouse biogeographic regions (Table 1, Figure 1). This will be achieved through the designation of Smoky Mouse Protection Zones around areas of high quality known and potential habitat, followed by targeted predator control, the construction of trial small-mammal refuges, and the instigation of a valid population monitoring protocol. A captive breeding colony will be established for nutritional studies and potential re-introduction. Further research into the floristic composition (including hypogeal fungi) and habitat use by the Smoky Mouse in each region will allow the development of ecological burning regimes and management strategies aimed at providing continuity in availability of patches of high quality habitat.

Program Implementation

The Recovery Plan will run for five years from the start of implementation. The Smoky Mouse Recovery Team, comprising representatives from seven agencies and organisations with an interest in, and responsibility for, Smoky Mouse conservation will coordinate implementation of the recovery plan. Any technical, scientific, habitat management or education issue requiring skills not available within the Recovery Team will be referred to specialist organisations and individuals as appropriate. Implementation of individual actions will remain the responsibility of the relevant agencies and organisations identified in the Recovery Plan (subject to available resources), who will be responsible for preparing work plans and monitoring progress toward recovery within their own jurisdiction.

Program Evaluation

The Recovery Team will be responsible for informal evaluation annually. Towards the termination of the Recovery Plan, an external reviewer will be appointed to undertake a formal review and evaluation of the recovery program.

Recovery Objectives

The **Long-term Objective** of recovery is to achieve a down-listing of the Smoky Mouse to the Vulnerable category through reduction of threats to populations in The Grampians, South Eastern Highlands and Eden Hinterland. This will be achieved by increasing regional population sizes to at least 300 adult individuals, and by appropriate management of fire, logging regimes and predators.

Within the life span of this Recovery Plan, the **Specific Objectives** of recovery are to:

1. Designate protection zones around known populations.
2. Refine knowledge of the distribution and abundance.
3. Examine population partitioning.
4. Minimise predation by the Red Fox, Feral Cat and Wild Dog.
5. Establish small-mammal refuges.
6. Develop and test burning regimes to maintain and enhance habitat quality.
7. Study habitat preference, diet and the effects of disturbance on population survival and connectivity.
8. Establish a captive breeding colony of Smoky Mice.
9. Establish and minimise risk of *Phytophthora cinnamomi* infection.
10. Increase community awareness and involvement.

Note: A summary of the recovery plan actions is provided here. Detailed implementation information can be found in the supporting document 'Background and Implementation Information for the Smoky Mouse Pseudomys fumeus *National Recovery Plan' available at* www.dse.vic.gov.au and *www.threatenedspecies.environment.nsw.gov.au*

Recovery Objectives, Performance Criteria and Actions - Summary

Objective	Performance Critera	Actions
1. Designate protection zones around known populations.	Two or more Smoky Mouse Protection Zones established in each of The Grampians, South Eastern Highlands and Eden Hinterland.	1.1 Designate protection zones around key Smoky Mouse populations. 1.2 Review current protection zones in the Eden Hinterland. 1.3 Review current Integrated Forestry Operations Approval Package (IFOA) conditions for Smoky Mouse in NSW.
2. Refine knowledge of distribution and abundance.	Increases in knowledge of population numbers and distribution in all regions.	2.1 Develop targeted survey techniques and monitoring protocols. 2.2 Develop habitat suitability index. 2.3 Undertake field survey and mapping in the ACT. 2.4 Undertake field survey and mapping in NSW. 2.5 Undertake field survey and mapping in Victoria.
3. Examine population partitioning.	Study of population partitioning completed and the results incorporated into future versions of this plan.	3.1 Estimate levels of genetic partitioning between the biogeographical regions. 3.2 Measure levels of heterozygosity within and between biogeographical regions.
4. Minimise predation by the Red Fox, feral Cat and wild Dog.	A high level of predator control is carried out in designated protection zones.	4.1 Develop predator control strategies. 4.2 Implement predator control strategies.
5. Establish small-mammal refuges at key sites.	Small mammal refuges developed and tested at two sites.	5.1 Establish small-mammal refuges in The Grampians or South Eastern Highlands and Eden Hinterland.
6. Develop and test burning regimes to maintain and enhance habitat quality.	Areas to be treated by ecological burning are defined and mapped, and burned at the next appropriate opportunity.	6.1 Review data on floristic composition of Smoky Mouse sites and fire response life history attributes of key plant species at those sites. 6.2 Select sites and undertake trial ecological burns. 6.3 Monitor vegetation and small mammal response to ecological burns.
7. Study habitat preference, diet and the effects of disturbance on population survival and connectivity.	Information on diet and habitat use in a range of habitat types and disturbance regimes obtained and used for conservation management.	7.1 Investigate utilisation of habitat and diet in undisturbed, burnt and logged sites. 7.2 Establish the nutritional importance of food resources and their relationship to habitat quality. 7.3 Monitor vegetation succession in disturbed and undisturbed sites. 7.4 Review data and survey floristic composition and small mammals at regenerating logged sites.
8. Establish a captive breeding colony.	Captive breeding colony of Smoky Mouse successfully established, breeding and recruiting young.	8.1 Establish a captive breeding colony of Smoky Mouse.

9. Assess and minimise the risk of habitat loss through *Phytophthora cinnamomi* infection.	Presence and risk of *Phytophthora cinnamomi* infection in each Smoky Mouse region identified and strategies developed to protect susceptible key areas.	9.1 Identify the presence and risk of *Phytophthora cinnamomi* infection and protect key areas of habitat.
10. Communication to increase community awareness and involvement.	Community understanding of and support for Smoky Mouse conservation is increased.	10.1 Involve the community in the Recovery Program. 10.2 Provide information about the Recovery Program.

Implementation Costs

The estimated cost of implementing the Recovery Plan is $1.57 million over five years.

Role and Interests of Indigenous People

Organisations that represent Indigenous peoples who have a cultural connection with land that is critical to the survival of the Smoky Mouse include Brambruk Incorporated for the Grampians Region, the Mooji Aboriginal Council and Far East Gippsland Aboriginal Community for coastal East Gippsland. The traditional lands of the people represented by Eden and Brungle-Tumut Local Aboriginal Land Councils coincide with extant populations of Smoky Mouse in NSW. In the ACT and region, the Ngunnawal people are the traditional users of the mountain ranges within Namadgi National Park that are habitat for the Smoky Mouse. The Ngunnawal are a diverse people composed of several subgroups.

In Victoria, Indigenous communities on whose traditional lands the Smoky Mouse occurs have been advised, through the relevant DSE Regional Indigenous Facilitator of the preparation of this Recovery Plan and were invited to provide comments. Consultation with Indigenous communities in NSW has not occurred at this stage but will be undertaken as part of the implementation of this plan. The interests of these groups are also incorporated into the National Park planning process, which covers most areas where the Smoky Mouse occurs. ACT Government agencies responsible for managing the park maintain liaison with the Namadgi Advisory Board (which includes representatives of the Ngunnawal people) on matters of park management and use.

Implementation of recovery actions under this plan will include consideration of the role and interests of Indigenous communities in each region.

Biodiversity Benefits

The Smoky Mouse has the potential to act as a flagship rodent, highlighting the habitat management needs and predation pressure on this important component of South-eastern Australia's terrestrial small mammal fauna. Implementation of this plan will have considerable benefits for a suite of flora and fauna species that require or occur in association with heathy vegetation, including Southern Brown Bandicoot, Southern Emu-wren, Beautiful Firetail, and the plants *Genoplesium ryoliticum*, *Leionema ralstonii* and *Westringia davidii*. It will also benefit a number of relatively neglected, potentially threatened species (but not yet listed under both State or Commonwealth legislation) including White-footed Dunnart, Gang Gang Cockatoo (both listed in NSW), Spotted Quail-thrush, and the plants *Philotheca virgata, Daviesia wyattiana* (both listed in Victoria), *Darwinia briggsiae, Grevillea irrasa* subsp. *irrasa*, *Pultenaea benthamii* and *Tetratheca subaphylla*, that inhabit dry open-forest communities on ridges and are highly susceptible to Cinnamon Fungus.

Social and Economic Impacts

Many of the known Smoky Mouse populations occur in conservation reserves and in these areas there are likely to be few social and economic implications of implementation of this recovery plan. However, some populations and predicted habitat in East Gippsland and the South Eastern Highlands, and significant populations

in the Eden Hinterland, occur within timber production forests. Thus there is potential to affect logging regimes in some areas of State Forest. These areas are currently under Regional Forest Agreements and any reduction in timber availability may necessitate compensation to the timber industry. The extent to which timber accessibility will be affected will depend on the nature of the habitat and the protection measures agreed to. In NSW adjustments have been made to timber harvesting prescriptions to compensate for sawlog resources made unavailable by the establishment of the Smoky Mouse reserves in Nullica State Forest. Apart from other potential impacts on the timber industry, no adverse social or economic impacts are anticipated.

Management Practices

There is considerable uncertainty over the conditions required to maintain suitable habitat for the Smoky Mouse. Major threats to the species include predation by introduced carnivores, floristic changes due to altered fire regimes, dieback caused by the Cinnamon Fungus, and loss, modification and fragmentation of habitat due to road construction and intensive timber harvesting. Currently there is little information to indicate whether logging, frequent burning or absence of burning will have long-term deleterious effects on Smoky Mouse habitat, and it is important to establish this in regions where these activities occur, to assist long-term management planning and protection strategies.

On-ground site management will aim to mitigate threatening processes to prevent declines and create conditions for maintenance or increase of population size. Activities that substantially alter or fragment habitat, especially where these result in the isolation of existing populations, need to be avoided. Fire regime is a key ecological process that strongly influences habitat quality for the Smoky Mouse. Current knowledge is inadequate to accurately specify an ideal burning regime for any of the key populations. However, it has been suggested that the understorey floristics and density at most Smoky Mouse sites in heath and dry forests can be maintained by fire regimes of moderate frequency (15–20 but up to 40 year intervals) and moderate intensity. It is possible that forest regeneration will eventually allow Smoky Mice to re-establish on logged areas, but this may require a time-frame longer than many current logging cycles.

A range of strategies will be necessary to alleviate these threats including control of pest animals, fire management, managing timber harvesting to reduce impact on Smoky Mouse habitat, and adopting methods and practices that restrict the spread of Cinnamon Fungus. Providing information to land managers and the broader community in the region will increase awareness of the species, provide for increased protection of existing populations, increase the likelihood of new populations being found, and reduce the risk of inadvertent damage occurring to habitat.

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