NSW National Parks and Wildlife Service

Kosciuszko Offset Action Plan: Smoky mouse

Kosciuszko Offset Project

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Environment and Heritage Group
Department of Planning and Environment
Locked Bag 5022, Parramatta NSW 2124
Phone: +61 2 9995 5000 (switchboard)
Phone: 1300 361 967 (Environment and heritage enquiries)
TTY users: phone 133 677, then ask for 1300 361 967
Speak and listen users: phone 1300 555 727, then ask for 1300 361 967
Email: info@environment.nsw.gov.au
Website: www.environment.nsw.gov.au

Report pollution and environmental incidents
Environment Line: 131 555 (NSW only) or info@environment.nsw.gov.au
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1. Objective

This Kosciuszko Offset Action Plan (KOAP) sets out management actions that, when implemented and measured, will deliver biodiversity gains for smoky mouse (*Pseudomys fumeus*) within Kosciuszko National Park (KNP).

The Kosciuszko Offset Strategy 2023 (KOS) sets out a framework for the development of KOAPs. It is based on a clear objective – to deliver a biodiversity gain in KNP equivalent to 120% of the biodiversity loss identified in the Snowy 2.0 environmental assessments.

In the Snowy 2.0 environmental assessments for Exploratory Works and Main Works, up to 229 hectares of habitat for smoky mouse was identified as being impacted by the project (impacts to smoky mouse were not identified under the Transmission Connection assessment). At an estimated 1 to 2 individuals per hectare (see Section 3 – Step 1 of the metrics-based approach), the impact of the project on the smoky mouse is estimated to be a reduction in the population of 344 individuals.

To deliver the 120% biodiversity gain identified under the Kosciuszko Offset Strategy, the objective of this Kosciuszko Offset Action Plan is to **increase the population of smoky mice in Kosciuszko National Park by 413 individuals.**

As this is a Commonwealth-listed species and the potential impacts on it are significant, this KOAP has been approved by both the Deputy Secretary, National Parks and Wildlife Service (NPWS) and the Deputy Secretary, Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW).

2. Species overview and key threatening processes

The smoky mouse is listed as **critically endangered** under the NSW *Biodiversity Conservation Act 2016* and **endangered** under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Table 1 provides a species summary for smoky mouse, including a description of the species, its habitat, preferred food sources and its distribution within KNP.

Table 1 Species summary – smoky mouse

Category	Summary
Description	The smoky mouse is similar in size to a small rat, with a head and body length averaging 90 mm and a tail averaging 140 mm. The average adult weighs 52 grams (ranging from 38 to 68 grams). The fur is fine, soft, pale grey to bluish grey above, with a grey to white belly and a ring of dark hairs around the eye. The tail is long, narrow and sparsely furred, mostly white to pinkish, with a narrow, dark stripe along the upper surface.
Habitat	The smoky mouse prefers open forest with a floristically diverse shrub layer with bush peas, heaths and wattles (families Fabaceae, Ericaceae and Mimosaceae) well represented. Ground cover in the form of dense, low vegetation, tussocks, woody debris and rocks provide shelter sites and protection from predators. Soil moisture, friability and litter cover conditions also need to be conducive to the development of and foraging for hypogeal (truffle-like) fungi. Smoky mouse occurs from the coast (in Victoria) to subalpine regions up to 1800 m. Nesting burrows have been found in rocky localities among tree roots and under the skirts of grass trees (*Xanthorrhoea* spp.). The vegetation at capture sites varies widely in age post-fire.
Diet	The main summer and autumn diet for smoky mouse consists of seeds and fruits from leguminous shrubs. It can also feed on some invertebrates such as Bogong moths in the high country, while relying on hypogeal fungi that predominate in winter and spring along with some flowers, seeds and soil invertebrates.
Distribution and population	There is uncertainty about the species' density and distribution including within KNP. Fauna surveys conducted for Snowy 2.0 between August 2017 and June 2019 in northern KNP recorded a large (unquantified) regional population of smoky mouse across an estimated 6,000 to 7,000 ha. Smoky mouse was identified at 71 locations with 61 locations within and adjacent to the Snowy 2.0 disturbance footprint. The species distribution within the survey area is predominantly associated with tall forests dominated by mountain gum and snow gum, with a moderate to dense shrubby mid-storey and dense ground cover, including logs and leaf litter.

Source: Saving our Species and personal communication Department of Planning and Environment, Biodiversity Conservation Division.

Table 2 provides a list of key threatening processes to smoky mouse within KNP that will be addressed via cost-effective management actions (see Section 3). Actions will also consider relevant Australian Government Threat Abatement Plans to reduce the impacts from key threatening processes on native species.

Table 2 Key threatening processes to smoky mouse in Kosciuszko National Park

Threat	Description
Disturbance	Primarily through clearing for road construction Loss of site occupancy/low recruitment leading to metapopulation collapse Fire regimes removing understorey vegetation
Feral herbivores	Grazing, browsing and trampling by introduced herbivores such as horses and deer, resulting in the reduction of food resources and depletion of shrub cover
Feral pigs	Direct predation, competition (including for hypogeal fungi), habitat/cover degradation and disease transmission
Feral predators	Predation from feral cats and foxes
Pathogens, diseases and microorganisms	Occurrence of *Phytophthora cinnamomi* infection in smoky mouse habitat that changes the structure, composition and condition of vegetation communities may affect the persistence of the species at the sites
Inappropriate fire regimes	Too frequent or too infrequent burning may impact on suitable habitat and food resources
Interactions with native species	Uncertainty about species' density and distribution throughout the area

Source: Saving our Species, draft Smoky Mouse Conservation Action Plan, and personal communication Department of Planning and Environment, Biodiversity Conservation Division

3. Kosciuszko Offset Strategy – metrics-based approach

The KOS requires expenditure of Snowy 2.0 offset funds to deliver biodiversity gains for KNP equivalent to 120% of the loss for threatened species, threatened ecological communities (TECs) and ecosystems impacted by the Snowy 2.0 project. The benchmark of 120% has been set because this is considered to be achievable over the life of this KOAP, and it can be demonstrated as a biodiversity gain.

In setting an objective to exceed the statutory requirements, the KOS recognised the difficulties in measuring biodiversity gains and the inherent fluctuations in biodiversity over time. It provides a margin that will increase confidence that the minimum statutory requirements are being met. The KOS takes a metrics-based approach that will be applied to the delivery of biodiversity offsets by NPWS. This will be achieved by following a three-step process:

Step 1: quantifying the impacts and benefits that must be delivered

Step 2: implementing actions to deliver the required offset

Step 3: measuring and reporting on the biodiversity benefit.

Step 1: quantifying the impacts on smoky mouse and benefits that must be delivered

It is estimated that 344 smoky mice will be impacted by Snowy 2.0 Exploratory Works and Main Works. The benefit that must be delivered is the successful and sustainable establishment of an additional 413 smoky mice in KNP (being 120% of the impact). This calculation is based on impacts to 229 hectares of smoky mouse habitat from Snowy 2.0 with an estimated population density of 1 to 2 individuals per hectare (an average of 1.5 smoky mice per hectare).

Step 1 limitations, assumptions and notes

- The estimate of 1.5 smoky mice per hectare is based on a 1997 Department of Planning and Environment study in the Nullica section of South East Forest National Park where the highest density of 30 mice over 20 hectares was detected (pre-fire estimate).
- Habitat at Lobs Hole Ravine in KNP has been identified as suitable habitat for smoky mice. It is reasonable to assume that 1.5 smoky mice per hectare (post 2019–20 fires) is achievable in this area and other areas in northern KNP.
- Following actions 1 and 2 (see Table 3 below), and as further studies and information on smoky mouse populations and densities in KNP become available over the life of this KOAP, the benefit that must be delivered under this KOAP will be refined and adjusted accordingly.

Step 2: implementing the management actions for smoky mouse to deliver the required offset

Delivering an offset of at least 413 additional smoky mice in KNP will involve the following management interventions:

- identifying an area (or areas) of suitable habitat for delivery of the offset (see action 1 in Table 3)
- measuring the current density (or other suitable metric such as occupancy) of smoky mice at that location and identifying the target density and, thus, the required area across which the offset actions are to be delivered (see actions 2 and 3 in Table 3)
- increasing the density (or other suitable metric) of smoky mice at that location through a targeted series of offset actions such as intensive feral predator and feral herbivore control above and beyond core management (see actions 4, 5, 6, 7 and 8 in Table 3), and, if required, the reintroduction of smoky mice if the current density is zero or very low (see Step 2 – limitations, assumptions and notes below).

Surveys to identify suitable habitat and the presence of smoky mice in KNP have begun under the Saving our Species program (Figure 1). The priority is to:

- identify suitable habitat in KNP that has existing populations of smoky mice
- identify suitable habitat in KNP that does not have existing populations of smoky mice.

To date, 26 survey blocks have been identified, prioritised and mapped (via a desktop exercise using available vegetation maps for KNP). Each identified survey block consists of up to 25 2-square-kilometre cells. Approximately one-third of these blocks have been surveyed (camera surveys with 4 cameras per cell) so far to identify the species' presence (yes/no). To date, results have been positive, with 1–2 sites showing higher than expected presence of smoky mice and the remaining surveyed sites showing occasional records of their presence.

Some of the survey blocks in Figure 1 include burnt and unburnt sites as well as sites now also identified under the Assets of Intergenerational Significance (AIS) program. Actions under this KOAP may, where appropriate, occur within AIS sites where offset funds are used to benefit the species and where actions go beyond those identified under the AIS program.

Actions needed to deliver the required biodiversity gains are listed in Table 3. They include identifying suitable habitat areas, measuring the current species density in those areas and addressing the identified key threatening processes (Table 2).

Table 3 Management actions for smoky mouse to deliver the required offset

Action number	Action	Threat addressed	Location	When	Who	Total cost (preliminary estimates)	Comment
1	Complete smoky mouse camera surveys for the remaining two-thirds of the identified survey blocks in KNP plus any additional sites determined by NPWS	Generating baseline information	KNP sites marked with diagonal or dotted hatching (Figure1). Blue polygons are first priority	2023 to 2025	NPWS	$300,000	Collaborate with delivery of Saving our Species to identify suitable habitat and presence of smoky mouse. Includes camera surveys (4 cameras per 2 sq km cell)
2	For sites already identified and surveyed as suitable smoky mouse habitat with smoky mouse present in northern KNP, identify (estimate) population density via occupancy modelling		KNP sites marked with cross hatching (Figure 1) (northern KNP surveyed sites)	2023 to 2025	Biometrician engaged to develop and apply an occupancy model as a surrogate for density	$50,000	Required to calculate management action gains Data is available for these areas Baseline occupancy that is robust, reliable and specific to smoky mouse to be calculated
3	Undertake a desktop assessment/calculation to determine the required area across which the offset actions are to be delivered		Select KNP sites from the sites identified in Figure 1 plus any other sites identified by NPWS	2023 to 2025	NPWS	$500	Based on the results of actions 1 and 2
4	Additional feral cat control in areas identified in action 3 (designated smoky mouse offset areas)	Feral predators	Designated smoky mouse offset areas	2023 to 2043	Dedicated cat control officer/s–cat removal is likely to give the greatest biodiversity	Up to $5.25 million over a minimum of 20 years	Additional to core cat management in KNP Use of a number of control methods such as Felixer grooming traps (lidar and camera trap with 1080 paste spray), leg hold trapping (and servicing of these), and ground shooting for at least the next 20 years (includes cost of traps)

Action number	Action	Threat addressed	Location	When	Who	Total cost (preliminary estimates)	Comment
					gain for smoky mouse in KNP		Include cat detection dog Controls can evolve with new technologies
5	Additional fox control in areas identified in action 3 (designated smoky mouse offset areas)	Feral predators	Designated smoky mouse offset areas	2023 to 2043	Integrated into existing fox control programs for northern KNP	Up to $500,000 over a minimum of 20 years	Additional to core fox management in KNP Consider enhanced baiting, such as aerial baiting, for the next 20 years as a minimum
6	Additional deer, horse and feral pig control	Feral herbivores	Designated smoky mouse offset areas	2023 to 2043	Integrated into existing feral herbivore control programs for northern KNP	Up to $1.2 million over a minimum of 20 years	Additional to core feral herbivore management in KNP Horse removal will be consistent with the KNP Wild Horse Heritage Management Plan
7	Additional monitoring of feral animal numbers	Feral predators/ feral herbivores	Designated smoky mouse offset areas	2024 to 2044	Integrate into existing feral animal monitoring	Up to $1 million over a minimum of 20 years	Implement monitoring to measure and track feral animal densities in the designated smoky mouse offset areas
8	Protection of unburnt sites identified in surveys as being suitable smoky mouse habitat	Fire – too frequent burning or too infrequent burning	Designated smoky mouse offset areas	2024 onwards	NPWS operational area staff including fire planning officers	Up to $100,000 over a minimum of 20 years	Work with fire planning officers to implement additional measures to ensure adequate unburnt habitat in designated smoky mouse areas, as appropriate
					Total cost	**$8.4 million**	

Step 2 limitations, assumptions and notes

- Very little monitoring of smoky mouse in KNP has occurred to date, limiting current understanding of the species in KNP. The Snowy 2.0 Exploratory Works and Main Works environmental assessments were the first significant monitoring of the species in the park.
- Captive breeding programs and translocation of smoky mouse into areas of KNP will be considered if the measures identified in Table 3 do not deliver increases in smoky mouse density.
- Threat control strategies and actions will continue to evolve throughout the life of this KOAP. This KOAP will be updated accordingly as new information, knowledge and management techniques become available.
- If *Phytophthora cinnamomi* infection in smoky mouse habitat occurs and is detected in areas where this KOAP is applied, management actions will be added to the KOAP to address this. Actions will be based on those listed in the Smoky Mouse Conservation Action Plans. They would include implementing hygiene protocols and developing and implementing a hygiene management plan, including emergency response procedures in the event of an outbreak or evidence of serious impact of pathogenic *Phytophthora cinnamomi.*
- The success of using occupancy as an approximation for density is a rapidly developing field and will continue to be evaluated throughout the project. Occupancy may be used as a secondary or interim metric if needed, or an alternative approach to measuring density may be implemented.
- Costs identified above will be revised as required, taking into account the relative cost effectiveness of different measures.
- Designated offset areas for different species are likely to overlap, with resulting management actions being carried out across multiple areas at once. This will maximise biodiversity gains and create cost savings, potentially enabling additional management actions to be undertaken or timeframes increased.
- Actions under this KOAP will not apply to sites directly impacted by Snowy 2.0 construction activities. Snowy Hydro Limited is required under planning approvals to undertake habitat rehabilitation at these sites. Reintroducing smoky mouse into Snowy 2.0 project sites is outside the scope and timeframe of this project and action plan.

Step 3: measuring and reporting on the biodiversity benefit to smoky mouse

The KOS states that each KOAP must describe how the required biodiversity benefit (offset) will be measured. This involves setting out the attributes to be measured and the methodology, timing and other details relevant to monitoring. A hierarchical approach is being taken to measuring the biodiversity benefit. It is as follows:

- the population density of a species is the desirable measurement attribute
- if this is not feasible due to challenges such as difficulty in capturing and detecting populations due to low numbers or species known to be trap shy, then other metrics (such as occupancy) combined with modelling will be considered instead
- if the attribute and monitoring design in 1 or 2 above is not working, then the attribute being measured will be revisited and another metric considered.

Any changes to metrics over time will be updated in the KOAP and reported on as part of the adaptive management approach under the KOS.

Table 4 Measuring biodiversity benefits to smoky mouse

Attribute to be measured	Metric	Location	Methodology	Monitoring design	Timing	Cost	Frequency of measurement
Population	Density (Spatial estimates of density using occupancy as a surrogate measure. Expert modelling will take time and will be refined, resulting in increased accuracy and rigor over time)	Designated smoky mouse offset areas	Camera surveys	Detailed monitoring design to be determined by biometrician (see action 2) – occupancy modelling will infer density gain/loss over the selected areas	During the active months, that is, spring to autumn	Up to $1 million over a minimum of 20 years for ongoing population monitoring	To be determined as part of the detailed monitoring design

Step 3 limitations, assumptions and notes

- Smoky mice are difficult to trap, making it difficult to undertake a direct population count of the species. A density estimate will be obtained using occupancy as a surrogate, subject to expert modelling.
- The challenges involved in monitoring low-density, relatively small species across large landscapes are well recognised. Advanced statistical approaches using presence/absence data, such as occupancy rates, have alleviated some of these challenges and, in some cases, have allowed population density/abundance estimates of reasonable accuracy.
- This KOAP will be updated once an occupancy model is developed for smoky mouse (action 2).

4. Governance

Reporting

As required under Snowy 2.0 approvals, NPWS must monitor, evaluate and publicly report on progress of the implementation program and the effectiveness of the specific projects and actions. An annual report (provided to NPWS, DCCEEW and published on the NPWS website within 3 months of the end of each financial year) will be prepared by NPWS on the Snowy 2.0 biodiversity offset program for KNP and its implementation, including progress with achieving the required increase in the population of the smoky mouse in KNP.

The annual report will:

- detail the expenditure from the biodiversity offset fund on agreed actions under the KOAPs
- outline any interest earned and reinvested into the offset program
- provide details about the conservation actions carried out for each approved threatened species, TEC and threatened ecosystem KOAPs such as:
    - the type of conservation action implemented – for example, feral animal control, habitat restoration
    - the geographic extent and location of the conservation actions
    - the proportion of the proposed conservation actions achieved, and proportion yet to be achieved
    - an analysis and summary of monitoring data
    - future conservation actions, with key timeframes including intended completion
- include details on progress towards each KOAP objective that has been delivered
- document where adaptive management principles have been applied to each KOAP to improve the effectiveness of the plans.

Adaptive management

Quantifying and measuring the biodiversity benefit for smoky mouse may present significant technical challenges. Combined with the influence of natural variability, it is anticipated there will be a level of uncertainty in relation to both measuring and interpreting relevant biodiversity benefits for smoky mouse. This uncertainty will be addressed by applying an adaptive approach, including reviewing and updating density numbers, monitoring, methodologies and strategies as new information, data or technology becomes available. At a minimum, action plans will be reviewed every 5 years.

Approvals

Date/approval	
Date prepared	June 2023
Date approved - NPWS	20 June 2023
Approved by	Atticus Fleming, Acting Coordinator General, Environment and Heritage Group, Department of Planning and Environment
Date approved - DCCEEW	8 September 2023
Approved by	Rachel Parry, Deputy Secretary, Department of Climate Change, Energy, the Environment and Water
Date for review	September 2028

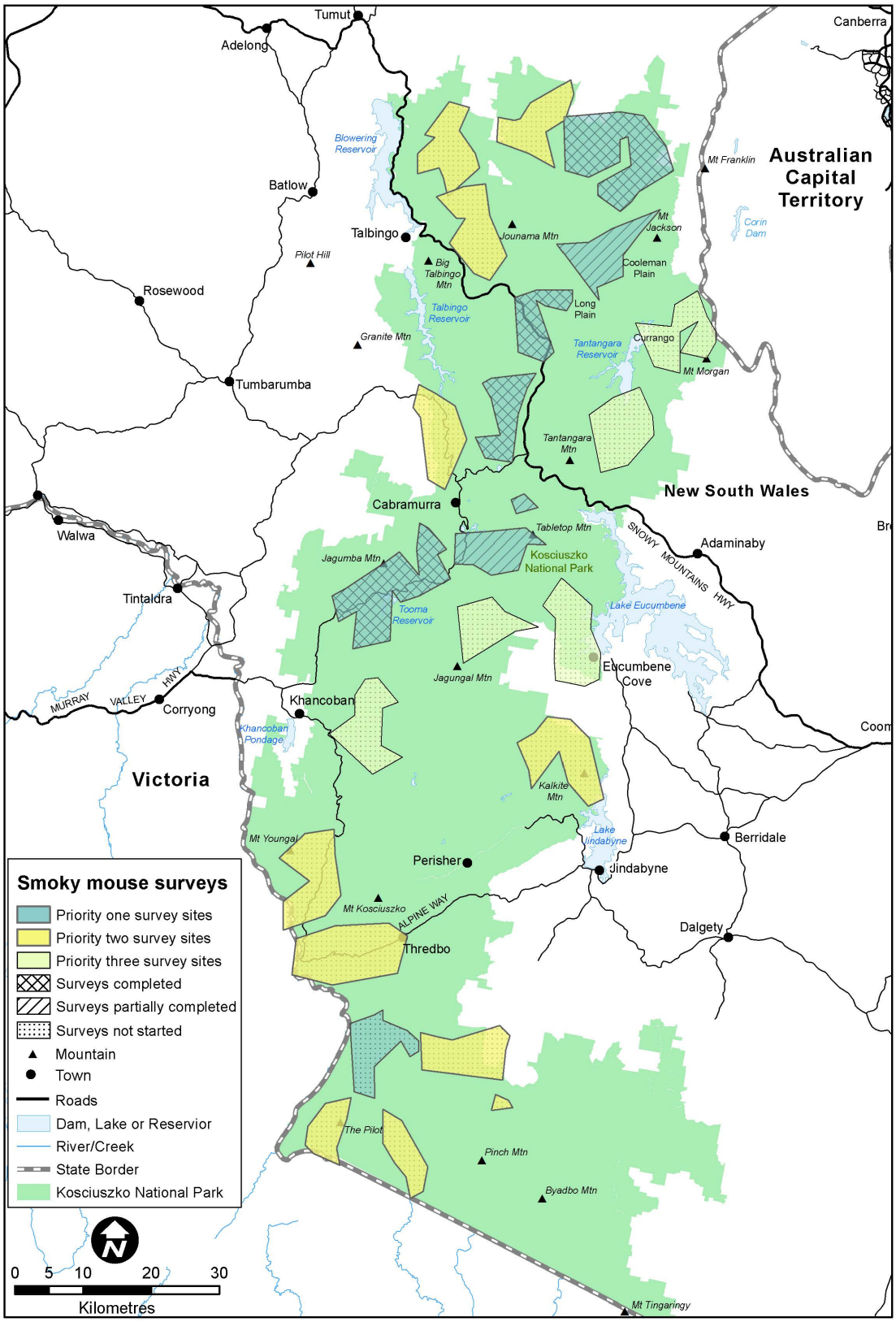

Figure 1 Smoky mouse monitoring areas – sites surveyed, northern Kosciuszko National Park (July 2022)

5. More information

- Approved threat abatement plans
- Assets of Intergenerational Significance