

Mountain Pygmy-possum Operational Contingency Plan

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Organisation abbreviations

| Abbreviations | Organisation |
|---------------|--|
| ARMB | Alpine Resort Management Board |
| CMA | Catchment Management Authority |
| DWNAC | Dhudhuroa Waywuru Nations Aboriginal Corporation |
| DELWP | Department of Environment, Land, Water & Planning |
| FCRMB | Falls Creek Resort Management Board |
| GBCMA | Goulburn Broken Catchment Management Authority |
| GLaWAC | Gunaikurnai Land and Waters Aboriginal Corporation |
| MBMSARMB | Mt Buller Mt Stirling Alpine Resort Management Board |
| MHRMB | Mt Hotham Resort Management Board |
| NECMA | North East Catchment Management Authority |
| NESP TSRH | National Environmental Science Program Threatened Species Recovery Hub |
| PV | Parks Victoria |
| TLWC | Taungurung Land and Waters Council |
| MPP RT | Victorian Mountain Pygmy-possum Recovery Team |
| ZV | Zoos Victoria |

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Overview

1.1 Purpose of the Operational Contingency Plan

The purpose of the Mountain Pygmy-possum (MPP) Operational Contingency Plan (OCP) is to ensure a coordinated and effective response to the recently observed Pouch Young Litter Loss (PYLL) in Victoria's Mountain Pygmy-possum populations. This plan outlines actions, timing and responsibilities for activities that will occur between October 2019 and June 2020. In addition, it will outline actions that begin during this period, but will continue beyond the scope of this plan. These actions will be incorporated into the Mountain Pygmy-possum Action Statement, currently in draft.

This plan and the outcomes from the activities will be reviewed by the MPP State Recovery Team at their annual meeting in March 2020 and advice will be provided to the Executive Director Biodiversity Division, DELWP for further consideration. An evaluation of the plan will be completed by May 2020, which will inform future actions. It is recognised that circumstances may change, and knowledge will evolve which could require other activities and research projects to be implemented, that are not currently included in this plan. This plan reflects current knowledge and scientific understanding and all actions consider the context of the overall risk to the conservation of the species.

1.2 Context for the MPP OCP

The Mountain Pygmy-possum *Burramys parvus* is listed as threatened under Victoria's *Flora and Fauna Guarantee Act 1988*. An updated Action Statement has been drafted and is expected to be released in December 2019. The species is also listed as Endangered on the *Environment Protection and Biodiversity Conservation Act 1999*. The National Recovery Plan for the Mountain Pygmy-possum was published in 2016. MPP is also listed as endangered under the New South Wales *Threatened Species Conservation Act 1995*.

Multiple agencies and organisations are actively involved in MPP conservation in Victoria, informed by the FFG Action Statement, National Recovery Plan for the MPP, resort specific plans and guided by the Victorian MPP Recovery Team. This plan has been developed in partnership with the agencies and organisations shown in Table 1. Traditional Owners have been consulted and will have the opportunity to play an active role in implementation of this plan. Partner organisations will ensure Traditional Owners have the opportunity to provide input into actions and outcomes that relate to cultural significance, knowledge and conservation of MPPs and Bogong Moths *Agrotis infusa*.

Table 1: Roles & Responsibilities

| Entity | Function | Role in OCP | Role in Vic MPP Recovery Team |
|---|--|--------------------------------------|-------------------------------|
| Executive Director Biodiversity Division, DELWP | Senior Responsible Officer | Project owner | Receives advice |
| Regional Director Hume DELWP | Stakeholder relationship and Natural Environment Programs (NEP) Hume management/resourcing | For information | Receives advice |
| DELWP NEP Hume | Coordination & facilitation; technical advice; Traditional Owner relationships | Development & implementation partner | Chair |
| Goulburn Broken CMA | Project manager, stakeholder engagement; administration of RLP funds; Traditional Owner relationships | Development & implementation partner | Guest member |
| North East CMA | Project manager, stakeholder engagement, administration North East Recovery Project funded by the Australian | Development & implementation | Guest member |

| Entity | Function | Role in OCP | Role in Vic MPP Recovery Team |
|--|---|---|-------------------------------|
| | Governments National Landcare Program; Traditional Owner relationships | partner | |
| Parks Victoria | Land manager, project manager | Development & implementation partner | Member |
| Zoos Victoria | Expertise, technical advice, captive breeding facilities, project manager, stakeholder engagement, public education & awareness, advocacy | Development & implementation partner | Member |
| Mt Buller Mt Stirling ARMB | Land manager, project manager, public education & awareness | Development & implementation partner | Member |
| Mt Hotham ARMB | Land manager, project manager, public education & awareness | Development & implementation partner | Member |
| Falls Creek ARMB | Land manager, project manager, public education & awareness | Development & implementation partner | Member |
| cesar Pty Ltd | Expertise, genetic analysis | Technical input | Member |
| Dean Heinze | Expertise | Technical input & advice, monitoring design | Member |
| University of Melbourne | Population mathematical modelling | Technical input | |
| Commonwealth Department of the Environment and Energy | Regulation, investment | Regulator, investor | |
| NSW Department of Planning Industry and the Environment | Expertise | Liaison | |
| National Environmental Science Program | Expertise | Advice & funding partner (TBC) | |
| La Trobe University Research Centre for Applied Alpine Ecology | Expertise | Advice & funding partner | |
| Taungurung Land and Waters Council | Traditional Owners; project implementation with GBCMA & ARMBs; information sharing | Active inclusion in implementation as desired | |
| Dhudhuroa Waywurru Nations Aboriginal Corporation | Traditional Owners; capacity building on Country; information sharing | Active inclusion in implementation as desired | |
| Gunaikurnai Land and Waters Aboriginal Corporation | Traditional Owners; project implementation with GBCMA & ARMBs; information sharing | Active inclusion in implementation as desired | |

1.3 Background to the development of the OCP

Population monitoring undertaken in 2017/18 and 2018/19 identified the phenomenon of pouch young litter loss (PYLL) at a number of sites in Victoria. PYLL has coincided with the occurrence of extremely low numbers of Bogong Moths in the alpine area – a key food resource for the MPP during the breeding season (October-January).

The Victorian MPP Recovery Team, at their meeting in March 2019, recommended that a contingency plan including a risk assessment of options/actions be developed. A contingency planning workshop was held on 11th June 2019 to identify possible actions – research, interventions, funding and awareness campaigns. A subsequent science workshop was held on the 24th July 2019 bringing together experts in MPP and Bogong Moth ecology, evolutionary biology, genetics and population ecological modelling, as well as representatives from state and federal agencies, to further develop the contingency planning process.

The outcomes of these two workshops (Appendix 3) and input from the Victorian MPP Recovery Team determined the necessity of developing and implementing the OCP.

The roles and responsibilities of partners, including current activities and activities planned as part of the MPP OCP, has been identified and agreed as part of the finalisation of the OCP (Tables 3 and 4). The Executive Director Biodiversity, DELWP is the Responsible Officer for the MPP OCP, on behalf of the Minister Energy, Environment and Climate Change. Inclusion of an activity in the OCP does not supersede any regulatory permit requirements.

1.4 Timeframe and deliverables of the MPP OCP

Implementation of this MPP OCP will be from October 2019 through to June 2020. A number of processes will however, have been initiated prior to ensure the activities can proceed in line with alpine snow melt, MPPs emerging from hibernation and the normal seasonal arrival of the Bogong Moths.

| Project output | Acceptance or verification criteria | Authorisation | Estimated completion |
|---------------------|--|---|--------------------------|
| MPP OCP drafts | Initial drafts circulated to project partners for input | Manager, Threatened Species Policy, DELWP | Completed |
| Final draft MPP OCP | Final draft, subject to outstanding approvals, circulated to partners for planning | Manager, Threatened Species Policy, DELWP | Completed |
| MPP OCP 2019-20 | Endorsed MPP OCP approved for implementation | ED Biodiversity, DELWP | Completed |
| Monthly updates | Monthly project update report is completed by each partner and shared | Partner organisations | First week of each month |
| Draft evaluation | Evaluation of early results presented and discussed with Victorian MPP Recovery Team | Victorian MPP Recovery Team | March 2020 |
| MPP OCP evaluation | Program evaluation and feedback to ED Biodiversity | ED Biodiversity, DELWP | May 2020 |
| MPP OCP review 2020 | Revise MPP OCP for 2020-21 | ED Biodiversity, DELWP | August 2020 |

2. Background

2.1 Current status – Mountain Pygmy-possums

The MPP is the only mammal restricted to the alpine and sub-alpine areas of mainland Australia. Three genetically distinct regional populations are recognised from the Mount Kosciuszko area (Northern population) in New South Wales, and the two Victorian populations located in the Mount Bogong to Mount Hotham area (Central population), and at Mount Buller (Southern population) (Osborne *et al.* 2000, Fig. 1). A key component of the preferred habitat of the Victorian MPP populations includes high elevation boulderfields typically above 1200 metres elevation. Trapping and radiotelemetry studies have shown that the species is largely confined to well-defined boulderfields with associated shrubby heathland (Caughley 1986; Heinze and Williams 1998; Broome 2001a; Mansergh 1989; Heinze *et al.* 2004). In addition, they forage, and sometimes nest in the shrublands with scattered boulders adjacent to the main boulderfields (Mansergh 1989; Broome 1992; Walter 1996; Heinze *et al.* 2004). MPPs are omnivorous, eating a variety of seeds, berries and invertebrates, including the migratory Bogong Moth (BM) which typically congregates in high numbers at the higher elevations of boulderfields and form an important part of the species diet in spring and summer (Gibson *et al.* 2018; Mansergh *et al.* 1990; Smith and Broome 1992), as well as allowing MPPs to rebuild body fat reserves needed for hibernation (Geiser and Broome 1991 & 1993).

Boulderfields in the sub-alpine and alpine areas of Victoria are both rare and disjunct, consequently the distribution of MPPs follows a similar pattern (Heinze *et al.* 2004). Low elevation valleys divide the Central population into three sub-populations, including Mt Bogong, the Bogong High Plains, and the Mt Hotham area. These sub-populations are further divided into 15 recognised local populations, including 12 within the Alpine National Park and three solely within adjacent alpine resorts (Heinze 2005). The Southern or Mt Buller population is the most confined and is known to exist as a single fragmented local population entirely within the Mt Buller Alpine Resort. Key threats have been identified as habitat loss and fragmentation, climate change, decline in BMs, fire, predation by feral cats and foxes, erosion and sedimentation, winter impacts from ski resort operations and snow sports, genetic loss and small populations, and weed invasion (DELWP 2016).

Population monitoring has been undertaken at varying frequencies across the MPPs range since the early 1980s. Monitoring is primarily undertaken early in the breeding season when pouch young in each population can be assessed but are relatively small (generally early November to early December). Annual monitoring has consistently been undertaken on all populations within Victoria's alpine resorts for over 10 years through funding provided by each Alpine Resort Management Board. Annual monitoring has occurred at Mt Buller for 22 of the past 23 years. Other key populations have been monitored periodically (i.e. Mt Loch north, Mt Higginbotham west, Timms Spur).

Mt Loch east has been monitored as part of assessing impacts on a source site of removing 10 MPPs for a captive breeding research program run by Zoos Victoria since 2016. Sites across the Victorian range, including Mt Loch east, have had sporadic monitoring over the last 20 years, including after the 2003 alpine fires and assessing source sites following the genetic rescue at Mt Buller. Additional monitoring has been undertaken in 2018 as part of the Regional Land Partnership (Commonwealth) funded projects coordinated by the North East and Goulburn Broken Catchment Management Authorities.

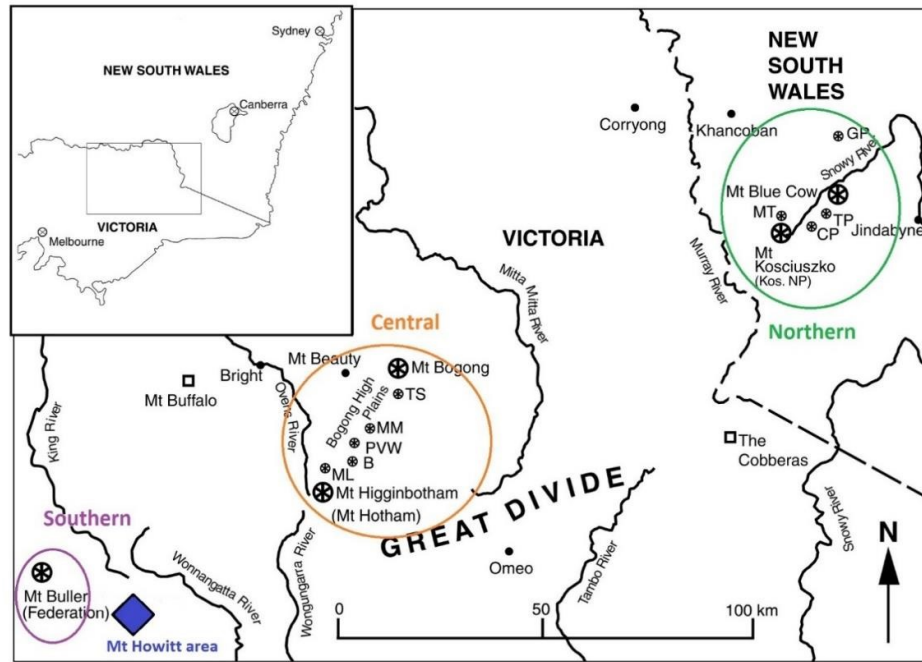


Figure 1. Regional populations of the Mountain Pygmy-possum (MPP). (See Figure 2 for greater detail on the central population).

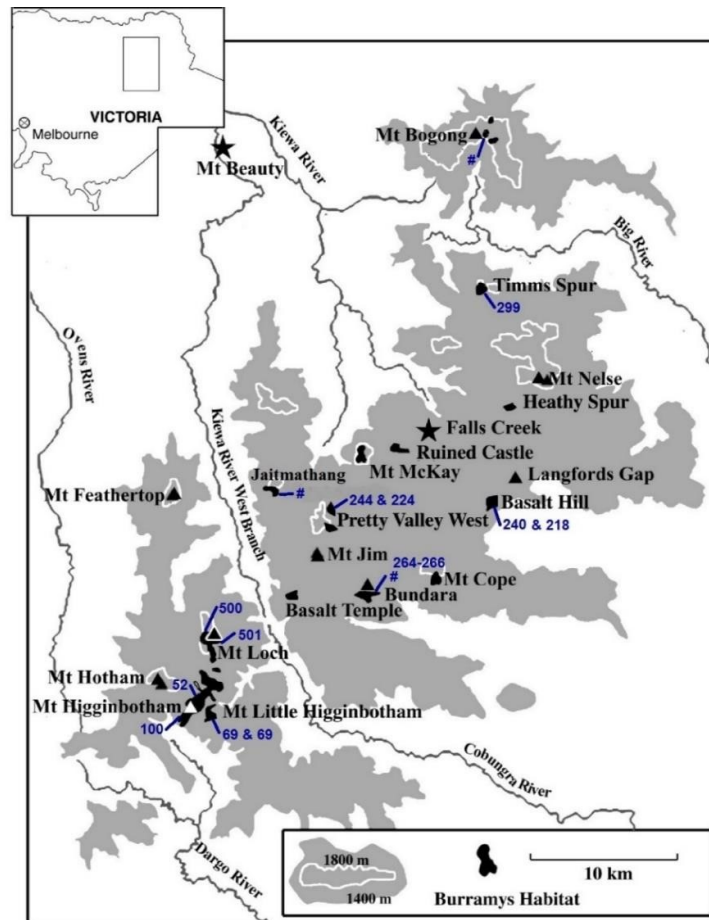


Figure 2. Distribution of local populations of the central MPP population

2.1.1 Pouch Young Litter Loss

Over the last two years, pouch young litter loss (PYLL) has emerged as an issue that may affect the current and future viability of the Mountain Pygmy-possum. Consensus at both the June and July contingency planning workshops linked the observed PYLL to the significant decline in Bogong Moths (BM) *Agrotis infusa* in alpine areas. Decline in the availability of BMs was identified as a threat under the National Recovery Plan for the Mountain Pygmy-possum *Burramys parvus* (DELWP 2016). The BM is a key and primary food source for the MPP (Mansergh et al. 1990; Smith & Broome 1992) following hibernation and during the breeding season (October-January). The causal link between lack of BMs and PYLL is supported by the opportunistic post-mortem analyses conducted in 2018/19, which found no signs of disease or underlying infection (viral or bacterial) in dead pouch young. The evidence strongly suggests a lack of nutrition lead to their death.

PYLL is evidenced by recently deceased young still within the pouch, or an absence of young that coincides with extended teats and a lack of milk. Significant PYLL has only previously been detected following the 2003 alpine bushfires (Heinze, 2005). This was an extreme event throughout much of the alpine region that occurred during the millennium drought and resulted in MPPs being restricted to small refuge areas. This led to increased density of animals in these areas and likely subjected them to significant social pressures.

Generally monitoring is not conducted after the first week of December due to the additional level of stress likely to be inflicted on trapped individuals and the risk of females losing litters (Dean Heinze pers. comm. 2019). Therefore, the frequency and impact of PYLL on the viability of the species is unknown. However, the significant PYLL observed in 2017 and 2018 during the traditional monitoring timeframe (late November to early December) was considered unusual enough to prompt further monitoring into late December in these years.

Since the post bushfire PYLL observations, the phenomenon had not been detected until 2016 at Timms Spur, a site monitored only in some years. On this occasion, trapping was undertaken a little later in December than normal, which led to the observation. Monitoring was subsequently undertaken at multiple sites in 2017/18 and 2018/19, with later season sampling revealing significant PYLL at these locations (Heinz, 2019). Recorded PYLL are presented in Table 2.

Table 2. Percentage PYLL detected in key MPP populations since 2016 (end date of surveys in parenthesis)

| Population | 2016/17 | 2017/18 | 2018/19 |
|------------------------|------------------|-------------------------------------|--------------------------------------|
| Mt Higginbotham | - | 13% (29/11/2017) | 19% (4/12/2018) |
| Mt Little Higginbotham | - | 11% (26/11/2017) | 63% (4/12/2018) |
| Mt Loch East | - | 12% (5/12/2017) 75% (17/12/2017) | 60% (6/12/2018) 95% (31/12/2018) |
| Mt Loch North | - | - | 4% (1/12/2018) 50% (31/12/2018) |
| Mt Buller | - | - | 18% (16/11/2018) 54% (18/12/2018) |
| Timms Spur | 50% (12/12/2016) | 33% (15/12/2017) | 8% (15/12/2018) 60% (2/1/2019) |
| | | | |

There is uncertainty regarding PYLL in other populations monitored through funding provided under the Regional Land Partnerships (RLP) in 2018, due to the low numbers being trapped and the timing of trapping at these sites (Heinz, pers. comm. 2019).

It has been emphasised by MPP experts that there is considerable uncertainty around the extent of PYLL in years prior to 2016 and that it is possible that PYLL is a regular phenomenon. However, evidence from various monitoring programs suggests that the PYLL observed recently is atypical. While Mt Buller has been the most extensively monitored MPP population over the last 10 years while the genetic rescue was undertaken (Weeks et al. 2017), very little monitoring has been undertaken in December with the exception of December 2013, when no loss of pouch young was recorded. Also, observations of PYLL of greater than 10% of females trapped has not been observed in late

November prior to the 2017 and 2018 seasons. Regular trapping in early December in NSW from 1986-1998 did not detect PYLL at a population scale (Broome 2001b; and Linda Broome, pers. comm.).

Data on the female age cohort structure of MPP populations from 5 populations suggest that despite recent observations of PYLL, each of the MPP populations monitored had experienced relatively normal levels of juvenile recruitment from the previous breeding season, with no major impacts on age structure. However, this has not been statistically assessed. As MPPs cannot be reliably aged using tooth wear or body weight, age is assigned when the individual is first captured (usually spring/early summer). Therefore, assignment of ages to untagged individuals in a site that is not annually monitored, diminishes the ability to accurately assess recruitment for that year (Heinze pers. comm. 2019). Consistent annual monitoring of populations is required to fully identify the success of juvenile recruitment. There is a need to better understand:

- a) the relationship between PYLL and survival to adulthood;
- b) the “normal” level of juvenile mortality from pouch young through to recruitment into the adult population; and
- c) the frequency entire litters are lost under normal Bogong Moth abundance.

It will also be important to look at levels of adult survival and whether low weight or litter loss in females is an indicator of higher mortality.

Analyses of recently obtained genetic data indicating levels of genetic diversity and population structure for the six key central region MPP populations, as well as for the southern region Mt Buller population has been undertaken. These data indicate that all populations surveyed have maintained levels of genetic diversity over the 15-year period since the previous assessment, in spite of persistently low census numbers for most MPP populations and significant stochastic factors including the 2003 and 2006 alpine fires and the recent episodes of PYLL. The exception to this is the Mt Buller population, which has benefitted significantly from the genetic rescue program implemented there. Genetic diversity estimates are relatively high in all populations. It should be noted that if high levels of PYLL is a significant factor that has only arisen in the last year or two, any genetic effects are not likely to be apparent for a few years.

While females can live for up to 12 and males up to five years, the majority of individuals of both sexes survive for only one to three years. The 15% of females that extend the age pyramid, provide population persistence through successive poor seasons (Mansergh & Scotts 1990; Broome 2001a). Differential survival between the sexes means that there are usually fewer males at breeding time.

It is not clear at what stage of the MPP life cycle that the most intense selective pressures act against developing juveniles, or to what extent these dynamics are influenced by existing population density or food resource abundance.

Population viability models that have been recently developed for the MPP have drawn attention to the risk of high levels of PYLL, but do not incorporate the latest genetic data and thus have limited capacity to predict adverse effects of inbreeding depression. Advice provided during the science (July) workshop regarding the use of population viability models, highlighted their sensitivity to the accuracy of input data and the associated assumptions. They are therefore likely to be more effective in assessing the relative benefits of different actions, rather than making absolute predictions of outcomes or for predicting population extinction (Weeks & Kriesner, 2019). They can have significant utility for assessing the value of existing monitoring programs and to inform how and when to monitor to be likely to pick up key signals (triggers), as well as to help determine the impact of potential interventions. Inclusion of density-dependence functions in the population models (as population size decreases, survival and recruitment increases; or as resources decrease, carrying capacity declines) was also considered a critical factor in the further development of MPP population viability models.

2.2 Current status – Bogong Moths

The lifecycle and migratory patterns of the BM are poorly understood. Published data from the 1950s on the extent of BM breeding grounds is considered to significantly underestimate the area, which likely extends considerably further to the west and south (Green, pers. Comm. 2019; and McDonald, pers. comm. 2019).

Qualitative data from Mt Gingera (ACT), Kosciuszko NP (NSW) and Mt Buffalo (Vic), summarising the pattern of BM abundance since the 1951/52 summer, concludes there has been a downward trend in BM abundance throughout the Australian alpine region over the summer months over the last 20 to 30 years. This is underlying a varying annual pattern that appears to be largely driven by the extent of winter rainfall across the moth's breeding grounds. For the past two summers, BMs have been at extremely low abundance or absent throughout the alps. Climate change impacts including significant drought, pesticide use and conversion of a large proportion of available agricultural land to rice and cotton farming were posed as significant factors in a declining trend in BM abundance.

3. Plan

3.1 Objectives

3.1.1 Broader objectives

The objectives for Mountain Pygmy-possum conservation are reflected in the *Flora and Fauna Guarantee Act 1988* Action Statement (updated version in draft). The long-term conservation objective is to ensure that the species persists across its range and maintains its potential for evolutionary development in the wild. With the severe threat to the species from climate change, strategies for its long-term survival need to be considered.

The specific objectives of the draft Action Statement are:

- To maintain or increase the number of Mountain Pygmy-possums in the wild;
- To maintain and enhance the extent and condition of Mountain Pygmy-possum habitat;
- To investigate key aspects of the biology and ecology of the Mountain Pygmy-possum; and
- To increase community awareness of and support for the conservation of the Mountain Pygmy-possum.

3.1.2 Objectives of this plan

The MPP OCP aims to address the short- to medium-term threat of reduced Bogong Moth numbers and any immediate impact on the viability of MPP populations. The key objectives of this plan are to:

1. minimise the impacts of the Bogong Moth shortage on the viability of MPP populations;
2. address key knowledge gaps in our understanding of MPP and Bogong Moths;
3. develop management capabilities to respond to significant risks; and
4. determine the most cost-effective management actions to apply.

3.2 Scope

3.2.1 In scope

| Inclusions |
|---|
| Communication plan, including interstate advocacy |
| Management action options and timing |
| Research actions, options and timing |
| Risk analysis |
| Reporting to DELWP and MPP State Recovery Team |
| Evaluation |

3.2.2 Out of scope

Exclusions

Interstate (New South Wales) actions and interventions

Interstate regulatory response

Broad scale *ex situ* intervention

Long-term interventions (though the plan will include actions that are initiated during this season and continue into the longer term)

3.3 Constraints and assumptions

3.3.1 Constraints

All actions to be undertaken will have considered the overall risk to the conservation of MPPs. Two direct interventions were considered as part of the OCP:

- Capture and release of females with pouch young was postponed, allowing for the collection of further information about when, how and where it could be applied and why it would be used; and
- Supplementary feeding will be implemented on a trial basis to develop capacity and knowledge and will include associated monitoring and evaluation.

Access, both geographical and seasonal, are significant constraints in MPP habitat locations and will need to be accounted for in all planned actions/design of monitoring.

3.3.2 Assumptions

- Partner agencies and organisations will provide agreed resources and funding;
- Sites are accessible;
- Data collected during monitoring will provide the relevant information to inform future actions; and
- Data will be shared between partner organisations to achieve the shared outcomes of the plan.

4. Management action options

4.1 Mountain Pygmy-possum knowledge gaps

There are significant gaps in our understanding of the cause, extent and impacts of PYLL on the MPP. The current knowledge gaps include, but are not necessarily limited to the following:

- the extent of PYLL within and between populations and implications for recruitment and breeding;
- if there is any relationship between the health of individuals or between the size, location or spatial make up of populations and the extent of PYLL;
- sex ratios within the population;
- the number of juveniles prior to hibernation;
- the condition of adults during times of high PYLL and how this affects their survival across the hibernation period; and
- the MPP diet in Victorian populations, especially alternate food sources to BM and if this varies across the populations.

- impact and timing of translocation of captive bred animals on them or their offspring and other animals' survival

4.2 Bogong Moth knowledge gaps

There are substantial gaps in our understanding of the BM lifecycle, migratory patterns and its role as a keystone species in the alpine ecosystem. Research is needed to inform its distribution and abundance across geographic regions (including key breeding areas) and how this varies seasonally and over longer timescales, threats and their impacts on population numbers, preferred food plants, physical habitat requirements, thermal tolerance, identity and extent of reliance on native food plants, drought refuge strategies and migratory patterns.

Some BM monitoring is currently undertaken in alpine areas under several programs, including by Taungurung Traditional Owners as part of Goulburn Broken Catchment Management Authority's (GBCMA) Regional Land Partnerships (RLP) contract with the Commonwealth Government and in partnership with the Mt Buller Mt Stirling Alpine Resort Management Board. Qualitative data on abundance of BMs from a longitudinal study (~ 70 years) from three locations in Victoria, ACT and NSW, was presented at the science workshop in July (Weeks et al. 2019). This data provides insights into the pattern of distribution of the species over a very long period. Specific BM monitoring has also been undertaken in NSW. There is a need to review the data collected (and the data collection protocols) to explore how this information can best be used to increase our overall knowledge of the BM.

4.3 Current MPP management activities

There are currently a broad range of management activities and monitoring programs being undertaken across some MPP populations, for a range of reasons. Many of these activities are closely aligned with the draft MPP Action Statement and National Recovery Plan for the MPP and have been endorsed by the Victorian MPP Recovery Team. The MPP OCP does not propose changes to these existing programs and actions proposed within the MPP OCP will complement existing programs and respond to gaps in current knowledge. See Appendix 2 for the table of current activities and relationship with the MPP OCP.

4.4 Specific actions of the Operational Contingency Plan

Based on the outcomes of the two workshops and subsequent discussions with stakeholders, a list of actions has been developed. Detailed project plans are being drafted by partner agencies, to deliver on actions committed to under this plan. Approvals, where relevant, are the responsibility of the organisation/individual delivering the action, in consultation with DELWP and land managers. Monthly progress reports will be provided to DELWP and will form the basis for an evaluation of the plan.

Table 3 outlines the scope of the actions to be undertaken, their purpose and general timing. The alignment of each action to each of the objectives (from 4.1.2 and repeated below) is included. The priority of the action is also identified, where known and as agreed by partners during the development of this plan.

Objectives (from 3.1.2)

1. To minimise the impacts of the Bogong Moth shortage on the viability of MPP populations;
2. To address key knowledge gaps in our understanding of MPP and Bogong Moths;
3. To develop management capabilities to respond to significant risks; and
4. To determine the most cost-effective management actions to apply.

Table 3: Specific Actions of the Operational Contingency Plan

| Action | Purpose | Timing | Priority | Relevant objective(s) | Parties involved |
|---|---|--|----------|-----------------------|---|
| 1. MPP Monitoring | <ul style="list-style-type: none"> To extend the long-term monitoring database To better understand the occurrence of PYLL To get a better understanding of habitat use/sites in addition to standard monitoring plots To collect additional genetic material for population analysis To collect dead pouch young for genetic samples and necropsy | October 2019 – March 2020 | High | 2 | ARMBs; CMAs; Zoos Victoria; Parks Victoria; La Trobe Uni; DELWP |
| 2. MPP Modelling | <ul style="list-style-type: none"> To integrate current knowledge of MPP life history traits, census population numbers, dispersal, and (potentially) genetic diversity/gene flow To undertake sensitivity analyses and inform: <ul style="list-style-type: none"> the impact of PYLL on overall recruitment within the population, assuming density dependent relationships; the likely relationship between MPP population carrying capacity and food resource availability; the point at which effective size (N_e) of MPP populations may become too small for those populations to be likely to remain genetically viable over time; the development of trigger points for management interventions; the impact of proposed management interventions and the metrics that must be met for the success of these management interventions; and the impact of reduced adult body weights on survival. | April – June 2020 | High | 2,3,4 | DELWP; University of Melbourne; Zoos Victoria |
| 3. Genetic analysis of BM population | <ul style="list-style-type: none"> To better understand the site fidelity and migration routes of BM To better understand environmental cues to predict population size | October 2019 – June 2020 | Medium | 2,3 | DELWP; cesar |
| 4. BM monitoring and ecological studies | <ul style="list-style-type: none"> To refine monitoring protocol to quantify BM population across the alps To better align BM abundance with MPP population health To better identify location and habitat condition of breeding grounds To help determine the cause of BM population decline (land | Commencing October 2019; Detailed research program by February 2020; | High | 2,3,4 | DELWP; NESP TSRH |

| Action | Purpose | Timing | Priority | Relevant objective(s) | Parties involved |
|--|--|--|----------|-----------------------|--------------------------------------|
| | degradation, pesticides, climate/drought, etc) • To predict good and bad BM years in advance of the Spring MPP breeding season | implementation subject to resourcing | | | |
| 5. BM sighting & reporting (Citizen Science) | • To increase knowledge of BM movement across landscapes | Implemented | Medium | 2 | Zoos Victoria |
| 6. Reduction/alteration of outdoor lighting | • To minimise distractions along migration routes for BMs • To reduce distractions within ski resorts and increase BM abundance in boulderfields | October - December 2019 | Medium | 1 | ARMBs; Zoos Victoria |
| 7. Supplementary feeding trial* | • To develop a palatable and effective supplementary feed as an alternative to BMs for deployment in the field • To develop a practical deployment strategy that minimises the risk of undesired impacts • To develop and implement a monitoring and evaluation plan that assesses the efficacy of the supplementary feed deployment and outcomes for MPP • To develop and trial supplementary feeding techniques (in captive breeding population) • To provide a nutritional food source for MPPs for use in traps, in addition to walnuts, where formal dietary analysis is not being undertaken | October - December 2019 | Medium | 3, 4 | Zoos Victoria (lead); Parks Victoria |
| 8. Additional diet analysis | • To better understand dietary composition during breeding season | Collection in conjunction with MPP monitoring; analysis to June 2020 | Medium | 2 | Dean Heinze; La Trobe Uni |
| 9. Additional MPP genetic studies | • Analysis of additional tissue samples to better understand MPP population dynamics | Dependent on funding/endorsement | Low | 2 | TBD |
| 10. Targeted cat control (to optimise fox baiting at key | • To counter the potential increase in cat numbers as a result of the existing fox control program • To reduce overall predation pressure on MPP population | From October 2019; dependent on effective control | High | 1,4 | ARMBs; Parks Victoria; CMAs |

| Action | Purpose | Timing | Priority | Relevant objective(s) | Parties involved |
|---|--|----------|----------|-----------------------|-----------------------------|
| sites) | | measures | | | |
| 11. Habitat restoration, rehabilitation and reconnection works | <ul style="list-style-type: none"> To increase foraging opportunities for MPPs, reducing vulnerability to predation and reducing competition for food (e.g. from Bush rats) To restore degraded habitat for expansion of MPP populations (e.g. restoration of the old Little Higginbotham quarry site) Maintain existing habitat through reduced threatening processes e.g. sedimentation | Ongoing | Medium | 1,4 | ARMBs; Parks Victoria; CMAs |

* Subject to relevant statutory approvals

4.5 Project Risks and Mitigation

The following table outlines all potential risks and mitigating actions to reduce these risks. These risks have been assessed in the context of:

- A) Success of the MPP OCP, considering either poor implementation and those things that are out the control of implementation partners; and
- B) Impact on Mountain Pygmy-possum species viability.

Matrix used to calculate Risk Rating

| Consequence | Likelihood | | | | |
|-------------|------------|----------|-------------|-------------|----------------|
| | | Unlikely | Possible | Likely | Almost Certain |
| | Minor | Low | Low | Medium | Significant |
| | Moderate | Medium | Medium | Significant | High |
| | Major | Medium | Significant | High | High |

Table 4: Risks and mitigations relating to Actions

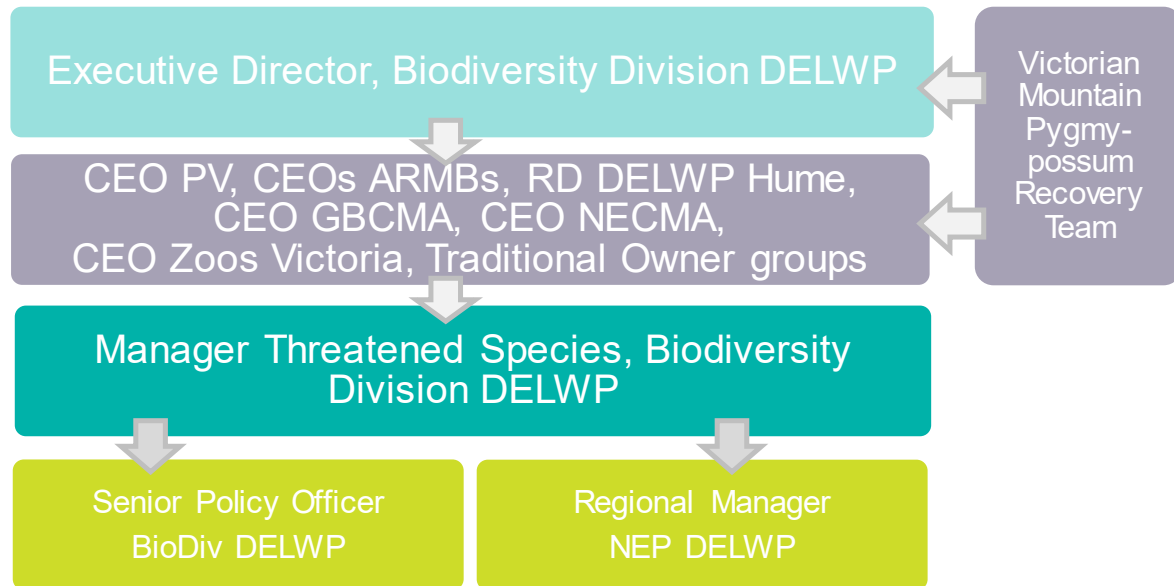
| Initial risk | Likelihood | Consequence | Initial rating | Mitigation | Residual rating |
|--|----------------|-------------|----------------|---|-----------------|
| 1. MPP Monitoring | | | | | |
| Monitoring protocol doesn't provide additional data to address PYLL knowledge gaps | Possible | Moderate | Medium | Monitoring protocol designed with timing to address specific questions relating to PYLL. Key knowledge gaps evaluated by independent scientist prior to Spring 2019 | Low |
| Juvenile recruitment (true indicator of PYLL effects) difficult to determine | Possible | Major | Significant | Consecutive monitoring to be undertaken at key sites at the appropriate time of year to accurately detect juvenile recruitment | Medium |
| Unidentified pathogen may cause or exacerbate PYLL | Unlikely | Major | Low | Opportunistic necropsy analyses to eliminate pathogens as contributing to PYLL | Low |
| Late snow cover delays access to monitoring | Possible | Moderate | Medium | Flexibility in the timing and resourcing of monitoring | Low |
| 2. MPP Modelling | | | | | |
| Insufficient data for model development | Possible | Moderate | Medium | Use qualifying statements with caveats On-going collection of data to refine model development | Low |
| 3. Genetic analysis of BM population | | | | | |
| Moth genetic analysis is not undertaken | Possible | Moderate | Medium | Project is resourced | Low |
| 4. BM ecological studies | | | | | |
| BM larval habitat, ecology and migratory patterns are poorly understood | Almost certain | Major | High | Collaborate with partners and broader scientific network to design and implement a monitoring program for BM | Medium |

| | | | | | |
|--|----------------|----------|-------------|---|-------------|
| 5. BM sighting & reporting (Citizen Science) | | | | | |
| Too much information collected or information unreliable | Possible | Minor | Low | Ensure project is designed to engage people and raise awareness; database designed to cater for large response; BM fact-sheet developed; incorporate photo-verification | Low |
| 6. Reduction/ alteration of outdoor lighting | | | | | |
| Any change to lighting has negligible effect on BMs | Likely | Minor | Medium | Record occurrence of BM in lighted areas on known migratory routes | Low |
| Difficulty in modifying lighting regimes within built-up areas on migratory routes | Almost Certain | Moderate | Significant | Implement 'lights off' campaign; concentrate efforts in known migratory routes; leverage existing networks and influencers | Medium |
| 7. Supplementary feeding trial* | | | | | |
| Interaction with competitors and predators have a negative impact on MPPs | Possible | Major | Significant | Monitor visitation to the supplemental food and the boulderfields. Run a trial of supplementary feeding in one site in 2019-20 to determine impacts | Medium |
| 8. Additional diet analysis | | | | | |
| Insufficient animals trapped to collect representative samples | Unlikely | Minor | Low | Samples to be collected at all monitored sites for analysis | Low |
| Sampling protocols are not adhered to resulting in contaminated samples | Possible | Moderate | Medium | Data collection protocol training provided to all site monitors | Low |
| 9. Targeted predator control | | | | | |
| Cat control is ineffective | Almost Certain | Moderate | High | Liaison and collaboration across all tenures to use all legal control methods where appropriate. Engage cat specialists to effectively reduce source population | Significant |

* Refer to animal ethics Supplementary Feeding Trial application for full description of risks and mitigation strategy.

5. Operational organisation and control

5.1 Project organisation



5.2 Project coordination and liaison

DELWP will maintain regular coordination between the project partners by:

- scheduling monthly meetings;
- seeking and sharing brief written progress reports from the lead partners; and
- circulating weekly email updates.

DELWP will also maintain regular communication with key contacts in the Australian Government Department of the Environment and Energy, including ensuring compliance with Commonwealth legislation. DELWP will also maintain regular communication with key contacts in the New South Wales Department of Planning, Industry and the Environment.

6. References

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Appendix 1: Communication plan

Mountain Pygmy-possum Operational Contingency Plan COMMUNICATION FRAMEWORK



Introduction

The purpose of this Communication Framework is to outline a collaborative approach to raise awareness for the Mountain Pygmy-possum, the current issues and actions surrounding pouch young litter loss, and the required communications action we can take to assist recovery. It includes all channels we can use, plus all stakeholders, timing and key spokespeople, as well as agreed key messages and Frequently Asked Questions. It also serves as a basis for group consensus amongst the Victorian MPP Recovery Team and stakeholders, to ensure all plans are saved in the one place.

Stakeholder and Target Audiences

Recovery Team Members and Primary Stakeholders

- Victoria's Minister for Energy, Environment and Climate Change
- Australian Minister for the Environment
- Australian Threatened Species Commissioner
- Victorian Department of Environment, Land, Water and Planning
- Saving our Species program – NSW Department of Planning Industry and the Environment
- Australian Department of Environment and Energy
- Parks Victoria
- Zoos Victoria Board and Foundation Board
- Mt Hotham Alpine Resort Management Board
- Mt Buller Mt Stirling Alpine Resort Management Board
- Falls Creek Alpine Resort Management Board
- The University of Melbourne
- La Trobe University
- Ecology Links
- cesar Pty Ltd
- Goulburn Broken Catchment Management Authority
- North East Catchment Management Authority
- Taungurung Land & Water Aboriginal Council (TLWAC)
- Dhudhuroa Waywurru Nations Aboriginal Corporation
- Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) representing Traditional Owners from the Brataualung, Brayakaulung, Brabralung, Krauatungalung and Tatungalung family clans
- Media – local and national
- NSW community
- Victorian community

Target Audience

- Broad: ACT, QLD, SA, NSW and Victorian public
- Targeted: Canberra and surrounding district residents, local government, councils, community groups, businesses/lessees in Alpine Resorts and alpine resort residents

Special Interest Groups

- Schools/education sector
- Citizen Science Groups

Third Party Endorsers

- Zoo and Aquarium Association Board

Communication objectives

The aim of this plan is to outline a coordinated approach to communications between partner organisations implementing the Mountain Pygmy-possum Operational Contingency Plan, specifically to:

- Ensure primary stakeholders can provide a unified and collaborative voice to raise awareness for the MPP and explain the response to the current litter loss issues.
- Coordinate communications and stakeholder relations activities with all interested parties.
- Create awareness in the community of the status of the species, and the need to implement priority actions.
- To ensure the public are given factual and timely information and hopeful actions to take.
- Enhance support for the recovery program and the species.
- Promote the value of threatened species conservation in general through the demonstrated past successes throughout the Action Statement and Recovery Plan, including revegetation, translocations to improve genetic viability, long term research, migratory ‘tunnels of love’.
- Provide an accurate source of information for consistent messaging for the recovery program which includes multiple agencies and Non-Government Organisations.
- Identify and mitigate against engagement/ communication risks.

Key external communication channels

- Mainstream media (print, radio, TV)
- Social media (Twitter, Facebook, Instagram, YouTube)
- On site opportunities e.g. at festivals, presentations, displays
- Retail opportunities (tote bags, posters)

Standard messages

In developing communications products, these messages (or a pertinent subset of them) should always be included.

1. Mountain Pygmy-possums are ours (Victoria’s/NSW’s) and worth saving.
2. This (recovery) is a team effort.
3. There are simple actions that anyone can do to help.
4. The best available science is being applied to understand the issue and support the protection of the species.

Background information to inform key messages

- Background: List of agreed historical facts/messages – see Frequently asked questions
- Agreed messages about current litter loss issue and forthcoming planned events (e.g. mitigation strategies)
- Promote success of program so far

Protocol to be followed by all team members for MPP communications

If a member organisation is creating MPP-related materials, media releases, stories etc. that have any connections to the Recovery Team (i.e. any partner(s) is/are involved in any aspect of what the 'news' is about) or the Recovery Plan (i.e. the story is about an event that is contributing to or a planned part of MPP recovery) then:

- The partners relevant to the particular story will agree on the lead organisation for this story.
- In social media where space is limited partner organisations should be included using handles (e.g. Twitter, Facebook, Instagram) or hashtags (#MountainPygmyPossum, #MPPRecoveryTeam) where possible. See handle table below.
- We all understand that what is given to external media is not always going to make it through to the media's version of the story. However, we will follow this protocol for all material we produce.
- All media should be consistent with the objectives in this strategy and integrate the background information for key messages
- All partners promote opportunities for joint media announcements
- The lead organisation will **always** reference the recovery team as follows:
 1. Recognise the Recovery Team as an 'entity' e.g. the "*Victorian Mountain Pygmy-possum Recovery Team*". The entity reference could look, for example, like this: "*Zoos Victoria, as part of the Victorian Mountain Pygmy-possum Recovery Team, will this week do xyzabc etc. etc. etc.*"
 2. Name any Recovery Team member organisations involved in or supporting this story
 3. Include the Recovery Team "info footer" in all materials.

The MPP RT information footer is a standardised explanation of what the Recovery Team is and includes a list of all its members.

For example: "*The Victorian Mountain Pygmy-possum Recovery Team is a voluntary collaboration of conservation organisations. Partners in implementation include: The Department of Environment, Land, Water and Planning, Parks Victoria, Saving our Species program – NSW Department of Planning Industry and the Environment, Mt Hotham Alpine Resort Management Board, Mt Buller Mt Stirling Alpine Resort Management Board, Falls Creek Alpine Resort Management Board, The University of Melbourne, La Trobe University, Ecology Links, CESAR, Goulburn Broken CMA, North East CMA and Zoos Victoria are working together to save this precious native marsupial from extinction. For more information on the Recovery team, please contact Jerry Alexander, Convenor, Jerry.Alexander@delwp.vic.gov.au.*"

Partner media contacts

Media enquiries should be directed to the following key partner contacts:

| Organisation | Name | Title | Email | Phone |
|---------------|-------------------|--|--|--------------|
| Zoos Victoria | Michelle Lang | General Manager – Communications & Stakeholder Relations; Marketing, Communications & Digital Strategy | MLang@zoo.org.au | 0425 723 985 |
| DELWP | Hannah Settattree | Senior Communications Adviser, Environment and Climate Change | hannah.settattree@delwp.vic.gov.au | 0447 543 999 |

| | | | | |
|----------------------------|-----------------|---|--|--------------|
| Parks Victoria | Steph Zilles | Communications Advisor | stephanie.zilles@parks.vic.gov.au | 0498 007 891 |
| Mt Buller Mt Stirling ARMB | Louise Perrin | Environmental Services Manager | louise.perrin@mtbuller.com.au | 0409 417 405 |
| North East CMA | Katie Bowker | Marketing & Media Coordinator | katie.bowker@necma.vic.gov.au | 1300 216 513 |
| Mt Buller Mt Stirling ARMB | Ruth Gallace | Communications Advisor | Ruth.Gallace@mtbuller.com.au | 0438 607 257 |
| Goulburn Broken CMA | Fiona Lloyd | Communications Manager | fional@gbcma.vic.gov.au | |
| Goulburn Broken CMA | Caroline Keenan | Communications Officer | Carolinek@gbcma.vic.gov.au | |
| Mt Hotham ARMB | Anita Coita | | anitacoita@mthotham.com.au | 0447 331 267 |
| Mt Hotham ARMB | Bronwen Young | | bronwenyoung@mthotham.com.au | |
| Falls Creek ARMB | Ben Derrick | Director Economic Development & Land Management | benderrick@falls creek.com.au | 0400 110 046 |

Social media handles

Partner social media handles should be used where possible to promote a unified voice for the MPP.

| Organisation | Twitter | Facebook | Instagram | Other |
|---|----------------------------|--|---|-------------------------|
| Zoos Victoria | @ZoosVictoria | Zoos Victoria | @ZoosVictoria | |
| DELWP | @DELWP_Vic | Department of Environment, Land, Water and Planning | @delwp_Vic | |
| Parks Victoria | @ParksVictoria | Parks Victoria | @ParksVic | |
| Mt Buller Mt Stirling Alpine Resort Management Board | @mtbuller | Mt Buller Mt Stirling Alpine Resort Management Board | @mt_buller | |
| North East CMA | @NorthEastCMA | North East CMA (@northeastcma) | @northeastcma | |
| National Landcare Program (for posts on specific projects that are funded through the NLP – eg, certain works by Parks, and the ARMB) | @AusLandcare @envirogov | @NationalLandcareProgram @envirogov | | #NLP #Landcare |
| Falls Creek Resort Management | n/a | Falls Creek Resort | @falls creek Falls Creek | Village stakeholder EDM |
| Mt Hotham Resort Management Board | @MtHotham_RMB | @mthotham.rmb | @mt.hotham.resort | |

Mountain Pygmy-possum litter loss messaging

Background

In the spring of 2017 and 2018, Bogong Moths that annually migrate in their billions to the alpine regions in Victoria and NSW, were reduced to very low numbers. While low numbers of moths have been observed previously, 2017 and 2018 numbers were unprecedented. This leaves Mountain Pygmy-possums (MPPs) devoid of a primary food source for most of the breeding season. Several Victorian populations were subject to some additional monitoring in 2018. In these sites a minimum of 50%-95% of the females had lost their entire litters of pouch young. The mothers were in poor body condition, often no longer lactating, and post-mortem examination indicated that starvation was the most likely cause of death of the pouch young.

The population at Mt Loch east – historically the largest and most stable population of Mountain Pygmy-possum – has been most significantly impacted. In 2017, 75% litter loss was recorded and there was a subsequent 25% reduction in population size recorded by 2018. With few moths arriving again in 2018, 95% litter loss was recorded. The large size and lower levels of vegetation at this particular site may be causing a higher loss of young than is being observed at other smaller sites which contain greater habitat complexity and possible alternate food sources.

At all sites, alternative foods such as seeds, fruits become readily available in later summer and autumn, so possums that survive the period of low food may be able to regain body condition to successfully survive the following winter. The pouch young that do survive to independence may be more likely to survive to breed the following spring because of lower densities in the population. However, more monitoring data is needed to understand whether this is the case.

A number of very small populations of MPPs have persisted for decades, but the current phenomenon is unprecedented in recorded history. Whether and how populations will cope is a key focus for all stakeholders, as are which interventions could reduce the impact of Pouch Young Litter Loss.

Key messages (litter loss)

- In Spring 2017 and 2018, very low numbers of Bogong Moths arrived in the Victorian alps.
- Bogong Moths typically comprise up to 70-80% of the diet of MPPs in breeding season (Gibson et al. 2018).
- In sampling undertaken in some Victorian populations, a minimum of 50-95% loss of MPP pouch young was observed in females by the end of December 2018.
- Pouch young litter loss (PYLL) has not yet been observed in NSW, though their monitoring regime may not have occurred at an appropriate time to identify losses.
- Whether and how populations of MPPs will cope with the absence of Bogong Moths is a key question being investigated by the Victorian MPP Recovery Team and its partners.
- There is insufficient knowledge to predict whether and when Bogong Moths may return in any appreciable number.
- The Victorian MPP Recovery Team and their partners are working together to conduct key activities to better understand the implications for PYLL in MPP populations and implement a plan to respond to the issue and support conservation of the species. This will include increased monitoring and research into MPPs and Bogong Moths, trial provisioning of supplementary food to

wild populations, working with local communities to reduce lighting to assist moth migration and increasing revegetation and connectivity of MPP populations to provide alternate food sources and increased population sizes in the future.

- Communities can help protect the Mountain Pygmy-possum and Bogong Moth by turning off lights to help moth migration, stop using pesticides and spread the word about the plight of the Mountain Pygmy-possum.

Strategic Considerations

Include details about recovery work, team interests, any integration of departments or issues which could prove informative to the overall approach.

- The MPP State Recovery Team developed a draft Action Plan for MPP Pouch Young Litter Loss in June-July 2019.
- A science workshop was held in late July to draw on the collective expertise of experts in the field of MPPs, Bogong Moths, evolutionary biology, genetics, mathematical modelling and conservation biology, to better understand the issues, knowledge gaps and options for action.
- The Victorian MPP Recovery Team agreed to increase awareness raising and media around MPPs and Bogong Moths to raise support for the recovery of these species.
- A Mountain Pygmy-possum Operational Contingency Plan is being implemented by the partner organisations in response to the observed PYLL that lays out the actions, timing and risk analyses of the various activities for the immediate to medium term. This will align with the broader MPP Recovery Plan, which sets out the strategic approach to MPP conservation.

While media may be opportunistic and fast turnaround times are required to benefit from opportunities as they arise, the majority of media and awareness raising events (e.g. festivals, on ground activations) should be carefully planned and shared well in advance.

Frequently Asked Questions

How many Mountain Pygmy-possum are left?

- There are around 2000 Mountain Pygmy-possums (*Burramys parvus*) left in the wild
- The Mountain Pygmy-possum has been listed as 'threatened' under the *Flora and Fauna Guarantee Act 1988*.
- The Mountain Pygmy-possum has been listed as 'endangered' in NSW under the Threatened Species Conservation Act 1995.
- The MPP is listed on the International Union for Conservation of Nature (IUCN) Red List as 'critically endangered'.

Was the Mountain Pygmy-possum 'rediscovered'?

- The Mountain Pygmy-possum was only known from the fossil record and thought to be extinct until 1966, when a living possum was discovered in a ski-hut on Mount Hotham. The Mt Buller population was not discovered until 1996.

How much does the Mountain Pygmy-possum weigh?

- The Mountain Pygmy-possum can weigh between 35 g following hibernation and 80 g prior to hibernation

Where does the Mountain Pygmy-possum live?

- The Mountain Pygmy-possum is the only Australian mammal restricted to the sub-alpine and alpine zone above 1200 metres
- Three isolated and genetically distinct populations occur at: Mt Kosciuszko area (NSW); Mt Buller (Victoria) and in the Bogong High Plains between Mt Bogong and Mt Higginbotham (Victoria).
- The species is largely confined to naturally-occurring boulderfields and rock screes in alpine and subalpine areas
- Females generally occupy higher quality, higher elevation habitat, and males move to these female habitats during the breeding season.

How long does the Mountain Pygmy-possum live?

- The Mountain Pygmy-possum is the longest-lived, small, terrestrial marsupial known. A small number of females have been recorded living for 12+ years, however 85% of animals live for only 1-3 years, with males generally shorter lived than females.

How many young do Mountain Pygmy-possums produce?

- Females produce multiple young and multiple paternity (greater than one father siring the litter) occurs in some litters. Females have a short ~13-day pregnancy in spring and raise up to 4 young (as the females have only four teats to which young attach).

What do Mountain Pygmy-possums eat?

- The Bogong Moth (*Agrotis infusa*) is the main food item of the Mountain Pygmy-possum during the breeding season.
- They also eat other invertebrates, nectar from the flowers of alpine shrubs, and a range of seeds, drupes and berries, especially the hard-shelled seeds of the Mountain Plum Pine and Snow Beard-heath prior to hibernation.

How long do Mountain Pygmy-possums hibernate?

- Adult Mountain Pygmy-possums hibernate for up to seven months under the snow. They can start hibernating at any time between late summer to the start of winter and finish when there is advanced snow-melt in spring.

What are the key threats to the Mountain Pygmy-possum?

- Key threats to the MPP include:
 - Loss, degradation and fragmentation of habitat;
 - Erosion and sedimentation in boulderfields;
 - Predation by cats and foxes;
 - Genetic loss and small population issues;
 - Winter impacts from ski resort operations and snow-sport activities which may interrupt hibernation, though these are largely abated through significant efforts by alpine resorts to protect the species' habitat;
 - Bushfire and fuel hazard reduction;
 - Climate change and associated effects such as loss of snow cover, weed invasion and competition from introduced species; and
 - Decline in numbers of Bogong Moths.
- Our challenge is to:
 - isolate and mitigate the threats that we can control;
 - understand what interventions will be the most effective;
 - implement strategies to protect and recover populations; and
 - raise awareness of the plight of MPPs and Bogong Moths and the actions the community can take to help these species.

What are the key threats to the Bogong Moth?

- There are many unknowns around the threats to Bogong Moths and research is planned to investigate these to inform management in the future. Potential threats include climate change, worsening drought conditions, changes to land use and agricultural practice, introduced predators such as feral pigs, the use of agricultural pesticides, community lighting on migration routes, etc.

Where are Bogong Moths found?

- Every year, Bogong Moths migrate over distances of 1,000 km or more from their breeding grounds in central, western and northern NSW, southern Queensland, eastern South Australia and western Victoria to summer aestivation sites in Australia's alpine and sub-alpine areas. The species is also found in parts of Western Australia and Tasmania.

How many Bogong Moths are there?

- Current estimates suggest 10 billion moths emerge from their larval habitats across eastern Australia. An estimated 4.4 billion moths migrate to the alpine area of Victoria and NSW each year, but their numbers have been declining over the past two decades and have shown an unprecedented collapse in the past 2 years.

What do Bogong Moths eat?

- Young Bogong Moths (larvae) eat broad leafed plants, while adult moths eat nectar from flowers, and honeydew. Little is known about their preferences and if there are regional affinities or key species.

How are we helping the Mountain Pygmy-possum?

- The Mountain Pygmy-possum Recovery Team works together to ensure that the species persists across its range and maintains its potential for evolutionary development in the wild. Key objectives of the team are to maintain or increase the number of Mountain Pygmy-possums in the wild, maintain and enhance the extent and condition of Mountain Pygmy-possum habitat, investigate key aspects of the biology and ecology of the Mountain Pygmy-possum and to increase community awareness of and support for the conservation of the Mountain Pygmy-possum.

What was the 'genetic rescue' at Mt Buller Mountain Pygmy-possum?

- The Mt Buller MPP population was down to just a handful of animals in 2005 and was at risk of extinction due to the low genetic diversity and with few males remaining in the population. Males were translocated from Mt Hotham to improve genetic diversity of the population. By 2015, there were almost 140 animals. The project was part of implementation of a site-specific recovery plan which also managed threats, including predation by foxes and cats and restored habitat by recreating boulderfields and through revegetation.

What can members of the public do to help?

- Report fox and feral cat sightings to agencies (e.g. Alpine Resort Management, DELWP, PV)
- Turn your unnecessary outdoor Lights Off for the Bogong Moth to help moths migrate
- Log sightings of Bogong Moths on the 'Moth Tracker' website
- Purchase a 'Totes for Wildlife' Bag to raise funds and awareness for MPPs (online, at Zoos Victoria properties and at PetStock stores).
- Support Victoria's Mountain Pygmy-possum Recovery Team members and partners to help the MPP.
- Donate to Alpine Resorts Management Programs, PV, Zoos.

Appendix 2: Current activities of partner organisations and relationship with OCP

| Organisation & funding source | Current activities | Funded by | Relevance to OCP |
|--|---|---|---|
| DELWP Hume region – | Translocation of MPPs at Mt Buller | Icon Species (State) | Outside of scope |
| | Genetic analysis of population at Mt Buller | Icon Species (State) | Data may inform PVA and risk analyses |
| RLP project: MPP Recovery in the Victorian Alps, coordinated by the North East CMA | Genetic analysis of North Eastern population | Australian Government National Landcare Program (NLP) | Data may inform PVA and risk analyses |
| | Sedimentation control at Mt Hotham | Australian Government NLP | Outside of scope |
| | Annual population monitoring at specific North East population locations across the ANP and Alpine Resort lands | Australian Government NLP | Data may inform PVA and risk analyses |
| | Predator control & analysis (gut analyses, camera-trap monitoring) | Australian Government NLP | Outside of scope |
| | Revegetation | Australian Government NLP | Alternative food source for MPP |
| | Weed removal | Australian Government NLP | Enhancing habitat |
| RLP project: MPP Recovery Mount Buller coordinated by the Goulburn Broken CMA | Cat control & analysis (gut analyses, camera-trap monitoring) – shooting and trapping | Australian Government NLP | Targeted cat control |
| | Revegetation | Australian Government NLP | Alternative food source for MPP |
| | Weed removal | Australian Government NLP | Enhancing habitat |
| | Media communication – turn lights off to improve numbers of BM in boulderfield | Australian Government NLP | Inform resort occupants of importance of turning lights off |
| | BM monitoring | Australian Government NLP | Contributing data |
| | Engagement of Traditional Owners in monitoring activities | Australian Government NLP | Engagement of Traditional Owners in threatened species management |
| Parks Victoria | Predator control | RLP Biodiversity Response Planning | Reduce predation risk |
| | Predator monitoring | RLP Biodiversity Response Planning | Contribute information on predators and management effectiveness |
| | Habitat Management (weed control) | RLP | Enhance habitat |

| Organisation & funding source | Current activities | Funded by | Relevance to OCP |
|-------------------------------|---|---|--|
| Mt Buller Mt Stirling ARMB | Annual and additional monitoring as required | MBMSARMB | Contributing data |
| | Fox monitoring and control | MBMSARMB | Reduce predation risk |
| | Cat monitoring and control | MBMSARMB | Reduce predation risk |
| | Predator monitoring (camera traps), control, and analyses (including scat/diet) | MBMSARMB | Reduce predation risk and contribute information on predators and management effectiveness |
| | Habitat restoration and revegetation | MBMSARMB | Enhancing habitat and providing alternative food sources |
| | Education, awareness and advocacy | MBMSARMB | Increase public knowledge |
| | Weed Control | MBMSARMB/TLWC/NLP | Enhance habitat |
| | BM monitoring | MBMSARMB/TLWC/NLP | Contributing data |
| Mt Hotham RMB | Annual monitoring | | Contributing data |
| | Microchipping of MPP at Mt Little Higginbotham annually | Hotham RMB | Contributing data |
| | Fox monitoring and control | DELWP Biodiversity Response Planning (BRP)/RLP/Hotham RMB | Reduce predation risk |
| | Cat monitoring and control | BRP/RLP/Hotham RMB | Reduce predation risk |
| | Habitat Restoration – willow removal, sedimentation reduction works | RLP/Hotham RMB | Enhancing habitat |
| Falls Creek RMB | Annual monitoring | FCRM | Contributing data |
| | Fox monitoring and control | BRP/RLP/FCRM | Reduce predation risk |
| | Cat monitoring and control | BRP/RLP/FCRM | Reduce predation risk |
| | Predator monitoring (camera traps) control and analysis (scat and diet) | BRP/RLP/FCRM | Contributing data |
| | MPP habitat restoration | RLP/FCRM | Enhance habitat |
| Zoos Victoria | Mt Loch east annual population monitoring (2016 onwards) | Zoos Victoria | Contributing data |
| | Monitoring of Mt Little Higginbotham tunnel | Zoos Victoria | Outside of scope |
| | Necropsy of dead pouch young | Zoos Victoria | Contributing data |
| | Captive breeding & | Zoos Victoria | Expertise to apply to |

| Organisation & funding source | Current activities | Funded by | Relevance to OCP |
|-------------------------------|--|---------------|---|
| | feeding / management / animal husbandry | | interventions |
| | Advocacy, education | Zoos Victoria | Increased awareness and support |
| Ken Green | Mt Buffalo (Mt Gingera and Mt Kosciusko) moth monitoring | | Contributing data and expert analyses |
| Traditional Owners | BM monitoring, Mt Buller (Taungurung) | | Actions taking place on Country across multiple locations |

Appendix 3: Potential management actions from workshops

| Approach | Short-term (18 months to end 2020) | Medium-term (5yrs to 2024) | Long-term (to 2037 and beyond) | Decision for inclusion in MPP OCP |
|------------------------|--|--|-----------------------------------|---|
| Monitoring | Trapping in key populations multiple times per season to track PYLL rate and determine if/when intervention is required. Needs to be balanced with potential options for increased predator control | | | Priority – need to consider frequency and methodology and potential negative impacts on females |
| | | Build capacity to undertake annual monitoring in most or all populations | | Capacity for 2019/20 monitoring regime is considered sufficient |
| | Continue necropsy of dead pouch young → | | | Supported – approval for continued collection of dead young may need to be sought |
| | Health assessment of possums during trapping | | | Supported – need to balance level of handling and intervention with potential negative impacts on females |
| | Genetic monitoring across all populations → | | | Supported to degree that funding is available |
| | Develop and establish a robust monitoring program for Bogong Moths across breeding, migration (including caves) and aestivation/larval habitat with entomologists | | | Priority – to be further developed, including development of population modelling that supports prediction of 'good' and 'bad' moth years prior to spring |
| On-ground intervention | Moths: Provide moth boxes to communities to collect and redistribute moths from houses to boulderfields | | | Not supported as part of the MPP OCP. This action is unlikely to result in improved outcomes and may have perverse outcomes through disturbance to boulderfield habitat. |
| | Moths: Trial artificial light sources in boulderfields to attract moths. In conjunction with increased predator control where required. Include camera monitoring. | | | Not supported as part of the MPP OCP. May have perverse outcomes through increased disturbance of habitat, inaccessibility of many sites and potential increased attraction of predators and competition. |
| | Ex-situ: Implement ex-situ strategies in key populations, if PVA analysis indicates it is warranted → Option 1: Remove females with pouch young and care for them in captivity. Release all animals in autumn; or release all females and autumn and males in spring Option 2: Remove males following breeding and care for them in captivity to reduce competition with females and increase survival of males. Release males the following spring. | | | Not supported – proposal from ZV has been postponed subject to further data and modelling |
| | | | | Not currently part of proposal |

| Approach | Short-term (18 months to end 2020) | Medium-term (5yrs to 2024) | Long-term (to 2037 and beyond) | Decision for inclusion in MPP OCP |
|----------|--|---|-----------------------------------|---|
| | | Ex-situ: Develop and implement captive insurance program, if required → | | Not currently part of proposal |
| | Nutrition: Provide >100% daily nutrition requirement for lactating females in traps to reduce nutritional deficit → | | | Supported outside of locations where dietary research is occurring |
| | Nutrition: Trial supplementary feeding options in key populations. Strategies suggested including widescale drone drops, food scatters, feeding points beneath boulderfields, microchip triggered feeders - in association with increased predator control where required. | | | Supported as a single, small scale trial within MPP habitat with only direct feeding and subject to relevant approval processes. Small scale trial outside of MPP habitat testing broader food delivery methods is under consideration and subject to relevant approval processes. |
| | | Nutrition: Implement effective supplementary feeding options as warranted | | To be determined following evaluation of 2019/20 feeding trial and population modelling |
| | Habitat: Plant propagules and other native vegetation in key populations asap (to increase food availability in future seasons) | | | Habitat restoration as per MPP Recovery Plan and approved site management plans for various locations |
| | Habitat: Commence and expand boulderfield/habitat connectivity and reveg programs to connect populations and increase food sources → | | | Not supported as part of current MPP OCP |
| | | Habitat: Increase/commence reveg in type 2 habitat to improve habitat quality | | Habitat restoration as per MPP Recovery Plan |
| | | Habitat: Investigate the use of safe burns to improve habitat quality | | Not part of current proposal. Habitat restoration activities as approved by Victorian MPP Recovery Team and under MPP Recovery Plan |
| | Predators: Review integrated predator control program → | | | Integrated predator control review and increase supported where feasible to do so. Focus on cat control with consideration of predator interactions between cats and foxes |
| | | Genetic management: Develop and implement genetic rescue of populations in response to PYLL, if indicated by monitoring → | | Not supported as part of current MPP OCP – any future consideration following evaluation plan |
| Research | Complete Population Viability Analyses to inform most appropriate strategies for on-ground interventions | | | Priority – continued development of population models for both MPPs and Bogong Moths incorporating available data |

| Approach | Short-term (18 months to end 2020) | Medium-term (5yrs to 2024) | Long-term (to 2037 and beyond) | Decision for inclusion in MPP OCP |
|------------------------------------|--|--|-----------------------------------|--|
| | Diet: collect faecal and fur samples throughout the entire season for diet analysis | | | Supported – in addition to planned Honours project, collection of scats etc will be undertaken during monitoring program. Approach to be advised as part of monitoring plan. |
| | Refine nutritionally suitable supplement/diet items for use in the wild | | | Supported as part of supplementary feeding trial. May be deployed to monitoring program, where it does not interfere with dietary research |
| | | Compare seasonal variation in diet across the species' range | | Supported as part of extended monitoring program. |
| | Bogong Moths: initiate longer-term project on why they migrate, whether there is site fidelity, and potential connectivity of populations → | | | Supported, including genetic research and development of population models |
| | | Investigate other moth and invertebrate species that could be bred and released in MPP habitat | | Not supported as part of current MPP OCP |
| | Investigate citizen science potential for moth monitoring (ensure data is appropriate and comparable across sites). Naturalist clubs, Traditional Owners and others. Potential use of inaturalist app. | | | Supported – 'Moth Tracker' app released |
| | Develop media strategy for entire RT | | | Supported - Communication plan to form part of MPP OCP |
| Education and Communication | Moths: Campaign for decreased lighting in resort and local community areas → Strategies include curfews on unnecessary outdoor lighting, lighting for safety on sensors/timers, globes/light wavelengths that are less likely to attract moths, covers on lights to focus direction and reduce moth attraction | | | Supported as part of alpine resorts and Zoos Victoria campaign |
| | Raise awareness among Federal and state agencies | | | Communication plan to form part of MPP OCP |
| | Public education program to reduce artificial light use in local communities | | | Communication plan to form part of MPP OCP |
| | Widespread SE Australia public education program to reduce spraying of moths during migration (eg in Canberra where annual moth spraying is well known) | | | Communication plan to form part of MPP OCP |
| | Engage Trust for Nature if properties contain moth sites | | | Communication plan to form part of MPP OCP |
| | Add MPP information on snow, weather, resort, other web sites | | | Communication plan to form part of MPP OCP - use existing platforms for new OCP comms |

| Approach | Short-term (18 months to end 2020) | Medium-term (5yrs to 2024) | Long-term (to 2037 and beyond) | Decision for inclusion in MPP OCP |
|----------|--|-------------------------------|-----------------------------------|---|
| | Provide stickers/posters to communities and resorts to place on walls/light switches as reminders to reduce lighting | | | Communication plan to form part of MPP OCP |
| | Engage Traditional Owner groups | | | Priority – partner with Traditional Owner organisations eg monitoring, exchange of ecological knowledge and consideration of culturally significant species in planning |
| | Implement media blitz prior to and throughout breeding season | | | Communication plan to form part of MPP OCP |

