Australian Government
Department of Climate Change, Energy, the Environment and Water

Conservation Advice for *Liopholis montana* (mountain skink)

In effect under the *Environment Protection and Biodiversity Conservation Act 1999* from 10 August 2022.

The mountain skink *Liopholis montana* © Copyright, Stephen Mahony (Australian Museum)

Conservation status

Liopholis montana was assessed by the Threatened Species Scientific Committee to be eligible for listing as Endangered under Criterion 2. The Committee's assessment is at **Attachment A**. The Committee's assessment of the species' eligibility against each of the listing criteria is:

- Criterion 1: Insufficient data
- Criterion 2: B2ab(i,ii,iii,iv,v): Endangered
- Criterion 3: Insufficient data
- Criterion 4: Insufficient data
- Criterion 5: Insufficient data

The main factors that make the species eligible for listing in the Endangered category are its restricted area of occupancy, severe fragmentation, ongoing loss and degradation of habitat and

inferred decline in mature individuals. The mountain skink has been reported as rare, declining, and its populations as fragmented (Osborne & Evans 2015; Coyne 2000; Donellan et al. 2002; Senior 2019, Clemann et al. 2018).

Before the 2019/2020 fires burnt approximately 32% of the mountain skink's known and likely distribution, the mountain skink was assessed as Near Threatened on the IUCN Red List of Threatened Species, approaching Criteria B2a (Clemann et al. 2018).

Species can also be listed as threatened under state and territory legislation. For information on the current listing status of this species under relevant state or territory legislation, see the Species Profile and Threat Database.

Species information

Taxonomy

Conventionally accepted as *Liopholis montana* (Donellan et al. 2002).

Description

The mountain skink is a stoutly built species that has two distinct colour morphs: a patterned morph and a plain morph (Robertson and Coventry 2019; Chapple et al. 2008). The basic colour of the head, body, limbs, and tail is grey-brown with most individuals being plain-backed with a reddish-brown dorsum (Donellan et al. 2002). The patterned morph has a series of dorsolateral blotches or vermiculation's, occasionally being sufficiently continuous to outline spots of the underlying brown colouring (Donellan et al. 2002).

Individuals are considered to be adult at a snout–to-vent length of approximately 74 mm and mean and maximum adult snout–to-vent length is 92 mm and 111 mm respectively (Donellan et al. (2002). The mountain skink can be distinguished from *Liopholis whitii* by the absence of dark-edged pale ocellate markings, particularly above the base of the forelimb and can be distinguished from *Liopholis guthega* and by the absence of broad paravertebral stripes (Robertson and Coventry 2019).

Distribution

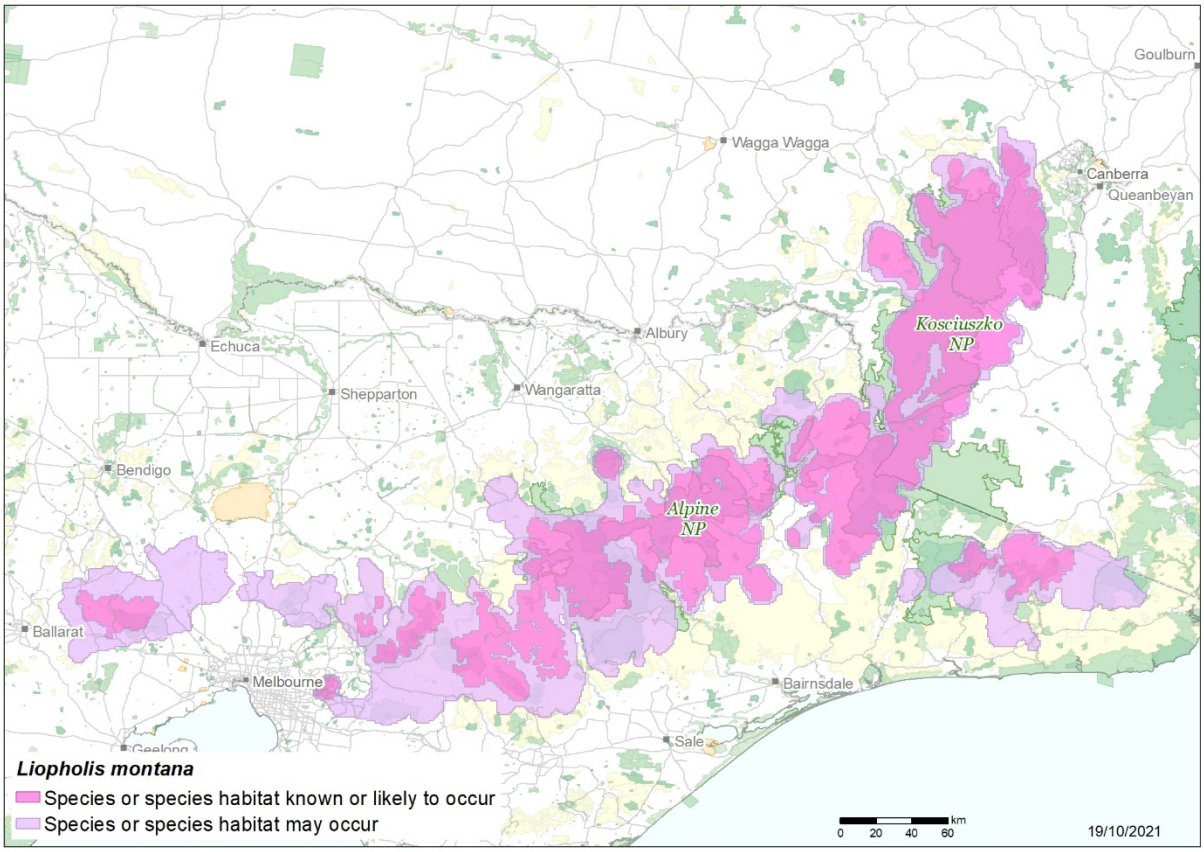
The mountain skink occurs in montane and subalpine areas stretching from the Bimberi Range in the Australian Capital Territory (ACT), through the Snowy Mountains in New South Wales (NSW), into Victoria (Green & Osborne 2012). Populations also occur in Wombat State Forest to the northwest of Melbourne at an elevation of 620 m and at Sassafras in the Dandenong ranges, Victoria, at a similar elevation (Farquhar et al. 2021; Chapple and Farquhar 2021).

Throughout its range it occurs in a series of apparently isolated subpopulations at elevations ranging from 620 m (Wombat State Forest) to 1800 m (Mt Gingera, ACT) (Clemann et al. 2018; Wilson & Swan 2013, Cogger 2014, Green and Osborne 2012; Farquhar et al. 2021). The mountain skink overlaps slightly in elevational distribution with both *L. whitii* and *L. guthega*. Whilst there is a broad zone of distributional overlap between the mountain skink and *L. guthega* at 1600–1700 m, the two species have never been found in the same habitat at the same time in any area throughout their range (Senior et al. 2021). Recognising that occupancy of habitat is dependent on many variables including interactions between species and which species become dominant, climate change may make some areas more thermally suitable for the mountain skink and could potentially expand its elevational range (Senior et al. 2019).

The mountain skink occurs in at least three protected areas: Alpine National Park, Kosciuszko National Park and Namadgi National Park (Clemann et al. 2018). In the ACT it has been recorded at Mt Gingera, Ginini Flats, Mt Ginini, Stockyard Spur, Mt Scabby, Rolling Ground Gap, Square Rock (Osborne 2021). In NSW it has been recorded at Rennix Gap, Whites River and near Smiggin Holes and in Victoria at Mt Hotham, Mt Bogong, Sawyers Hill, Bryces Gorge and Saltlick Saddle (Donellan et al. 2002), and several other locations at montane to subalpine elevations (N. Clemann and Z. Atkins unpublished data).

The current distribution of the mountain skink is best reflected in Map 1 as the 'species known to or likely to occur' mapping.

Map 1 Modelled distribution of the mountain skink



Source: Base map Geoscience Australia; species distribution data Species of National Environmental Significance database.

Cultural and community significance

The cultural and community significance of the mountain skink is unknown, however an action of this Conservation Advice is to improve the understanding of any cultural significance of this reptile to Indigenous Australians. This is due to the high cultural significance of the species' habitat to Traditional Owners of the alpine country including but not limited to the Ngunnawal, Monaro Ngarigo, Wiradjuri, Wolgalu, GunaiKurnai, Bidawal, Dudhuroa, Jaithmathang, Mitambuta, Ngarigu-Currawong, Taungurung, Waywurru and Wurundjeri peoples (Flood 1980; 1996).

Relevant biology and ecology

The mountain skink construct burrow networks beneath rocks (Donnellan et al. 2002). It lives in colonies and appears to exhibit stable pair bonds (Senior 2019), with females giving birth to up to four young (Donnellan et al. 2002). It has an omnivorous diet that includes seasonal fruits (Donnellan et al. 2002).

Habitat

The mountain skink occupies habitats with granite and basalt boulders, rocks, slabs, rock screes or tors (Green and Osborne 1994; Donnellan et al. 2002; Chapple 2003; Cogger 2014) and large logs (W. Osborne and Z. Atkins pers. obs.) in tall open-forest, woodland, and heathland vegetation (Donnellan et al. 2002; Green & Osborne 1994) in montane and subalpine areas of south-east Australia from 600–1700m above sea level. In the north of its range, the mountain skink occupies montane and subalpine conditions above 1400 m; however, in more southern locations it occupies taller eucalypt forest down to 900 m (Donnellan et al. 2002) and down to 630 m in the west of its range (Farquhar et al. 2021).

This habitat provides the mountain skink with refugia from fires, extreme weather events and predators, and is used for foraging, breeding, burrowing, thermoregulation and social interactions. When this document refers to mountain skink habitat, these are areas known to be continuously, periodically, or occasionally occupied by the mountain skink or to have been occupied in the past but no longer do because of a threatening process. As outlined in Map 1, spatially, mountain skink habitat is best represented to occur within the areas modelled as 'known and likely to occur' in Map 1.

Areas within the modelled distribution may also include areas which are not mountain skink habitat. Alternatively, they may appear, based on attributes above to support the mountain skink but the species has not been detected through surveys. These areas must be assessed for the role or value they provide for the species long term survival in nature. They may provide buffers to mountain skink habitat from threats; be areas of infrequent but ecologically critical dispersal events; are areas that are required by the species as the climate changes; as translocation sites under future or unexpected decline or catastrophic events; or as areas which are able to be occupied naturally with time.

Populations

Genetic information on population structure is lacking but the species appears to be occurring in disjunct colonies each consisting of only one or two warrens, each containing only a small number of lizards (Clemann et al. 2018; Senior 2019). Given this pattern of distribution and habitat requirements within a specific elevation zone, the severe fragmentation of populations and its ongoing vulnerability from key threats of fire, logging and predation, all populations are considered important until findings from population genetics prove otherwise.

Threats

The Australian Alps have the highest richness of threatened squamates (including skinks) in Australia (Tingley et al. 2019). The mountain skink is primarily threatened by logging in parts of its range (Clemann et al.2018) and clearing of habitat, climate change related threats such as increased frequency, extent and severity of wildfires (Ward et al. 2020), timber harvesting in parts of its range (Clemann et al. 2018), and predation by invasive predators (Watson 2006;

Woinarski et al. 2018; Stobo-Wilson et al. 2021). Threats specific to the mountain skink in order of greatest consequence to the species are outlined in Table 1.

Table 1 Threats impacting the mountain skink

Threat	**Status and severity** [a]	**Evidence**
Climate change – Increasing the frequency of wildfire resulting in mortality, increased predation risk and habitat degradation during post fire vegetation succession	Status: current/future Confidence: known Consequence: major Trend: increasing Extent: across the entire range	5389 km^2 (approximately 32 %) of the known and likely modelled distribution of *L. montana* was burnt in 2019/2020 bushfires. Of this 2550 km^2 (approximately 49 % of the fire-affected area) was burnt with a high to very high severity equating to 15 per cent of its overall known and likely distribution (Map 2). An expert elicitation process predicted a population size decline in *L. montana* of up to 11% after ten years post the fires, with a lower 80% confidence bound of 32% population loss (Legge et al 2021). These estimates assumed no further extensive fire events. Wildfire is predicted to increase in the alpine/sub alpine environment, impacting on reptiles. These environments have slow recovery rates after disturbance (Pickering et al. 2004). Being rock-dwellers and burrowers in addition to inhabiting logs which are likely diminished by fire, the mountain skink is afforded some protection from the direct effects of fire (e.g., being killed by heat or smoke), and is impacted primarily from predation post fire by feral cats (*Felis cactus*), by loss of foraging habitat, and by habitat modification such as shading-out basking spots and making visual detection of prey difficult. Known colonies of mountain skink in Kosciusko National Park were not affected by the 2019/2020 bushfires, however, populations in Victoria were impacted by fires (Melanie Schroder, Nick Clemann. pers. comm.).

Logging and associated activities	Status: current/future Confidence: known Consequence: major Trend: unknown Extent: across part of its range	Much of the species' range falls within areas targeted for 'forest utilization', and both logging and road building are ongoing within its range, and the extent of logging is projected to expand within the species' range as new logging coupes are approved or scheduled coupes are logged (Clemann et al. 2018).
Prescribed burning	Status: current/future Confidence: unknown Consequence: major Trend: unknown Extent: across part of its range	Prescribed burning is undertaken by government agencies throughout the distribution of the mountain skink. Prescribed burning has also been undertaken in the Wombat State Forest where new populations of mountain skink have recently been discovered (AFAC 2015; Chapple and Farquhar 2021). Long-unburned forests and woodlands can be more important for reptile richness and abundance than areas with prescribed burning (Dixon et al. 2018). Dixon et al (2018) have recommended that in order to maximize reptile richness and abundance in forests and woodlands, future fire management planning should aim to (a) retain the current long-unburned areas and manage them as an asset to protect, and (b) transition a higher proportion of forests and woodlands to long-unburned.
Predation by feral cats and foxes	Status: current Confidence: suspected Consequence: major Trend: unknown Extent: across the entire range	*Liopholis* skinks are highly susceptible to cat predation (Woinarski et al. 2018) and potentially by foxes (Olsson 2005; Stobo-Wilson et al. 2021). The mountain skink has many of the traits that make it vulnerable to cat predation, including having high predictability in activity with permanent burrows, being colonial and occurring in open areas (Woinarski et al. 2018). Feral cats are known to occupy mountain skink habitat (Watson 2006; Schulz and Wilks 2017).

Climate change - Creating potential for displacement of species through reduction in habitat.	Status: future Confidence: suspected Consequence: major Trend: increasing Extent: across the entire range	Alpine habitats including sub alpine woodland is predicted to experience large change as a result of the climate by 2060–2079 (Love et al. 2019) potentially reducing the area of habitat available to the mountain skink and making some areas more favourable for lower elevation species such as *L. whitiii* (Atkins et al. 2018; Clemann et al. 2018).
Feral herbivores such as horses and deer	Status: current/future Confidence: suspected Consequence: unknown Trend: increasing Extent: across part of its range	The mountain skink is potentially at risk from habitat degradation caused by feral horses (*Equus caballus*) in the Eastern Victorian highlands (Parks Victoria 2021) and as demonstrated through impacts on *L. guthega*, in Koszciusko National Park (Driscoll et al. 2019). Deer may also be impacting mountain skink through reductions in the availability of shelter and food as demonstrated by findings on other reptiles in Victoria (Bartlett 2012; Hampton and Davis 2020).

Status—identify the temporal nature of the threat;
Confidence—identify the extent to which we have confidence about the impact of the threat on the species;
Consequence—identify the severity of the threat;
Trend—identify the extent to which it will continue to operate on the species;
Extent—identify its spatial content in terms of the range of the species.

Each threat has been described in Table 1 in terms of the extent that it is operating on the species. The risk matrix (Table 2) provides a visual depiction of the level of risk being imposed by a threat and supports the prioritisation of subsequent management and conservation actions. In preparing a risk matrix, several factors have been taken into consideration, they are: the life stage they affect; the duration of the impact; and the efficacy of current management regimes, assuming that management will continue to be applied appropriately. The risk matrix and ranking of threats has been developed with in-house expertise using available literature.

Table 2 Mountain skink risk matrix

Likelihood	**Consequences**				
	Not significant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost certain	Low risk	Moderate risk	Very high risk	**Climate change (increased wildfire frequency)** and **Logging**	Very high risk
Likely	Low risk	Moderate risk	High risk	**Feral cats**	Very high risk

Likelihood	Consequences				
	Not significant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Possible	Low risk	Moderate risk	**Herbivores**	**Climate change (species displacement through reduction in habitat)**	Very high risk
Unlikely	Low risk	Low risk	Moderate risk	High risk	Very high risk
Unknown	Low risk	Low risk	Moderate risk	**Prescribed burning**	Very high risk

Conservation and recovery actions

The Australian alpine region was heavily impacted by the 2019–20 bushfires, with over 573,000 hectares impacted, 60 % of which was at high or very high severity (DAWE 2020). After the fires, it became one of seven bushfire affected regions that received a share of the $110 million regional funding available to support strategic on-ground actions for the most fire-impacted native plants and animals, ecological communities and natural assets. This funding formed part of the Australian Government's $200 million investment to support the recovery of bushfire affected wildlife and their habitat. These actions include weed, pest animal and erosion control and habitat restoration, which are likely to assist recovery of the mountain skink (DAWE 2020). Research into reptiles in the Victorian Alps is also underway as part of the Victorian Government's Bushfire Biodiversity Response and Recovery program (Phase 1) (ARI 2021).

Further to the above funding and on ground action across the Australian Alpine region, the Commonwealth invested an additional $800,000 in the conservation of alpine reptiles and appointed the Victorian Government as a National Species Coordinator to lead recovery actions for alpine skinks, including the mountain skink. Under this coordination, targeted surveys commenced in 2021 to improve understanding of the mountain skinks status, distribution, habitat preferences, ecology and management needs. Surveys will span the species' known and likely distribution. This work is specifically targeting fire-affected regions where the mountain skink is known to occur to provide insights into vulnerability and resilience to fire under a changing climate. Tissue samples are also being collected for genetic analysis to better understand population structure across the species distribution.

Primary conservation outcome

It is not considered possible that conservation and management priorities outlined below could in the next ten years result in this species no longer qualifying for listing as threatened under the EPBC Act. This is because the mountain skink has a restricted area of occupancy well below the eligibility level for Criterion B, has largely irreversible future threats of climate change (wildfire and species displacement) cat and fox predation, and the recovery of its habitat after the 2019/2020 bushfires is predicted to be slow.

Achievable outcomes in the next 10 years include:

- Management of areas of mountain skink habitat directly or indirectly impacted by the 2019/2020 bushfires.
- Stable breeding colonies evident across ACT, Victoria and NSW.
- An increase in the number of known colonies of the mountain skink.
- An increase in the extent of protection of mountain skink habitat.
- An improved understanding of the species' population genetics.
- An improved awareness of the mountain skink and its conservation and management priorities across the recreational and logging industries operating across its range.

Conservation and management priorities

While limiting disturbance and predation pressure on mountain skinks are conservation priorities, their efficacy is limited until targeted work on the mountain skink improves our understanding of species occurrence and habitat requirements (Atkins et al. 2018). Information and research priorities, including the works underway as part of the multi-regional bushfire funding package, are an important prerequisite to many of the conservation and management priorities identified below.

The immediate conservation priority is working with key stakeholders to ensure logging activities and planned burns avoid and protect mountain skink habitat. Second to this is conducting targeted post-fire surveys in mountain skink habitat impacted by the 2019/2020 bushfires, as well as in non-impacted habitat, to assess species persistence and develop a monitoring program. These actions will avoid further decline whilst refining our understanding of the species distribution, population size, trajectory and emerging threats as identified in the survey and monitoring priorities section below.

Logging (resulting in loss and modification of habitat)

- Protect and manage mountain skink habitat and prevent further loss.
  - Ensure that adequate protection measures are in place for mountain skink habitat in areas subjected to forestry and associated management activities (this includes logging, road construction, coupe burning).
  - Protect all known colonies of mountain skink in areas subject to timber harvest through forestry exclusion zones around colonies.
  - Review the effectiveness of timber harvesting regulatory prescriptions and related guidelines relevant to the protection of mountain skink and its habitat and revise where required.
  - Ensure land managers are aware of the mountain skink's occurrence, particularly in forestry coupes and provide protection measures against key and potential threats.
  - Ensure logging coupes within the modelled distribution of the mountain skink are assessed for skink occupancy before any logging proceeds.

Climate change and prescribed burning (resulting in loss and modification of habitat from fire and displacement of species)

- Develop a fire management strategy based on the presence of skink colonies with local fire and park management authorities (e.g., Parks Victoria, Victoria DELWP, NSW Parks and Wildlife Service and ACT Parks and Conservation), which considers the ecological needs of the mountain skink.

- Ensure immediate and ongoing post fire control of invasive predators within the habitat after fires occur.
- Undertake weed control directed by experts on the mountain skink after fire management around skink colonies.

Feral herbivores and predators (resulting in habitat modification and population decline)

- Ensure active surveillance programs are in place to detect the presence of feral horses and invasive predators around known colonies of mountain skink.
- Implement broad-scale management of invasive predators and herbivores, and intensive local-scale subpopulation suppression of feral cats and wild horses in mountain skink habitat.

Stakeholder engagement/community engagement

- Engage and involve Traditional Owners in conservation actions, including the implementation of Indigenous fire management and other survey, monitoring and management actions.
- Ensure information on the mountain skink and its habitat and colony locations is shared between forest management and environment agency staff in Victoria, NSW and the ACT. New population data and research should be available to all stakeholders to continue to implement best-practice land management that minimises the impacts of threats to the species.
- Where habitat is newly identified for the species in areas that are privately-owned, liaise with landholders to provide information on the species, its requirements and management needs, and encourage reporting of any mountain skink sightings.
- Increase the recognition and support for the species' recovery by disseminating information on the mountain skink and its conservation status to the public.

Survey and monitoring priorities

- Undertake surveys across the species range to improve understanding of distribution, habitat and the impacts of recent fires, and other important threats.
- Design and implement a monitoring program to:
  - document post-fire recovery;
  - determine trends in population size and distribution;
  - monitor the effectiveness of management actions and adapt them if necessary;
  - assess the viability and status of all colonies, including whether there has been any further decline or recovery.
- Monitor the abundance of feral animals across the species' range and responses of the mountain skink to predator control programs. Evaluate the use and effectiveness of management interventions and modify if required.

Information and research priorities

- Undertake genetic sequencing and analyses from tissue samples collected during the post 2019-2020 bushfire surveys.

- Understand the implications of competitive interactions between *L. montana, L. whitii* and *L. guthega*, given that subalpine habitat is projected to shift to higher elevations under climate change scenarios.
- Examine the microhabitat requirements of the mountain skink and of other species in the genus (*L. guthega* and *L. whitii*) and how these change along the altitudinal gradient, to work towards understanding the species vulnerability to climate change.
- Determine minimum tolerable fire intervals for the mountain skink.
- Investigate the potential to create safe havens for the mountain skink safe from predators and herbivores.

Recovery plan decision

The Conservation Advice is considered to provide sufficient guidance on the recovery of the species and a Recovery Plan is not required based on the following reasons;

- There are not significant complexities in conservation planning for the mountain skink that present special challenges for coordination of effort.
- The mountain skink does not predominately occupy Commonwealth land nor is it subject to threats that can be regulated under the EPBC Act through having a recovery plan.
- The mountain skink is largely restricted to State or Territory National Parks or Forest Reserves and responsibility for managing the key threats to the species can be guided efficiently and effectively through a Conservation Advice.

Links to relevant implementation documents

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The Threatened Species Scientific Committee finalised this assessment on 18 June 2021.

Attachment A: Listing Assessment for *Liopholis montana*

Reason for assessment

This assessment follows prioritisation of this species for assessment as a result of the impacts of the 2019/2020 Bushfires.

Assessment of eligibility for listing

This assessment uses the criteria set out in the EPBC Regulations. The thresholds used correspond with those in the IUCN Red List criteria except where noted in criterion 4, sub-criterion D2. The IUCN criteria are used by Australian jurisdictions to achieve consistent listing through the Common Assessment Method (CAM).

Key assessment parameters

Table 3 includes the key assessment parameters used in the assessment of eligibility for listing against the criteria.

Table 3 Key assessment parameters

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Number of mature individuals	Not known			Unknown
Trend	Declining			A structured expert elicitation process conducted in the absence of monitoring data for this species predicted a population size decline in *L. montana* of up to 10.7% ten years post the 2019/2020 fires, with a lower 80% confidence bound of 32%. These estimates assume no further extensive fire events in the range of the species (Legge et al. 2021).
Generation time (years)	4-5 years			The two most closely related congeners of the mountain skink mature at 2-3 years (*L. guthega*; Atkins et al 2020) or 2-4 years (*L. whitii*; Chapple 2005). The lifespan is 5-6 years in *L. guthega* (Atkins et al 2020) and up to 8 years in *L. whitii* (Chapple 2003), thus the generation length in the mountain skink can be assumed to be 4-5 years (Chapple and Farquhar 2021).
Extent of occurrence	34,942 km^2			Based on records from 1965-2017 (DAWE 2021).

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Trend	Decreasing			Much of the mountain skink's range is within areas targeted for timber harvest, and both harvest and associated road building are ongoing within its range. The extent of clear-fell logging is projected to expand within the species' range as new logging coupes are approved (N. Clemann and P. Robertson pers. comm. 2017 cited in Clemann et al. 2018).
Area of Occupancy	196 km^2	<196 km^2 Given records dating back to 1965 were used in the estimate.	Unlikely to be greater than 500 km^2	Based on records from 1965–2021 (DAWE 2021). Extensive survey work across its distribution has produced few additional records (Clemann et al. 2018), however a recent survey effort outside of its formerly predicted range revealed new locations extending the species range in Victoria (Chapple and Farquhar 2021) The AOO is however considered highly likely to be remain below the threshold for Endangered (<500km^2).
Trend	Contracting due to logging and likely loss of colonies and habitat degradation from 2019/2020 bushfires.			5,389 km^2 of the known / likely distribution of *L. montana* was burnt in 2019/2020 bushfires equating to 32% of its known/likely distribution. Of this 2550 km^2 (approximately 49 per cent) was burnt with a high to very high severity equating to 15% of its known/likely distribution (National Indicative Aggregated Fire Extent Dataset Mapping 2020).
Number of subpopulations	>10			
Trend	Contracting due to logging and likely loss of colonies and habitat degradation from 2019/2020 bushfires.			
Basis of assessment of subpopulation number				
No. locations	1	1	<5	
Trend	Contracting			
Basis of assessment of location number	The species is restricted to alpine woodlands and forests 900-1700 m above sea level which was subject to severe fire in 2019/2020 and skink habitats are predicted to be exposed to increased frequency and intensity of wildfires under climate change (Love et al. 2019; (National Indicative Aggregated Fire Extent Dataset Mapping 2020). The mountain skink's ecology also makes it highly vulnerable to predation from feral cats' post fires (Woinarski et al. 2018).			

Metric	Estimate used in the assessment	Minimum plausible value	Maximum plausible value	Justification
Fragmentation	Referred to as severely fragmented (Clemann et al. 2019) likely due to limited dispersal of the skink (Atkins et al. 2018; Koumoundouros et al. 2009; Olsson & Shine 2003) across landforms outside of its elevational niche such as lowland valleys to areas referred to as 'Sky Islands' (Atkins et al. 2018) which provide the suitable habitat and thermal niche for alpine reptiles. The isolation of known subpopulations and their presumed limited dispersal ability suggests recolonization of sites under threat scenarios such bushfires and or high predation pressure in a particular alpine region is highly unlikely and poses an extinction risk to subpopulations, with a large fire event putting the entire population at risk of extinction. Preliminary molecular evidence suggests there is a substantial amount of genetic divergence amongst populations of the mountain skink (Chapple and Farquhar 2021). Chapple et al (2005) demonstrated that there was 4.8–5.4% ND4 mitochondrial DNA divergence between the ACT and NSW populations (2.4–4.1 million years ago) of the mountain skink. No *L. montana* samples from Victoria were included in this phylogeny, however this result indicates that historically there has been limited geneflow amongst the populations and confirms that the species is severely fragmented (Chapple and Farquhar 2021).			
Fluctuations	Not subject to extreme fluctuations in EOO, AOO, number of subpopulations, locations, or mature individuals – no parameter was changed by an order of magnitude by the 2019/20 fire.			

Criterion 1 Population size reduction

Reduction in total numbers (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered **Very severe reduction**	**Endangered** **Severe reduction**	**Vulnerable** **Substantial reduction**
A1	≥ 90%	≥ 70%	≥ 50%
A2, A3, A4	≥ 80%	≥ 50%	≥ 30%

A1 Population reduction observed, estimated, inferred, or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(*a) cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

Based on any of the following

(a) direct observation [except A3]

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Criterion 1 evidence

Insufficient data to determine eligibility

The generation length in the mountain skink can be assumed to be 4-5 years (Table 3) and so three generations is 12-15 years

Given limited documented evidence of fire-affected species' population declines as a result of the 2019/2020 fires, Legge et al (2021) undertook an analysis to estimate the proportions of the distributions of species that overlapped with the 2019/2020 fires, and carried out a structured expert elicitation to estimate the proportional population change after fires of different severity, and the ensuing rate of population recovery. The expert judgements were then combined with the spatial analyses to generate estimates of overall population change from before the 2019-2020 fires, to immediately after, then out to three generations after the fires.

The mountain skink was predicted to have a population size decline of up to 10.6% three generations post the fires, with a lower 80% confidence bound of 32%. These estimates assume no further extensive fire events in the range of the species (Legge et al. 2021). These figures suggest the species could be eligible for listing under Criterion 1 A2 or A4, but additional data on population trends is required to confirm this. Although impact of the 2019/2020 bushfires and predictions of decline warrant concern for the mountain skink, the Committee has determined that the species is not eligible for listing under this criterion because there is insufficient data to determine eligibility.

Criterion 2 Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy

		Critically Endangered Very restricted	Endangered Restricted	Vulnerable Limited
B1.	Extent of occurrence (EOO)	**< 100 km²**	**< 5,000 km²**	**< 20,000 km²**
B2.	Area of occupancy (AOO)	**< 10 km²**	**< 500 km²**	**< 2,000 km²**
AND at least 2 of the following 3 conditions:				
(a)	Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b)	Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c)	Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Criterion 2 evidence

Eligible under Criterion 2 B2ab(i,ii,iii,iv,v) for listing as Endangered

The mountain skink has an area of occupancy of 196 km² based on records from 1965–2021 (DAWE 2021) meeting the threshold for Endangered under Criterion B2. Confidence in this estimate (and likelihood of it actually being lower given records dating back to 1965 have been used) is considered high, as extensive survey work across its distribution has produced few additional records (Clemann et al. 2018). The recent discoveries extending its western and southerly range in Victoria (Chapple and Farquhar 2021) are not likely to be followed by further discoveries to that would cause the AOO to exceed the Endangered threshold of >500km². The

species Extent of Occurrence is 50,496 km^2 and the area of known and likely distribution was mapped by the Department and estimated to be 17,118 km^2 (See Map 2).

Information on population demographics is lacking but the species appears to be uncommon, occurring in disjunct colonies with small subpopulations consisting of only one or two warrens each containing a small number of lizards (Senior 2019; Clemann et al. 2018). This represents a smaller colony size than the related *L. guthega* and *L. multiscutata* (N. Clemann and P. Robertson pers. comm. 2017 cited in Clemann et al. 2018). Like other alpine skinks, the mountain skink is likely to have poor dispersal ability (Atkins et al. 2018; Koumoundouros et al. 2009; Olsson & Shine 2003) and coupled with the isolation of subpopulations, suggests that recolonization of sites under threat scenarios such bushfires and or high predation pressure is highly unlikely and poses an extinction risk to subpopulations.

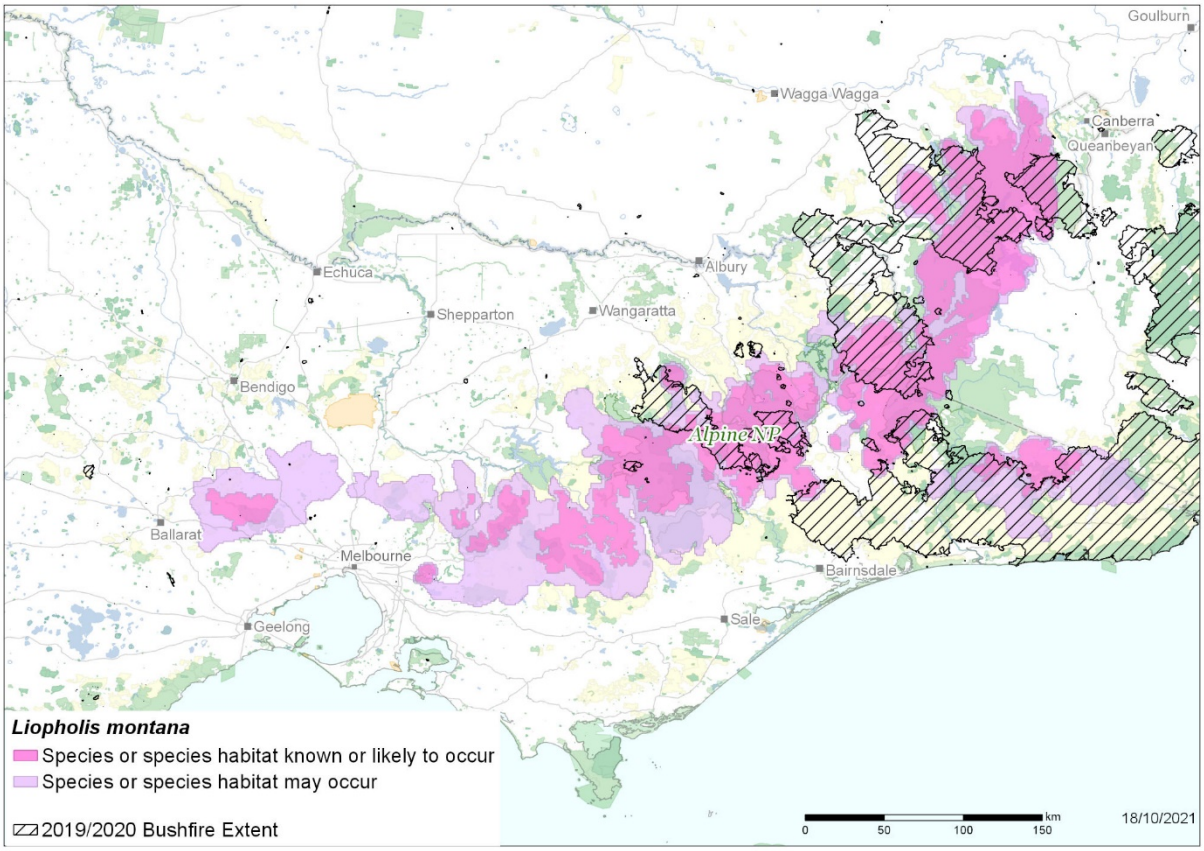
Due to the small size of subpopulations, their isolation from one another, and limited ability of skinks to disperse, the population is considered to be severely fragmented (B2a) as outlined in Clemann et al. (2018).

The number of locations is assessed as one given that it is plausible for a single fire to impact a large portion or even the entire range of the mountain skinks habitat in alpine and subalpine woodlands and forests between 600-1700 m above sea level. This elevational zone is exposed to the known and continued future threat of bushfires under climate change and post fire predation by invasive predators would occur across this entire area given the rocky refuge available to predators during fire. The combined effects of these threats could plausibly result in the population being eliminated or severely reduced within a single generation.

The mountain skink is also projected to have continuing decline in extent of occurrence due logging (Clemann et al. 2008) and has an estimated decline in area of extent and occupancy and quality of habitat (see Map 2) including an estimated decline in the number of mature individuals as estimated by Legge et al. 2021 of up to 10.6 per cent immediately post fires, or up to 32 per cent within the next three generations.

The Committee considers that the species' area of occupancy is restricted, it occurs in one location, is severely fragmented, and has continuing decline in area, extent and or quality of habitat, number of subpopulations and number of mature individuals. Therefore, the species has met the relevant elements of Criterion 2 to make it eligible for listing as Endangered.

Map 2 – Modelled distribution and 2019-20 bushfire extent (DAWE 2021)



Criterion 3 Population size and decline

		Critically Endangered Very low	Endangered Low	Vulnerable Limited
Estimated number of mature individuals		**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true				
C1. An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)		**Very high rate 25% in 3 years or 1 generation (whichever is longer)**	**High rate 20% in 5 years or 2 generation (whichever is longer)**	**Substantial rate 10% in 10 years or 3 generations (whichever is longer)**
C2. An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:				
(a)	(i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
	(ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b) Extreme fluctuations in the number of mature individuals				

Criterion 3 evidence

Insufficient data to determine eligibility

The population size of the mountain skink has not been estimated. The Committee considers that there is insufficient information to determine the eligibility of the species for listing in any category under this criterion.

Criterion 4 Number of mature individuals

	Critically Endangered Extremely low	Endangered Very Low	Vulnerable Low
D. Number of mature individuals	< 50	< 250	< 1,000
D2.[1] *Only applies to the Vulnerable category* Restricted area of occupancy or number of locations with a plausible future threat that could drive the species to critically endangered or Extinct in a very short time			D2. Typically: area of occupancy < 20 km² or number of locations ≤ 5

[1] The IUCN Red List Criterion D allows for species to be listed as Vulnerable under Criterion D2. The corresponding Criterion 4 in the EPBC Regulations does not currently include the provision for listing a species under D2. As such, a species cannot currently be listed under the EPBC Act under Criterion D2 only. However, assessments may include information relevant to D2. This information will not be considered by the Committee in making its recommendation of the species' eligibility for listing under the EPBC Act, but may assist other jurisdictions to adopt the assessment outcome under the *common assessment method*.

Criterion 4 evidence

Insufficient data to determine eligibility

The Committee considers that there is insufficient information to determine the eligibility of the species for listing in any category under this criterion.

Criterion 5 Quantitative analysis

	Critically Endangered Immediate future	Endangered Near future	Vulnerable Medium-term future
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

Criterion 5 evidence

Insufficient data to determine eligibility

Population viability analysis has not been undertaken. Therefore, there is insufficient information to determine the eligibility of the species for listing in any category under this criterion.

Adequacy of survey effort

The current survey effort for the mountain skink does not allow estimation of the number of mature individuals. This requires more detailed investigations as outlined in the conservation priorities.

Public consultation

Notice of the proposed amendment and a consultation document was made available for public comment for 30 business days between 16/08/2021 and 27/09/2021.

Listing and Recovery Plan Recommendations

The Threatened Species Scientific Committee recommends:

(i) that the list referred to in section 178 of the EPBC Act be amended by **including** *Liopholis montana* in the list in the Endangered category.

(ii) that there not be a recovery plan for this species.

Cataloguing data

This publication (and any material sourced from it) should be attributed as: Department of Climate Change, Energy, the Environment and Water 2022, Conservation advice for *Liopholis montana* (mountain skink), Canberra.

This publication is available at the SPRAT profile for *Liopholis montana* (mountain skink).

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