Science for Saving Species

Research findings factsheet

Project 4.1.4.2

Threatened Species Recovery Hub

National Environmental Science Programme

When do we move montane frogs to prevent climate change induced extinction?

In brief

Climate change is causing rapid contraction and fragmentation of montane habitats. Under current climate change projections, many species native to montane habitats face potential extinction, including several species of frogs. As existing habitat becomes increasingly unsuitable, new areas of suitable habitat may emerge elsewhere. Where these areas are too far away or disconnected for natural colonisation to occur, assisted colonisation may be a tool to avert extinction, if populations can be successfully established at the new sites.

We identified potential sites where two species of Critically Endangered Australian montane frogs threatened by climate change could be introduced. We applied a decision framework to determine the optimal timeframe for relocating each species to these areas.

For the northern corroboree frog (*Pseudophryne pengilleyi*), the best potential source populations were in the Australian Capital Territory (ACT) and New South Wales (NSW), with potential destination sites in Tasmania. For the spotted tree frog (*Litoria spenceri*), we identified one potential source population and one potential destination site, both in Victoria.

We found that for some combinations of source and destination sites, the optimal timing for assisted colonisation has already passed, while for other combinations the best timing is within the next two decades. The timing of optimal movements also depended on the proportion of adult frogs that survive translocation. All translocation strategies we explored would require further detailed investigation.

Background

Climate change is threatening the persistence of montane species worldwide. Without substantial climate action, decreases in both the size and connectivity of alpine habitats will be a key driver of population declines and will result in montane species being assigned to higher categories of extinction risk.

In Australia, montane frogs have experienced significant declines since the 1990s, with climate change (primarily manifesting as drought), the introduced chytrid fungus and wildfires being major individual threats that also interact with each other. Distribution modelling (e.g. Figure 1) has shown that some alpine frogs adapted to montane regions of the Australian Capital Territory, New South Wales and Victoria will lose suitable habitat under current climate change projections, unless substantial interventions are made. These species are not very mobile and are likely to contract to refugia rather than colonise new habitats. In some instances, suitable habitat may emerge in other parts of the continent, but frogs would not be able to reach these areas without human assistance.

Assisted colonisation is a form of conservation translocation. It is undertaken when a species that is under threat in its natural range is introduced to suitable habitat outside its natural range where the threat does not exist. Many instances of assisted colonisation have already taken place in Australia to prevent extinction of threatened mammals due to predation by introduced cats and foxes. However, translocations motivated by climate change so far remain rare. Recently an assisted colonisation trial of western swamp tortoises bred at Perth Zoo was undertaken. The tortoises were

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LEFT: Spotted tree frogs have a smaller range than the Northern Corroboree frog, and translocation planning will also need to consider other threats such as disease and introduced fish: Image: Adam Parsons.

Background

moved into higher rainfall areas 300 km south of their natural range, and this trial is currently under evaluation.

Translocations motivated by climate change require careful planning and risk assessment. One important consideration is identifying areas outside a species' natural range that could provide suitable habitat as the climate changes. Given the subdued nature of Australia's topography, habitats suited to cold-adapted alpine species are more likely to arise further south rather than at higher elevations.

Another important consideration is the best timeframe to conduct assisted colonisation, which is a complex decision, as it involves understanding the rate at which a source population is declining, as well as the rate that a population might increase if it is introduced elsewhere.

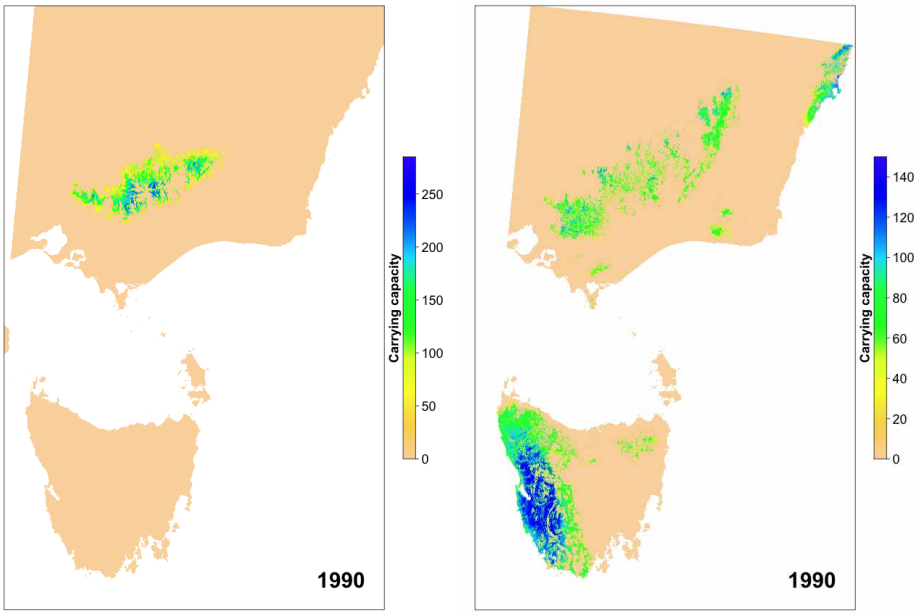

Figure 1. *Projected carrying capacity of two species of montane frog under the 1990 climate, with darker blue areas indicating regions that could support the largest frog populations. The left panel shows the spotted tree frog; the right panel shows the northern corroboree frog. Notably, the northern corroboree frog does not occur in Tasmania. Images: John Baumgartner*

Research aims

Our goals were firstly to determine the optimal timing for initiating assisted colonisation of two montane frog species, the northern corroboree frog and the spotted tree frog; and secondly to identify factors likely to influence success.

Table 1. *Key characteristics of two Critically Endangered montane frogs evaluated for their ability to persist under climate change.*

Species	Distribution	Altitudinal range (m)	Breeding habitat	Other major threats
Northern corroboree frog *Pseudophryne pengilleyi*	NSW, ACT	500–1646	Terrestrial, then aquatic	Disease, wildlife, feral horses
Spotted tree frog *Litoria spenceri*	Victoria	330–1100	Aquatic	Disease, introduced fish

What we did

This study explored the possibility of assisted colonisation for two montane frog species from south-eastern Australia, the northern corroboree frog and the spotted tree frog – also called Spencer's tree frog. It drew on previous research that had developed distribution models for the species that included forward projections under expected future climates.

We used existing models of environmental suitability coupled with population and dispersal models to examine the likelihood that each species would persist in areas they currently occupy under a high-emissions climate change scenario. We mapped future areas that might become suitable for them, and identified potential sites for assisted colonisation based on four criteria:

1. the site was predicted to be suitable for the species under climate change;
2. the increase in habitat suitability through time was large enough to allow a breeding population to establish;
3. the species could not colonise the site unassisted; and

*LEFT: Southern corroboree frogs (*Pseudophryne corroboree*) are bred in captivity across several facilities and could provide an alternative to moving frogs from one wild location to another. Image: Adam Parsons.*

What we did (continued)

4. there was a period of overlap in habitat suitability between the source and the destination site.

We used a previously published decision framework to find the best time to intervene and hypothetically relocate these species to sites where the climate should be suitable in the future. The framework took into account how the carrying capacity (the number of adults a patch of habitat can support) changed over time at both source and destination sites.

We simulated the movement of adult frogs from source to habitat patches in different years and assumed different levels of survival during translocations.

This allowed us to identify strategies that could maximise total population sizes of each species in the future. Together, these modelling approaches highlighted both the severity of the impact of climate change on montane frogs and the kind of practical decision-making that will be necessary to avert their extinction.

Key findings

Northern corroboree frog

Wild populations of the northern corroboree frog are currently found in the Brindabella Ranges in the ACT and the nearby Fiery Range and Bogong Mountains in NSW. There are three captive breeding programs for this species at Tidbinbilla Nature Reserve in the ACT, Taronga Zoo in NSW, and at Healesville Sanctuary in Victoria. For this species we identified two possible source populations in New South Wales, and two potential destination sites in Southwest National Park, Tasmania.

We found that the optimal time to move the northern corroboree frog was within the next two decades, but if translocation success was very low, then the optimal time to move has already passed.

For both source populations, it was optimal to translocate the species only when the population was at or above carrying capacity. This is because estimated rates of translocation survival are low, based on data generated by collaborators in the New South Wales Government where corroboree frogs affected by the chytrid fungus have been moved within their native range.

Spotted tree frog

The spotted tree frog breeds in rocky mountain streams of north-eastern Victoria and southern New South Wales, and is now only found in a few localities, having been badly affected by the Black Summer bushfires of 2019–2020. A captive breeding program for the species recently commenced at Healesville Sanctuary in Victoria. For the spotted tree frog, we identified one possible source population and one destination site near to Mount Hotham. The projected carrying capacity at the destination site by 2070 is around a quarter of the carrying capacity at the source site, but we predict the species will be extinct at the source site by 2070.

For this species, we found it would be optimal to move the source population at carrying capacity from 2035. By 2037, it became optimal to move the source population when it was larger than the carrying capacity of the destination site.

General considerations

For both species, our modelling assumed that survival probabilities are influenced by the effects of the introduced and deadly chytrid disease. Translocation could become more successful with improved translocation protocols and better control of chytrid. If so, then our modelling showed that the most optimal timeframe to move a population would change.

While assisted colonisation at the scale of moving many thousands of adult frogs may not be realistic, the time lag before any such movement becomes optimal might allow for improvement and upscaling of captive breeding. As the success of frog translocations increases markedly when more individuals are released, the establishment of new populations from captive breeding may allow assisted colonisation to be trialled. This would then allow translocation survival to be better estimated, and this information could be used to refine models that simulate the movement of wild populations.

LEFT: Tanks that are part of a captive breeding programs for the northern Corroboree frog at Tidbinbilla Nature Reserve in the ACT. Image: Peter Taylor TSR Hub

Implications and recommendations

Australia's threatened montane frogs face an uncertain future, even with the option to attempt assisted colonisations. This is due to the projected extinction of source populations over the next few decades unless substantial action on climate change is implemented. There is also a scarcity of suitable destination sites, and these sites have a predicted low carrying capacity.

Our models indicate that the optimal time to carrying out assisted colonisation has already passed for some source populations and, for others, it is approaching quickly over the next decade or two.

While this project is not yet advocating assisted colonisation for Australia's threatened montane frogs, it provides a structured decision framework for decisions about the optimal timing of any such interventions in the near future, and hence provides managers with a timeline for policy development and implementation.

Under current policy guidelines, conservation translocations such as the ones modelled in this project are unlikely to be approved by local agencies, partly because the suitable habitat that we identified as potential destination sites includes World Heritage estate in Tasmania. At present, the translocation of non-native species into Tasmanian World Heritage areas is considered to be contrary to maintaining the integrity of these areas. If assisted colonisation is to be considered as a serious conservation option for these two montane frogs, a swift re-think of policies will be necessary to support it as a potential management action.

The Bogong Mountains NSW. Image: Mick Stanic, Flickr, CC BY-NC 2.0

Further Information

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