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Edited by Pritpal S. Soorae





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Assessment of re-introduction methods for the Southern Corroboree Frog in the Snowy Mountains region of Australia.

David Hunter[1], Gerry Marantelli[2], Michael McFadden[3], Peter Harlow[4], Ben Scheele[5] & Rod Pietsch[6]

[1] - Threatened Species Officer, NSW Department of Environment, Climate Change and Water, P.O. Box 733, Queanbeyan, NSW, 2620, Australia (David.Hunter@environment.nsw.gov.au)
[2] - Amphibian Research Centre, PO Box 1365, Pearcedale, Victoria, 3912, Australia (gerry@frogs.org.au)
[3] - Unit Supervisor, Herpetofauna Division, Taronga Zoo, P.O. Box 20, Mosman, NSW, 2088, Australia (mmcfadden@zoo.nsw.gov.au)
[4] - Manager, Herpetofauna Division, Taronga Zoo, P.O. Box 20, Mosman, NSW, 2088, Australia (pharlow@zoo.nsw.gov.au)
[5] - Project Officer, NSW Department of Environment, Climate Change and Water, P.O. Box 733, Queanbeyan, NSW, 2620, Australia (Ben.Sheele@environment.nsw.gov.au)
[6] - Threatened Species Officer, NSW Department of Environment, Climate Change and Water, P.O. Box 733, Queanbeyan, NSW, 2620, Australia (Rod.Pietsch@environment.nsw.gov.au)

Introduction

The southern corroboree frog (*Pseudophryne corroboree*) only occurs in the Snowy Mountains Region of Kosciuszko National Park, and is one of Australia's most iconic frog species. This species occupies the sub-alpine zone between 1300 and 1750 m (Osborne, 1989), where it typically breeds in small ephemeral pools in sphagnum bog wetlands (Hunter *et al*., 2008). The southern corroboree frog has been in a continued state of decline over the past 20 years, and is likely to be extinct in the wild within the next 10 years if recovery efforts are unsuccessful. The primary cause of decline is chytridiomycosis, a disease caused by infection with the amphibian chytrid fungus, *Batrachochytrium dendrobatidis* (Hunter *et al*., in press). Given the dire predicament faced by the southern corroboree frog (monitoring of all sites in 2010 suggests there are fewer than 40 males remaining in the wild, Hunter unpublished data) preventing the

Adult male southern corroboree frog © D. Hunter extinction of this species relies on successfully establishing a captive breeding and re-introduction program. The southern corroboree frog is listed as Endangered in Australia under the *Environment Protection and Biodiversity Act* 1999, and Critically Endangered by the IUCN.

Goals

- Goal 1: Develop a successful re-introduction program to ensure the persistence of the southern corroboree frog in the wild.
- Goal 2: Develop efficient re-introduction techniques to maximize the value of available resources.
- Goal 3: Use information on post-release survivorship to identify the number of offspring required from the captive breeding program for future re-introductions.

Success Indicators

- Indicator 1: Breeding populations of the southern corroboree frog increase in size.
- Indicator 2: Accurate estimates of post-release survivorship to breeding have been attained for comparing different re-introduction strategies and setting targets for the captive breeding program.

Project Summary

Feasibility: The recovery program for the southern corroboree frog has multiple partner organizations that are committed to the long term goal of achieving self-sustaining populations of this species in the wild. It is acknowledged by all partners that this program is likely to take several decades to achieve this goal. This program has considerable public and government support, and the recovery of this species is an important objective for the biodiversity management of Kosciuszko National Park. An experimental augmentation program has previously been undertaken, which involved harvesting eggs from the wild and rearing them through to a late tadpole stage before returning them back to their natal pools (Hunter *et al*., 1999). While this program successfully increased recruitment to metamorphosis (Hunter *et al*., 1999), it failed to noticeably reduce population decline (Hunter, 2008). The current program is aimed at assessing two alternative re-introduction techniques; releasing tadpoles into artificial pools, and releasing four-year-old frogs. The potential merits of releasing tadpoles into artificial pools (400 liter plastic tubs) is that it should reduce rates of chytrid fungus infection in tadpoles, there will be no tadpole mortality associated with early pool drying, and there are negligible rearing costs prior to release. The four year old frog release is being trialed because this strategy has the greatest potential to reduce infection and mortality prior to sexual maturity. However, this technique has considerable rearing costs, and relies on frogs that have been in captivity for an extended period being capable of surviving and breeding in the wild after release. The majority of the animals used in these trials were harvested from the wild as eggs.

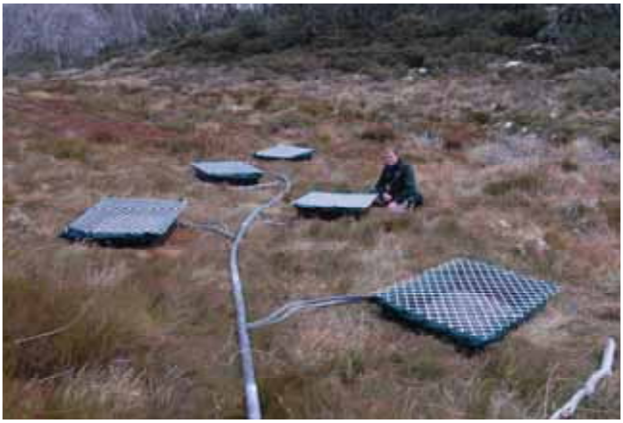
Implementation: *Release into artificial tubs* - Fifty eggs at hatching stage were placed in each of 20 artificial pools across four sites (five pools per site) in mid autumn (April or May) of 2008, 2009 and 2010. The artificial pools were 400 litre

Metamorph on net surface © D. Hunter

grey polypropylene tubs positioned within natural bog systems. Each tub had a constant flow from a nearby stream at a rate of approximately 20 litres per hour. A 2 cm layer of pond silt was placed on the bottom of each tub to provide a natural food source for the tadpoles. The top of the tubs were a minimum of 15 cm from the ground and positioned such that they could not be accessed by the common eastern froglet (*Crinia signifera*), which is a reservoir host for the chytrid fungus. Each pool was lined with shade cloth to provide an exit ramp for the metamorphosing frogs. Clumps of sphagnum moss were placed in two corners of each artificial pool to provide a moist refuge for the metamorphosing frogs.

Release of four year old frogs - In January 2006, 196 four-year-old frogs, and 15 five year old frogs, were released across two sites. Assuming an even sex-ratio for the released individuals, and since we only assessed male survivorship, the sample size of individuals for assessing the outcome of this study is half the number of individuals released. Prior to release, each individual frog was measured for snout-vent and tibia length, weighed, and their belly and throat photographed for individual identification using pattern recognition.

Post-release monitoring: *Release into artificial tubs* - The total number of tadpoles in each tub was assessed just prior to metamorphosis in late spring (November). Ten randomly selected tadpoles from each pool were also measured and staged. Upon reaching metamorphosis, a sample of the juvenile frogs were caught and swabbed for infection with the chytrid fungus. The mean survivorship from egg laying to metamorphosis across all pools was 35% in 2008, and 66% in 2009 (2010 has not been assessed at this stage). The results for 2008 are within the range of survivorship attained through augmenting recruitment in natural pools, while the results for 2009 are considerably greater (Hunter, 1999). The increase in survivorship during 2009 may have been due to better quality substrates provided in all pools, however this is unsubstantiated. The size of the tadpoles, and subsequent metamorphs, was typically greater than that observed in natural pools. Of the eleven artificial pools that attained survivorship through to metamorphosis in 2008, one pool was identified as infected with the chytrid fungus, which is lower than the 60% of natural pools identified as being infected in an earlier study (Hunter, 2008). Infection status of pools in 2009 and 2010 has not been analysed at this stage. While further assessment is required to determine



Artificial tubs © D. Hunter

the value of re-introducing eggs into artificial pools, the initial results are promising.

Release of four year old frogs - Six surveys of calling males were undertaken at each release site during the last two weeks of January in 2007, 2008, 2009 and 2010 to identify the position of male nest sites for later inspection to determine if any of the released individuals had returned to breed. Surveys were also undertaken at all potential breeding habitats within a 2 km radius of the release sites to determine whether the released frogs had migrated to adjacent areas. Towards the end of the breeding season (first week in February), the males were removed from their nest sites to identify individuals, assess size, and swabbed for chytrid fungus infection. No re-introduced males were observed breeding in January 2007, however five breeding males were located at one of the sites in 2008. Males were observed at both breeding sites in 2009, and one site continued to have breeding adults in 2010. Chytrid fungus infection was detected in one individual in 2009. Based on the number of frogs returning to breed, estimated variation (95% conf. limits) for survivorship ranged from 1%-17%.

Major difficulties faced

- The length of time required to assess the value of the egg re-introductions (minimum seven years) has limited decision making by the recovery team in the interim.
- Severe drought immediately after the release of the four year old frogs may have greatly reduced survivorship and breeding activity, and thus produced atypical results.
- The relatively small number of four year old frogs released may have limited statistical inferences. A larger release is planned for December 2010, which will more specifically assess the role of chytridiomycosis in post-release survivorship.

Major lessons learned

- Given the relatively low post-release survivorship attained for the techniques assessed at this stage, future re-introductions will require substantial progeny from the captive breeding program.
- Post-release survivorship for the different release strategies can have substantial variation among years and sites, which should be considered in the

design of future re-introduction experiments to ensure robust results are attained.

Success of project

Highly Successful	Successful	**Partially Successful**	Failure
		√	

Reason(s) for success/failure:

- Re-introducing four year old frogs can be used to maintain populations in the wild, however, substantial resources will be required to produce sufficient numbers of individuals.
- The high survivorship to metamorphosis, and low chytrid fungus infection rates, for the eggs re-introduced into artificial pools suggests this technique may be an efficient re-introduction technique.

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