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The Conservation and Demography of the Southern Corroboree Frog (*Pseudophryne corroboree*)

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ABSTRACT

The documented decline of amphibian populations over the past two decades has increased attention towards amphibian conservation. Much of this attention has been focused on testing hypotheses as to the causal factors of these declines, however providing convincing data to support any of these hypotheses has proved difficult. The testing of these hypotheses and the implementation of endangered species recovery programs has been restricted by a lack of knowledge of the ecology and population demography of amphibian species that have suffered dramatic declines.

This thesis presents aspects of the research phase of the recovery program for the Southern Corroboree Frog, *Pseudophryne corroboree*, a species that declined to very low numbers during the early 1980's. In particular, this research aimed to determine the distribution, abundance, population dynamics and demography of this rare species. A complete reassessment of the conservation status of *P. corroboree* was undertaken and the nature of the persistence of this species across the landscape was analysed. Temporal trends in abundance and its relationship with population size were also investigated. Early life-history survivorship and recruitment to metamorphosis were studied at the scale of individual nest sites and populations, and the adult male population age structure and annual mortality were investigated using skeletochronology.

The shout/response survey technique was used to survey and monitor the number of breeding male *P. corroboree* during this study. This method was found to provide consistent results when the surveys were conducted over a short (two week) period during the peak breeding season in January. Neither time of day, nor the number of males present at a pool, was found to influence the level of responsiveness of male *P. corroboree* to the shout/response technique. Variation in the number of responding males to the shout/response technique through the breeding season, assessed at a single site over two seasons, was unimodal with the peak responding period occurring during the last two weeks of January during both the 1998 and the 1999 breeding seasons.

A systematic survey covering 213 sites across the entire historic distribution of *P. corroboree* found this species to be persisting at 79 sites. The majority of these sites were in the north-western portion of the species former range, around the Jagungal Wilderness area, while no

extant sites were found in the south-eastern portion of the species former range in the Smiggin Holes and Perisher Blue ski resorts area. The overall abundance of males at persistent sites was extremely low, with 92 percent of sites having fewer than ten responding males. Only one site was found to support greater than fifty responding males. A logistic regression analysis found the persistence of *P. corroboree* to be associated with increased number of pools within a site, decreased distance to nearest extant population and geographic position (latitude and longitude) in the landscape. While annual variation was observed in the number of breeding males for individual sites, there was no overall trend for an increase or decrease in the number of males, regardless of population size. The average annual extinction rate for local populations was five percent during this study, with those populations becoming extinct having very few breeding males (between one and three) during the previous season.

Embryonic and tadpole survivorship was monitored for individual nests at three sites across three years. Recruitment to metamorphosis for *P. corroboree* was characterised by high variation in survivorship between nest sites, populations and years, while overall recruitment for nest sites was skewed towards lower survivorship. Average nest survivorship to metamorphosis across all sites and years was ten percent but the skewed nature of this survivorship meant that the majority of nest sites attained very low or no survivorship. The low proportion of nest sites that did attain high survivorship provided the greatest contribution to overall recruitment. The levels of embryonic and tadpole mortality observed in this study would be providing a considerable contribution to the regulation of current population sizes.

The greatest level of early life-history mortality was observed during the late autumn/winter egg and tadpole stage, with high survivorship during the summer and early autumn egg stage and the post-winter tadpole stage. The estimated sex ratio for seven populations, based on the number of eggs within male nest sites, indicated that for most populations, regardless of population size, there was a greater proportion of females to males. In general, the estimated sex ratio of smaller populations showed greater annual variation and had a lower average number of females to males than the single large population.

Tadpole surveys conducted across remnant populations during both 1998 and 1999 found recruitment to metamorphosis to be very low for the majority of populations. A third of all populations during both years attained no recruitment to metamorphosis, with those populations that did attain recruitment typically having fewer than 20 tadpoles. While sites

with more frogs generally recruited more tadpoles, there was no strong relationship between population size and the number of tadpoles recruited per male at the scale of either pool or site. There was also no significant difference in recruitment levels between the two years. Tadpole surveys across breeding pools within the single large population also found very low tadpole abundance. There was no strong relationship between the number of male frogs at a pool and the number of tadpoles per male and there was no significant difference in tadpole abundance between the two years. Based on the low density of males at pools and sites (typically less than five), and the skewed nature of nest survivorship identified from monitoring individual nest sites, it seems likely that both deterministic and stochastic factors are influencing recruitment levels in remnant populations of *P. corroboree*.

This study determined that adult male *P. corroboree* could be accurately aged using the technique of skeletochronology, and this technique was used to determine the adult male population age structure for three populations. The results indicated that adult male *P. corroboree* can reach sexual maturity from metamorphosis in three years, but the majority of individuals take four years. The oldest individual identified in this study was nine years old from metamorphosis. The adult male age structure at the single large site showed very little annual variation, whereas the two smaller populations showed highly pulsed age structures from one year to the next. The size of adult males was found to be a poor predictor of age. Annual adult male survivorship, calculated by following cohorts from one year to the next, was 55 percent. Based on this calculation of annual adult male survivorship, it seems likely that the initial decline in *P. corroboree* involved increased levels of adult mortality.

The results of this study indicate that the persistence of *P. corroboree* in the wild is precarious in the short-term. For this reason, it is recommended that efforts be undertaken to secure this species *ex situ*. Attempts to increase population numbers in the wild would greatly benefit from determining the factor(s) that have caused the decline in this species, however, failure to do so should not preclude field experimental management aimed at developing technique to increase the size of remnant populations. This is because it is likely that small population stochasticity is contributing to the current regulation of population size and it is possible that the factors that caused the decline in this species cannot be removed from the environment.

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