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Southern Corroboree Frog *Pseudophryne corroboree*

Review of Current Information in NSW

August 2008

Current status:

The Southern Corroboree Frog *Pseudophryne corroboree* is currently listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The NSW Scientific Committee recently determined that the Southern Corroboree Frog meets criteria for listing as Critically Endangered in NSW under the *Threatened Species Conservation Act 1995* (TSC Act), based on information contained in this report and other information available for the species.

Species description:

The following description was taken directly from Cogger 2000:

“Bright yellow above with shiny longitudinal irregular black stripes, the latter frequently broken and interconnected. This pattern extends over the limbs and flanks. Ventral surface broadly marbled with black and white or black and yellow. Skin slightly granular above with low warts which tend to coalesce to form longitudinal ridges. Smooth below. A large; flat femoral gland on each hindlimb. Inner metatarsal tubercle low, round, not shovel-shaped. Inner toe with a single phalanx. 30 mm.

Taxonomy:

Moore (1953) first described the Corroboree Frog *Pseudophryne corroboree* (Anura: Myobatrachidae) from a specimen collected at Round Mountain (which is now within Kosciuszko National Park). Until recently, only one species of Corroboree Frog was recognised (Cogger 1992). However, genetic divergence (Roberts & Maxson 1989; Osborne & Norman 1991, Morgan *et al.* 2008), differences in colour-pattern and morphology (Pengilley 1966; Osborne *et al.* 1996) and skin biochemistry (Daly *et al.* 1990) have provided arguments for recognising the Northern Form as a separate species. In addition, the two forms are allopatric in their range (Figure 1), being separated by the Kiandra and Coolamine Plains, and the steep topography associated with the upper Tumut River catchment. This recommendation has been generally accepted by other authorities (*e.g.* Tyler 1997; Cogger 2000) and the Northern Form, *P. pengilleyi*, is now recognised as a distinct species in the TSC Act (on Schedule 2, Vulnerable).

The bright yellow unbroken striped dorsal pattern of the Southern Corroboree Frog distinguishes it from the Northern Corroboree Frog *P. pengilleyi* which has a less brilliant lime-yellow, narrower broken pattern of stripes (Osborne 1991).

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Distribution and number of populations:

Historically the Southern Corroboree Frog is known from the sub-alpine areas of Kosciuszko National Park in southern New South Wales, from Smiggin Holes in the south, to the Maragle Range (about 5 km west of Cabramurra) in the north (Osborne 1989; DECC 2007) (Figure 1), at altitudes between about 1 300 and 1 760 m. This species has experienced a contraction in range and now only occurs along the western edge of its former distribution, from the Dargals Range in the south, to the Maragle Range in the north.

Osborne (1988, 1989) found that the frogs were not present at any of the potential suitable breeding sites that separate the northern and southern species, between Cabramurra in the south and Yarrangobilly in the north.

Searches in the Thredbo Valley and Cascades areas, south of Smiggin Holes and Mt Kosciusko, indicate that the Southern Corroboree Frog does not occur in the southern extensions of the Snowy Mountains. Surveys further south in the Victorian high country have also failed to locate the frogs (Woodruff 1959; Littlejohn 1962; Anon. 1977).

The topographical features influencing the distribution of the Southern Corroboree Frog appear to include barriers to dispersal such as deep river gorges (particularly those associated with the Happy Jacks, Tumut and Thredbo Rivers), broad frost-hollow valleys (e.g. the Happy Jacks, Kiandra and Long Plains), and the treeless alpine parts of the Kosciusko main range.

All known and historical populations of the Southern Corroboree Frog occur within Kosciuszko National Park (DECC 2007). Small populations of the Southern Corroboree Frog previously occurred in the Perisher-Smiggin and the Guthega resort areas within the park (Osborne 1988).

Subpopulations: Morgan *et al.* (2008) found high genetic diversity within the species and could not separate breeding sites into distinct subpopulations. This result is likely to reflect the historical gene flow. However, due to the recent and rapid population decline of the Southern Corroboree Frog, there are unlikely to be high levels of gene flow between occurrences, as these are now more isolated as a result of severe fragmentation of the total population. Based on common drainage systems, the method used for pooling sites in Morgan *et al.* (2008) and for the captive breeding program, there are possibly four to six subpopulations.

Locations: The Chytrid fungus, the most severe threat to this species, could easily be spread through all populations, as all known breeding sites are accessible to public visitation (through recreational activities such as skiing or bushwalking), as well researchers. The entire population of the Southern Corroboree Frog is therefore restricted to a single 'location' (IUCN 2008).

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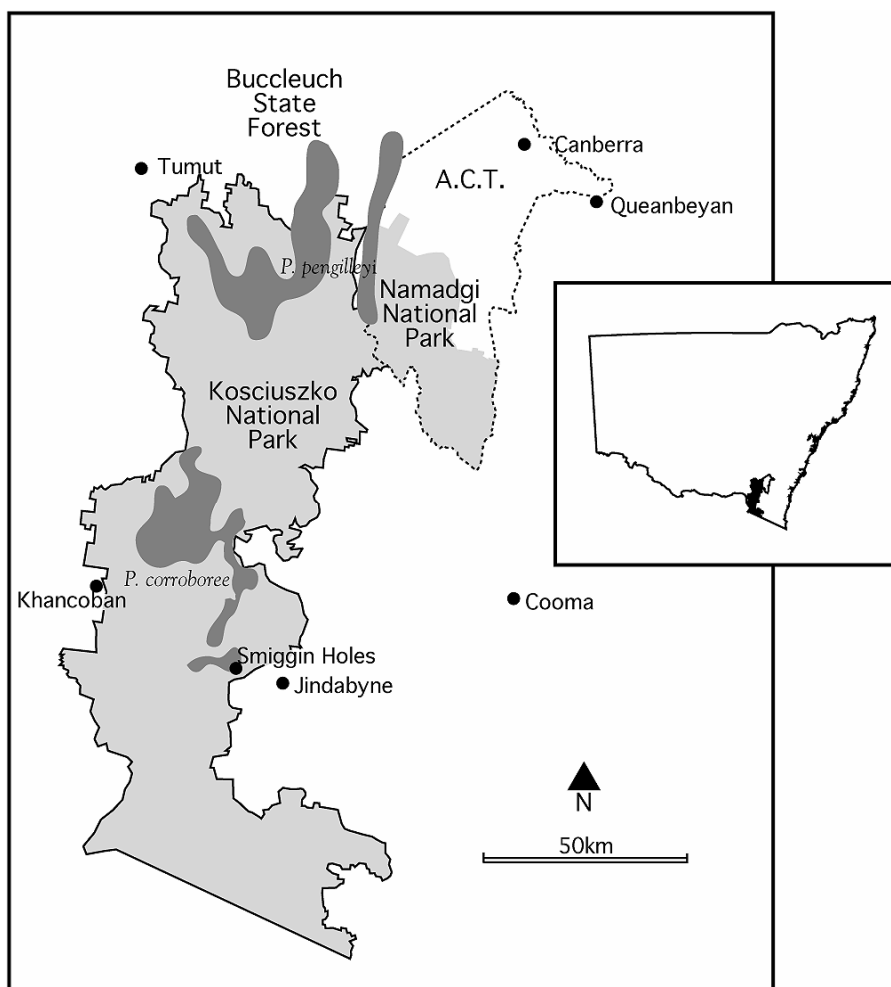


Figure 1. The distribution of *P. corroboree* and *P. pengilleyi*. Darker stippling indicates the historic range of the species. Source: DECC 2007

Ecology:

Key habitat requirements

The Southern Corroboree Frog is a habitat specialist, restricted to montane and sub-alpine woodlands, heathland and grassland utilising two distinct habitat types. The summer breeding habitat is associated with temporary pools and seepages in sphagnum bogs, wet tussock grasslands and wet heath. The terrestrial non-breeding sites occur in the litter, logs and dense ground cover in the understorey of snow gum woodland and heath forest adjacent to the breeding area (DECC 2007).

Life history

Like most frogs, the Southern Corroboree Frog has a typical two-stage life-cycle with an aquatic tadpole stage and terrestrial post-metamorphic juvenile and adult stage.

In early summer the adult males move into the breeding habitat. During favorable weather conditions from late December through to mid February, the males call from small chambers in moss or other soft vegetation at the edges of the breeding pools.

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Breeding occurs from January to February (Pengilley 1966, 1973). Females deposit 16 to 38 eggs in terrestrial nests occupied by the breeding males. Tadpoles develop within the egg capsule and hatching occurs during autumn and winter in periods of high rainfall or snowmelt. Tadpoles then move out of the nest site and into the adjacent pool before undergoing metamorphosis in early summer (Hunter *et al.* 1999). As they grow larger, the juveniles leave the breeding area and move into the adjacent non-breeding habitat where it is thought they remain until they are adults.

The average survivorship from egg to metamorphosis for this species was found to be 20% in the absence of early pool drying (i.e. drying of the pools before tadpoles reach metamorphosis) (Hunter 2000). Early pool drying during drought years typically caused 100% failure of recruitment to metamorphosis for that year (Hunter 2000). There is no information available on survivorship from metamorphosis to sexual maturity.

Generation length

Age to first reproduction for the majority of males was found to be four years from metamorphosis (Hunter 2000). It is likely that the majority of females take four or five years to attain sexual maturity (DECC 2007).

Annual survivorship estimates for the adult life stage is restricted to information attained on the male breeding population (Hunter 2000). The oldest individual identified was ten years old; however the average longevity is six years (expert advice, 2008). Annual survivorship for adult males has been determined to be between 50 and 60 percent (Hunter 2000). 'Generation length' (IUCN 2008) is estimated to be five to seven years.

Number of mature individuals:

Based on the number of males calling, the total population of mature individuals of Southern Corroboree Frog in the wild was estimated to be between 100 and 150 during surveys in January 2008 (expert advice, 2008).

Threats:

The major cause of declines in the corroboree frogs is now recognised to be as a result of the introduced Amphibian Chytrid Fungus (*Batrachochytrium dendrobatoides*) (Berger *et al.* 1999; Hunter *et al.* 2006). The initial decline of this species coincided with the first appearance of the disease in the population (Hunter 2007) and also with the decline of other frog species in along the eastern ranges of Australia in which chytrid has been implicated (Osborne *et al.* 1999; Berger *et al.* 1998). At one Southern Corroboree Frog site discovered in 2004, no frog had tested positive to chytrid infection up to 2005. In 2006 however, positive infections were recorded and by 2007 the population had declined by 93% (Hunter *et al.* 2006; Hunter *et al.* 2007)., 'Infection of frogs by Amphibian Chytrid causing the disease chytridiomycosis' is listed as a Key Threatening Process under the TSC Act in NSW.

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Other threats:

Drought - Because the Southern Corroboree Frog typically breeds in highly ephemeral waterbodies, this species is vulnerable to drought conditions. Hence, during drought years, entire cohorts of tadpoles may perish due to early pool drying (Hunter 2000), which ultimately influences fluctuations in the breeding adult population (Hunter *et al.* 2006).

Climate Change – Because the Southern Corroboree Frog occurs in a narrow climatic range (the sub-alpine and alpine regions of eastern Australia), any human induced or natural climate change is likely to have a serious impact on this species (Bennett *et al.* 1991). ‘Anthropogenic Climate Change’ is listed as a Key Threatening Process under the TSC Act in NSW.

Fire - The way in which fire may impact on this species is likely to vary, from direct mortality of individuals, to longer-term impacts resulting from habitat alteration. Evidence at this stage is only anecdotal but indicates a possible impact of fire on this species (expert advice, 2008). Extensive fires in 2003 burnt through the entire range of the Southern Corroboree Frog, during the peak breeding period, and burnt over 90% of the habitat (DECC 2007). Direct observations were made of males perishing in nest sites due to heat exposure (DECC 2007). It is also possible that these fires inhibited breeding activity or caused increase mortality in females (DECC 2007). There is also concern that these fires will result in a significant loss of bog habitats in Kosciuszko National Park, through erosion and drying out of peat beds. ‘High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition’ is listed as a Key Threatening Process under the TSC Act in NSW.

Feral Animals – Both Feral Pigs (*Sus scrofa*) and Feral Horses (*Equus equus*) have the capacity to damage over-wintering habitats adjacent to bog environments. Feral Pigs have also been observed damaging breeding areas used by Southern Corroboree Frogs (DECC 2007). Considerable effort has been undertaken to control these feral species throughout the Southern Corroboree Frog habitat (DECC 2007). ‘Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa*’ is listed as a Key Threatening Process under the TSC Act in NSW.

Extreme fluctuations:

Populations apparently fluctuate as a result of variable breeding success in response to drought. However, it is uncertain whether this species undergoes ‘extreme fluctuations’ (IUCN 2008).

Population reduction and continuing declines:

The rapid decline of the Southern Corroboree Frog over the last three decades is well documented. Observations made until 1966 indicate the species was abundant within its limited geographic range. Large numbers of individuals were frequently recorded at suitable breeding sites (Colefax 1956; Jacobson 1963; Pengilley 1966; Osborne 1989). For example, at Pipers Saddle near Smiggin Holes and at Alpine Hut south of Mt Jagungal, male breeding groups were

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estimated to consist of hundreds of calling individuals (Colefax 1956; Pengilley 1966; Osborne 1989).

In the summers of 1985 and 1986, Osborne (1988, 1989) undertook the first extensive surveys of the distribution and relative abundance of the Southern Corroboree Frog, in which 256 potential breeding sites were surveyed across the known historic range of the species in the Snowy Mountains. The results of this survey found that numbers of this species had declined markedly prior to these surveys. At 74% of extant sites, fewer than ten calling males were recorded at each site. The largest choruses, those estimated at greater than 25 males, were recorded at only 15% of the extant sites. In addition, the Southern Corroboree Frog was present at only 24% of surveyed sites and some of the previously recorded locations were now extinct.

A monitoring program of 18 populations over a thirteen year period (1986-1999) documented the continued decline of the Southern Corroboree Frog, with 14 of these populations becoming locally extinct and the density of frogs at the persistent populations being extremely low (Osborne *et al.* 1999; Hunter 2000). In addition to the monitoring program, a systematic survey of potential habitat across the historic range of the Southern Corroboree Frog was undertaken from 1996 to 1999, to ascertain the distribution and abundance of extant populations of this species. Of the 213 sites surveyed during this period, the frog was found to occur at 79 sites (Hunter 2000). The abundance of frogs at the extant sites was extremely low, with the majority of these sites having fewer than five calling males (Hunter 2000). Of the surveyed sites, 60 were locations the species was recorded previously as present by Osborne (1989), only eight of these sites were found to be extant (Osborne *et al.* 1999).

Osborne *et al.* (1999) also recorded a reduction in the distribution of the Southern Corroboree Frog. Few extant populations were found along the entire eastern edge of the former distribution. It was also found that in the southern-most extent of the Southern Corroboree Frog's former range (in the Smiggin Holes and Guthega region, south of the Snowy River) the number of sites at which the species was detected declined from 10 in 1986 to two by 1991 (Osborne 1991), and in 1997 and 1998 no frogs were recorded at any southern site (Osborne *et al.* 1999). The central portion of the former range, the region believed to be the core of the species distribution (Osborne 1988, 1989), also had experienced an extensive collapse in population. Frogs were found at only 21 sites with the number of frogs at each site being critically low (only four sites had greater than one calling males per site; only one site had greater than ten calling males).

In 1999, the number of annual monitoring sites was increased to 40 extant populations (Hunter 2001) and a total of 379 males were recorded (Hunter *et al.* 2007). By 2007, only eight of these sites still persisted, all of which had experienced a decline in numbers, with a total of 13 calling males recorded (Hunter *et al.* 2007) (Figures 2 & 3).

All non-monitored sites known to contain frogs during the late 1990's were re-surveyed between 2004 and 2007. Of these 39 sites, only two sites were found to still contain calling males. Further survey work undertaken in 2005 and 2006 located eight new sites (Hunter *et al.* 2007). Of these ten total sites only three were found to be extant in 2007 with a total of 15 calling males. One large site found in 2004 suffered a severe decline of 93% from 2006 to 2007 (140 to nine males).

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As documented by the long-term monitoring program, the Southern Corroboree Frog has failed to show any signs of recovery since the initial population crash, with many of the monitored populations continuing to decline to extinction (Osborne 1989; Osborne *et al.* 1999; Hunter *et al.* 2007). In addition, the current population sizes are very low and monitoring has demonstrated a high propensity for populations consisting of fewer than five calling males to become extinct within a few years (Osborne 1998). The result of the declines in 2006/2007 corresponds with the failed recruitment to metamorphosis four years prior in the summer of 2002/03 (Hunter *et al.* 2007). The delayed effect of this failed recruitment is due to the time taken to reach sexual maturity from metamorphosis in this species (four years: Hunter 2000). Hence, this decline is expected to continue because failed recruitment to metamorphosis has occurred each year after this period. Therefore, it is reasonable to conclude that the current population trajectory will continue, and that the Southern Corroboree Frog will be extinct in the wild within two to five years (Hunter *et al.* 2007; expert advice, 2008).

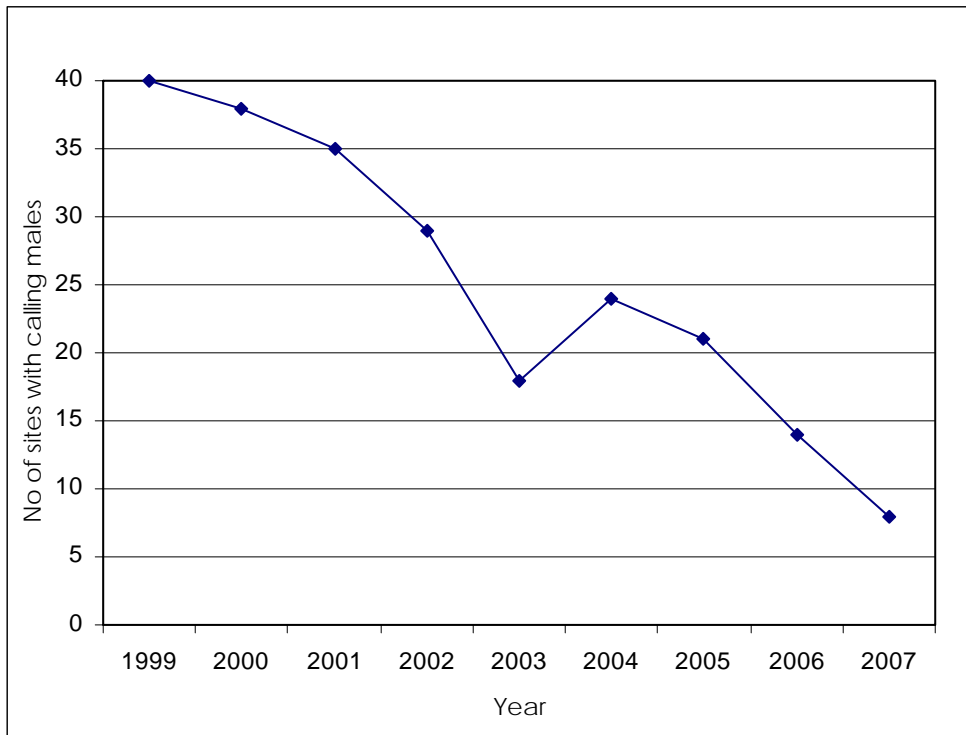


Figure 2: Change in the number of monitored sites with calling *P. corroboree* males since 1999.

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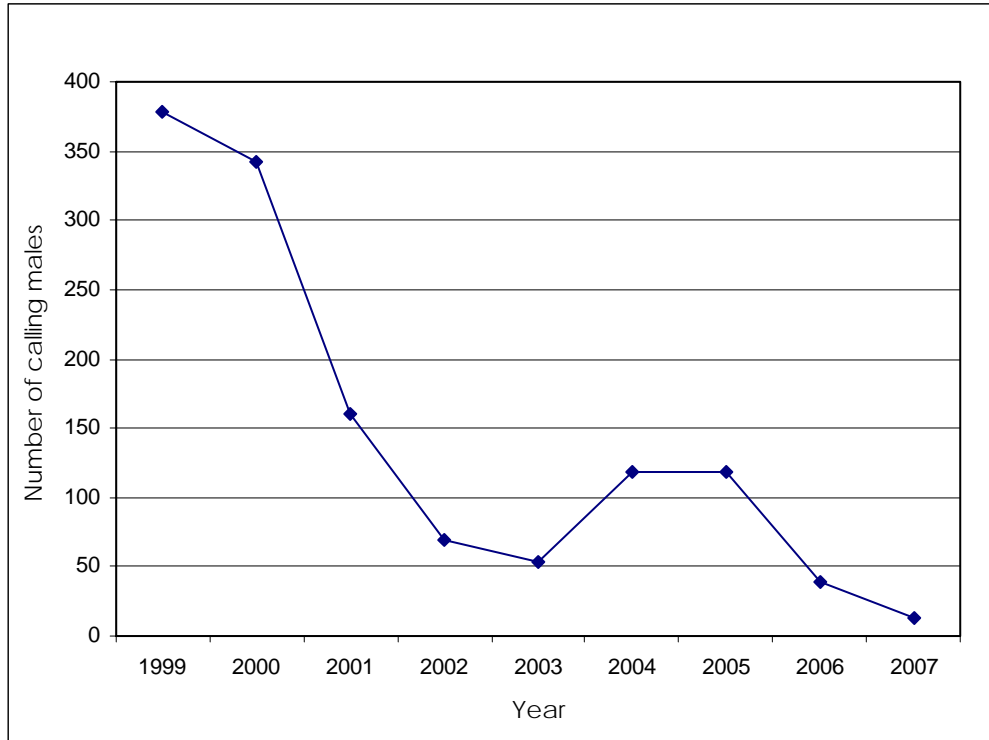


Figure 3: Change in the number of calling *P. corroboree* males in the 40 monitored sites since 1999.

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Recovery actions:

Captive breeding program and population augmentation:

As it is believed that in the absence of a successful management technique, the Southern Corroboree Frog decline is likely to continue until species becomes extinct in the wild (DECC 2007; expert advice, 2008), all known populations of this species are now subject to invasive techniques. This involves the removal of eggs for captive rearing, breeding and reintroduction experiments (DECC 2007).

The Southern Corroboree Frog has been successfully bred in captivity at the Amphibian Research Centre and the Melbourne Zoo. However, the proportion of adults breeding at this stage is insufficient to maintain a self-sustaining colony of this species (DECC 2007).

In 2006, 196 four-year-old frogs and 15 five-year-old frogs were released at several sites. None of the released frogs returned to breed during the January 2007 breeding season (Hunter *et al.* 2007). As no reintroduced frogs have bred, these individuals are not included as part of the total number of 'mature individuals' (IUCN 2008).

Extent of Occurrence (EOO) & Area of Occupancy (AOO):

Historically the Southern Corroboree Frog has always had a limited geographic distribution. Osborne (1989) recorded that this species occupied an area of about 400 km², with a linear range of 51 km and with the broadest part of the range, near Mount Jagungal, being 24 km.

The overall geographic range of the species has now contracted, and includes extensive areas where the frogs are now either extinct or in much reduced numbers. The EOO for the species is now less than 45 km², and AOO is less than 36 km² (based on a 2 x 2 km grid cell, the scale recommended by IUCN (2008) for assessing areas of occupancy).

Severe fragmentation:

Surveys suggest that the Southern Corroboree Frog has become locally extinct from over 85% of areas where it was historically known to occur (Hunter 2007). Fragmentation and isolation of populations has occurred as a result of these local extinctions between currently occupied sites, leading to distances that frogs are unlikely to be able to disperse across. Ecological observations show that this species is slow-moving and has high breeding site fidelity (expert advice, 2008). Dispersal capabilities are unknown, although local extinctions have resulted in breeding sites being separated by more than 5 km, a distance believed to be beyond the dispersal capacity of frogs (Duellman & Trueb 1986).

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Explanatory note

Between 2007 and 2009 the NSW Scientific Committee undertook a systematic review of the conservation status of a selection of plant and animal species listed under the Threatened Species Conservation Act. This species summary report provides a review of the information gathered on this species at the time the Review was undertaken.

The Scientific Committee's report on the Review of Schedules project and final determinations relating to species that were either delisted or had a change in conservation status can be found on the following website: www.environment.nsw.gov.au .

The Committee gratefully acknowledges the past and present Committee members and project officers who ably assisted the Committee in undertaking the Review of Schedules Project. Information on the people involved in the project can be found in the Acknowledgement section of the project report entitled "Review of the Schedules of the Threatened Species Conservation Act 1995. A summary report on the review of selected species" which is available on the abovementioned website.

This species summary report may be cited as:

NSW Scientific Committee (2008) Southern Corroboree Frog *Pseudophryne corroboree*. Review of current information in NSW. August 2008. Unpublished report arising from the Review of the Schedules of the Threatened Species Conservation Act 1995. NSW Scientific Committee, Hurstville.