National Recovery Plan

for the

Baw Baw Frog *Philoria frosti*

Gregory J. Hollis

Australian Government

State Government Victoria
Department of Sustainability and Environment

Prepared by Gregory J. Hollis, Department of Sustainability and Environment, Victoria

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This Recovery Plan has been developed with the involvement and cooperation of a range of stakeholders, but individual stakeholders have not necessarily committed to undertaking specific actions. The attainment of objectives and the provision of funds may be subject to budgetary and other constraints affecting the parties involved. Proposed actions may be subject to modification over the life of the plan due to changes in knowledge.

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Cover photograph: Female Baw Baw Frog *Philoria frosti*, Mt Baw Baw Vic. by Gregory Hollis

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Summary

The Baw Baw Frog *Philoria frosti* is a smallish brown frog endemic to the Baw Baw Plateau and escarpment area, in the Central Highlands of Victoria, about 120 km east of Melbourne. The total extent of occurrence of the species is about 135 km^2. On the plateau, Baw Baw Frogs occur in sub-alpine wet heathland and woodland, while on the escarpment, frogs occur in montane habitats such as cool temperate rainforest, mixed forest and wet forest.

Prior to 1983, the Baw Baw Frog was considered relatively common within its limited distribution. However, since then the species has undergone a precipitous decline in abundance, especially on the plateau, and range has contracted. Causal factors responsible for the decline remain largely unknown, although climate change and/or an introduced pathogen may be responsible. Other threats may have included land use activities such as forestry and operation of the alpine resort on Mt Baw Baw, atmospheric pollution, increased UV-B radiation due to depletion of stratospheric ozone and the impact of pest plants and animals. The Baw Baw Frog is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and Threatened under the Victorian *Flora and Fauna Guarantee Act 1988*.

This document constitutes the revision of the first Recovery Plan for the species (Hollis 1997). The plan assesses the performance of the previous plan, and considers the future conservation, management and research requirements for the species. It identifies conservation objectives, the actions to be taken to ensure the species' long-term survival prospects across its distribution, and the parties responsible for their implementation. It also identifies criteria for which the success of implementation of actions will be assessed. The actions identified will be undertaken or managed by the Victorian Department of Sustainability and Environment, Parks Victoria, Mt Baw Baw Alpine Resort Management Board, Amphibian Research Centre, James Cook University and selected external consultants. Successfully achieving the objectives of this Recovery Plan is subject to budgetary and other constraints affecting the parties involved. The plan may also be subject to amendments in the event of new information, or following recommended changes by the Baw Baw Frog Recovery Team.

Species Information

Description

The Baw Baw Frog belongs to the amphibian family Myobatrachidae. Females grow to about 52 mm snout-vent length and males about 45 mm (Littlejohn 1963). The dorsal surface of adults is predominantly brown to dark brown with cream–yellow flecks or spots, and/or larger patches spreading from the top of the head and snout to the back. A characteristic brown-black lobe-shaped parotoid gland occurs behind each eye, extending back over each shoulder. The skin is coevered with small tubercles or warts, particularly on the sides and rump. The ventral surface is smooth and cream to yellow, heavily pigmented with brown flecking. The tympanum is hidden and fingers and toes are unwebbed. As well as the difference in maximum size, the sexes can be distinguished by other external features. Males have a dark brown-black throat, longer legs and wider heads, while females possess a flanged inner first and second finger. Following metamorphosis, juvenile frogs are cream to brown with dark brown irregular flecks and patches, and a distinct dark-brown band occurs from the snout through the eye to the base of the forelimb. Larvae have a rounded body and tail about twice body length? and are creamish-white and unpigmented at hatching, with pigment increasing during development (for more detailed descriptions of adults see Spencer 1901; Littlejohn 1963; Barker *et al*. 1995; Cogger 2000).

Life History

Male Baw Baw Frogs call from September to March, with a peak in calling activity in October and November (Malone 1985a; Hollis 1995; Hollis 2004). Egg laying appears to coincide with this peak in calling activity (Malone 1985a, b; Hollis 1995; Hollis 203). Egg masses are deposited in a transparent foam nest about 8 cm diameter and 4 cm high (Littlejohn 1963) at the calling site, or nearby, during inguinal amplexus. The foam nest is produced by the female beating air bubbles into the mucous and eggs with her flanged fingers during egg laying (Littlejohn 1963). The egg mass may be deposited at varying depths in vegetation, or below the ground surface to a metre or more in depth, depending on the structural attributes of the site (G. Hollis *pers*. *obs*.). Clutch sizes range from 50–185 eggs (Littlejohn 1963; Malone 1985a, b; Tyler 1992). Eggs are white, unpigmented and about 4 mm in diameter (Malone 1985b). Oviposition of more than one clutch may occur at a single site (Malone 1985b; G. Hollis *pers. obs*.), and it is also possible that females deposit a portion of their eggs at more than one site (Malone 1985a.). Eggs are deposited in natural cavities formed from vegetation, logs, rocks and soil that act as catchments for water (Littlejohn 1963; Malone 1985a; Hollis 2004). Eggs hatch in 5–8 weeks and larvae are non-feeding, hatching with a residual yolk mass that sustains them through to metamorphosis (Malone 1985a, b). Larval development occurs at the oviposition site which, while wet, usually has very little free water, although larvae retain the ability to swim (G. Hollis *pers. obs*., Malone 1985a, b). The larval period ranges from 5–10 weeks, with individuals metamorphosing at about 7 mm snout-vent length (Malone 1985a, b). The maximum age recorded is about 15 years, with males reaching sexual maturity at 3.5 years and females at 4.5–5.5 years (Hollis 2004). The Baw Baw Frog feeds principally on terrestrial and aquatic insects, also taking worms, spiders and crustaceans (Hollis 2002).

The duration of the breeding season appears closely linked with temperature and rainfall. Longer seasons were positively correlated with greater total rainfall and negatively correlated with increasing average temperature (Hollis 2004). Commencement of the breeding season appears to coincide with the arrival of warmer spring temperatures, although completion occurs with daily ambient and substratum temperatures increasing by 2.8°C and 0.4°C respectively (Hollis 2004).

Adult Baw Baw Frogs are relatively sedentary over breeding and post-breeding season periods. During the breeding season, most males remain at breeding sites for the duration of calling activity. Towards the end of the breeding season, males disperse into drier habitats adjacent to the breeding sites, with linear movements up 82 m occurring. Female frogs entered breeding sites during the peak of male calling activity to lay eggs (2–3 weeks), then returned into adjacent drier habitats following the breeding season (Hollis 2004). Adult frogs move about when conditions are wet, with movement limited by increased temperature and reduced

humidity (Hollis 2004). Virtually nothing is known about the movements of juveniles and sub-adults, although recently metamorphosed frogs probably remain in close proximity to breeding sites (M. Littlejohn *pers. comm*.; G. Hollis *pers. obs*.) and sub-adults may potentially be more mobile.

Distribution and Population

The Baw Baw Frog is restricted entirely to the Baw Baw Plateau and escarpment area, located in the Central Highlands of Victoria, approximately 120 km east of Melbourne (Figure 1), in the IBRA Australian Alps bioregion (*sensu* DEH 2000). The species has an extent of occurrence of about 135 km^2, encompassing sub-alpine habitats (1,260–1,560 m) and montane habitats down to 960 m elevation on the south-western escarpment of the Baw Baw Plateau, and 1,200 m elevation on the north-eastern escarpment (Hollis 2004) (Figure 2). This area includes 75.4 km^2 within the Baw Baw National Park, 3 km^2 within the Mt Baw Baw Alpine Resort, and 56.1 km^2 within State Forest (Figure 2).

The adult male population of the Baw Baw Frog was estimated at 7,000 individuals in 2002 (based on the number of calling males; Hollis 2004). However, the current population is believed to be now substantially less than this due to ongoing decline up to 2008 (G. Hollis unpubl;. data). About 65% of the population occurs in State Forest (managed by DSE) on the south-western escarpment of the plateau, between 960 and 1,300 m elevation (Hollis 2004). The remaining population occurs on the plateau within the Baw Baw National Park (managed by Parks Victoria) and the Mt Baw Baw Alpine Resort (managed by a Board of Management) (Hollis 2004). The number of adult females is not known.

Habitat

Habitat utilised by the Baw Baw Frog includes distinct vegetation types occurring at sub-alpine (>1,300 m) and montane (950–1,300 m) elevations. In these areas, the species utilises aquatic habitats during the breeding season (September–December) and both aquatic and terrestrial habitats during the non-breeding season (December–May) (Hollis 2004). Habitats used during the winter period remain unknown, but are likely to consist of terrestrial or aquatic habitat also used at other times of the year.

Vegetation communities utilised in the sub-alpine zone during the breeding season include wet heathland and montane riparian thicket (montane scrub cool temperate rainforest, Peel 1999), whilst sub-alpine woodland is used during the non-breeding season (Hollis 2004). Vegetation communities utilised at montane elevation during the breeding season include cool temperate rainforest (see Peel 1999 for floristic varieties), cool temperate mixed forest and montane wet forest, whilst those utilised during the non-breeding season include non-aquatic locations comprising the same vegetation types used during the breeding season (Hollis 2004). Preference by the species for habitats located on the south-western side of the plateau is thought to be due to the wetter, cooler climatic conditions present on the south-western escarpment, and the drier climate present on the north-eastern side where the extent of drier vegetation types is greater (Hollis 2004).

At a micro-habitat scale, breeding activity occurs along seepage and drainage lines on sloping terrain within frost hollows (sub-alpine) and gully systems (montane), with structural complexity being important for egg deposition sites, which need to catch and retain some water (Littlejohn 1963; Malone 1985a; Hollis 2004). During the non-breeding season, frogs may occupy terrestrial habitats where they feed and shelter in damp localities beneath vegetation, in and under logs, under rocks, and in soil cavities between vegetation roots (Hollis 2004).

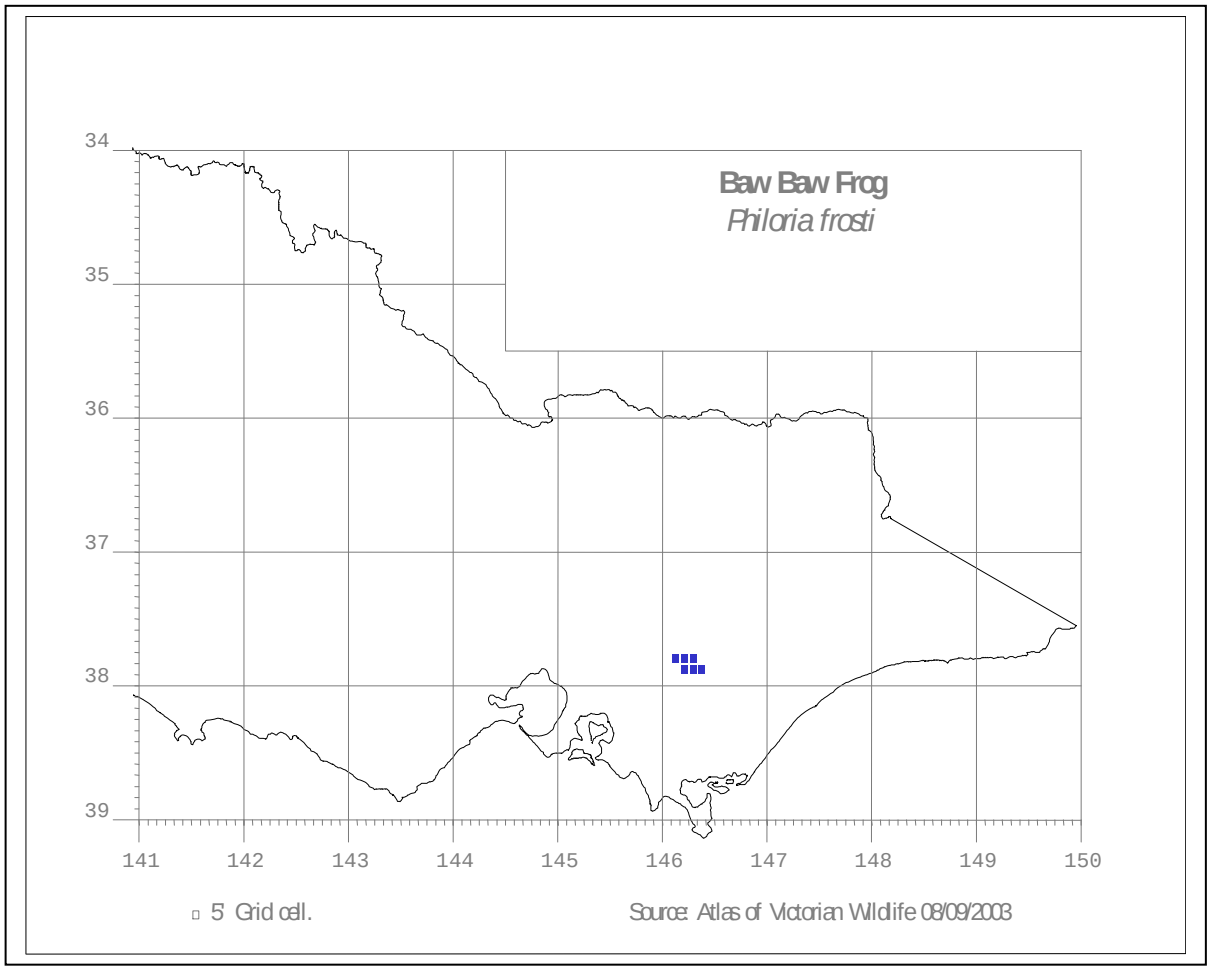

Figure 1. Distribution of the Baw Baw Frog
(within five minute latitude/longitude grids: Atlas of Victorian Wildlife, Department of Sustainability and Environment).

A recent comprehensive examination of breeding habitat use by Baw Baw Frog identified specific floristic and biophysical attributes preferred by the species (Hollis 2004). At a macro-habitat scale, environmental gradients that best explained these attributes included decreasing altitude, wetter and cooler climate, greater topographic protection, southerly aspects, steeper and uneven landform and wetter substratum conditions. At a micro-habitat scale, environmental gradients included greater topographic protection, steeper landform, increasing cover of vegetation and woody debris, water chemistry (increasing conductivity and decreasing acidity), and soil structure; loam-textured soil horizon 1 (montane habitats), peat soil horizon 1 (sub-alpine habitats), and sand-textured soil horizon 2 (Hollis 2004). Breeding habitat attributes relating to a cooler, moist climate, and topographic protection, are enhanced on the south-western escarpment of the Baw Baw Plateau.

Vegetation mapping of the Baw Baw Plateau, constructed by aerial photograph interpretation (API) (Roberts 1996), accurately identifies the distribution of breeding and non-breeding habitat for the Baw Baw Frog at sub-alpine elevation. However, due to a tall, dense canopy of eucalypts, the locality and distinction between breeding and non-breeding habitats at montane elevation is not as evident using API mapping. Modelling of the breeding habitat of the species, based on landscape variables derived by a digital elevation model at known frog localities, was subsequently undertaken to provide information on the distribution of breeding habitat at montane elevation (Liu & White 1999) (Figure 3). This modelling has been successfully used to locate habitat and detect populations of Baw Baw Frog in previously unsurveyed montane areas.

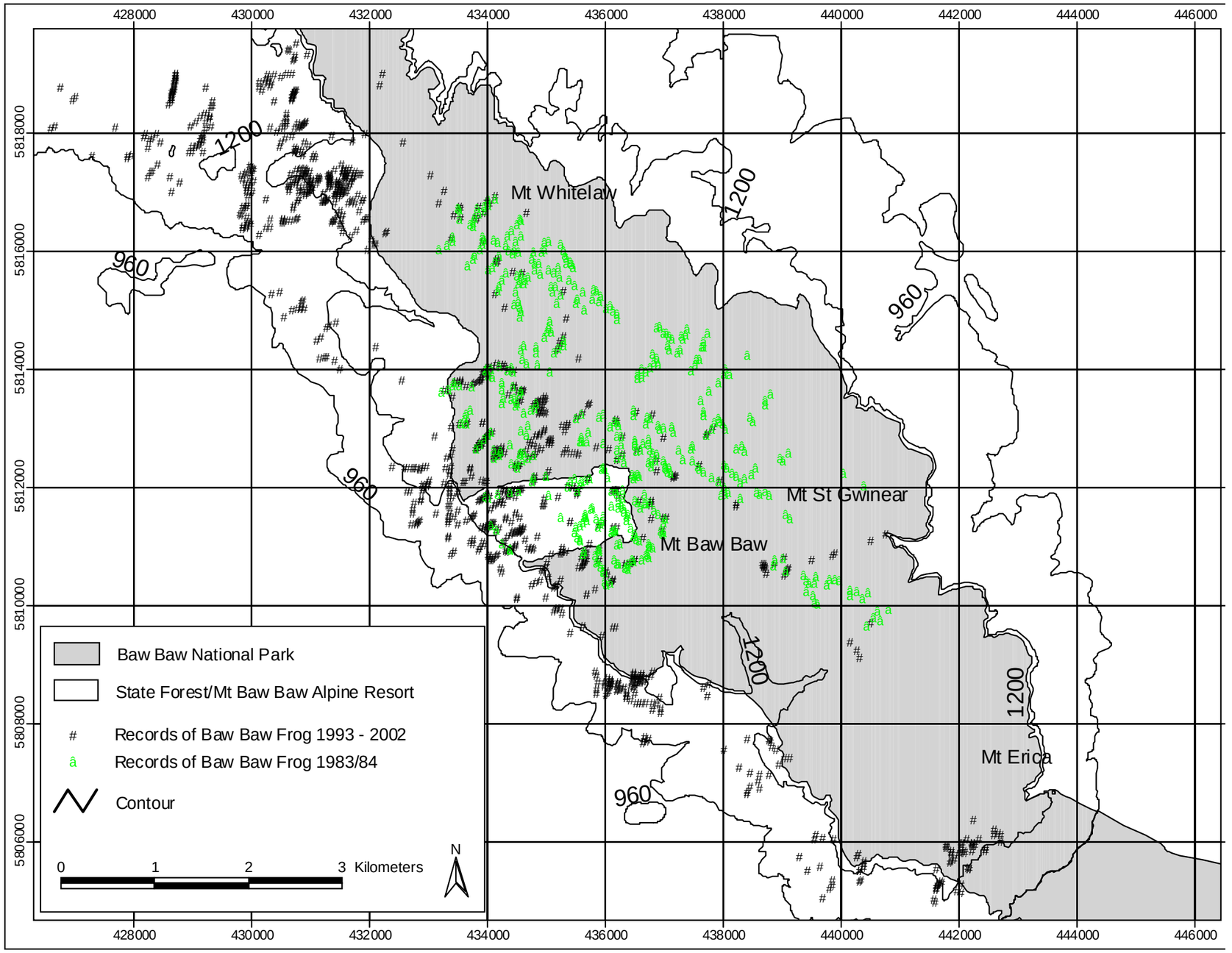

Figure 2. Historic and extant distribution of the Baw Baw Frog.

(recorded during population surveys in 1983-84 (Malone 1985a) and 1993-2002 (Hollis 2004), grid lines = Australian Map Grid Reference)

Figure 2. Historic and extant distribution of the Baw Baw Frog

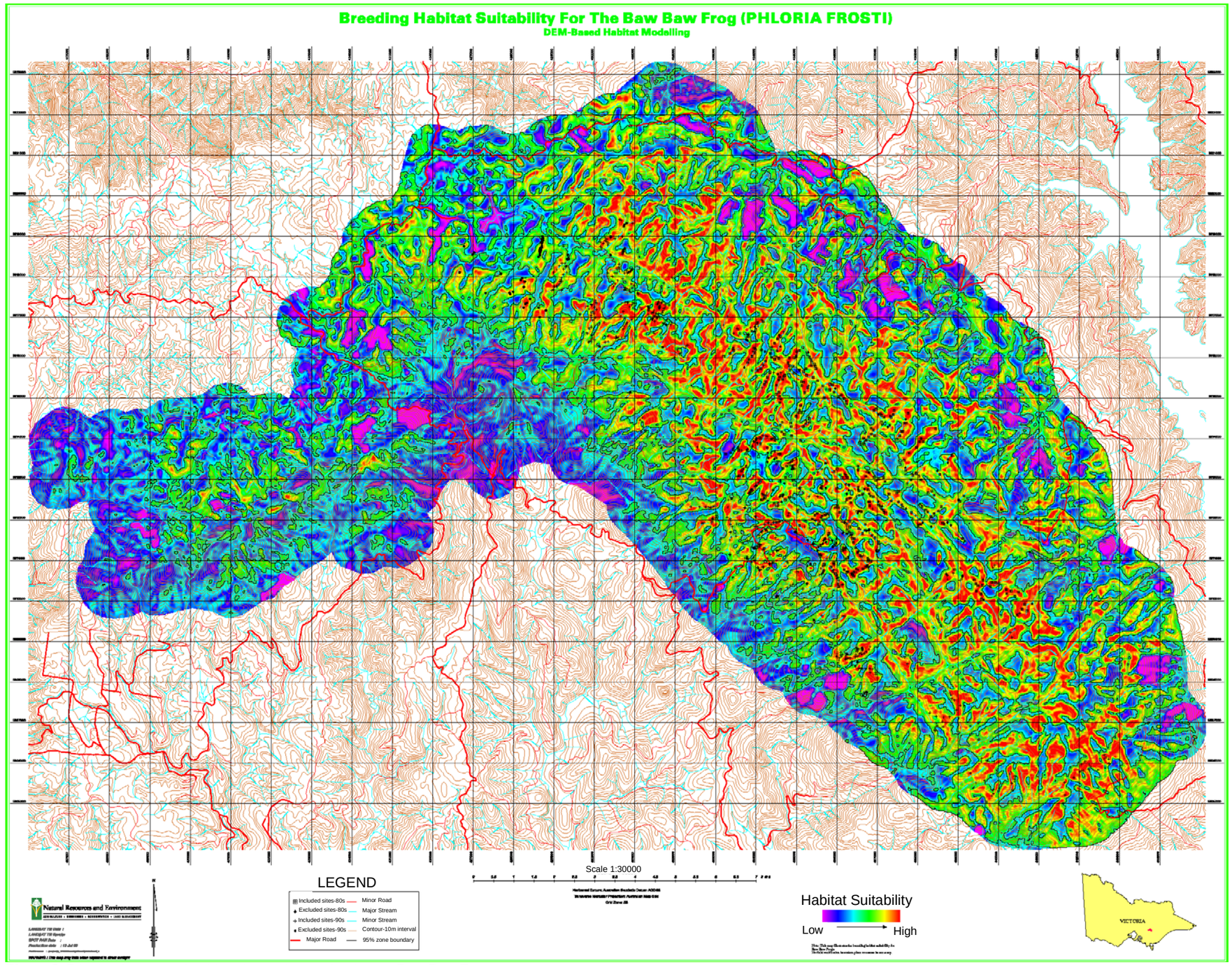

Figure 3. Distribution and suitability of breeding habitat for the Baw Baw Frog
(including 95% confidence interval (black line), derived from digital elevation-based modelling: Liu & White 1999).

Decline and Threats

Prior to 1984, the Baw Baw Frog was considered relatively common within its limited distribution on the Baw Baw Plateau, with an estimated 10–15,000 adult males present (Hollis 1995; Osbourne *et. el.* 1999; Hollis 2004). However, since then the species has undergone a substantial decline in abundance (Figures 4–9). There has been a precipitous decline in numbers of calling males on the Baw Baw Plateau, especially above 1,400 m altitude (Figure 4), where no calling males have been dectected since 2005. The species disappeared from many frost hollow breeding sites on the plateau, with extremely small populations remaining in others. At 1,300–1,400 m altitude, there was a major decline up to 1992 (Figure 6), with a very slight recovery in numbers noted between 1993 and 2002 (Figure 7). Survey transects censused between 1983 and 1993 indicate a decline in calling males has also occurred in the montane zone (960–1,300 m) (Figure 8), with a slight decrease in numbers of calling males between 1996 and 2002 (Figure 9). This pattern of decline has subsequently placed more importance on protection of populations on the south-western escarpment of the Baw Baw Plateau between 960 and 1,300 m. These montane populations appear to have also declined, but not to the same extent as at elevations above 1,300 m. The population of adult males declined from 10–15,000 in 1984 to about 7,000 in 2002 and fewer than 3,000 in 2008 (Hollis 2004; unpubl. data).

Around the globe, amphibian populations are in decline (Blaustein & Kiesecker 2002), and over 30 species of Australian amphibians have been reported to have declined or become extinct over the past two decades (Osbourne *et. al.* 1999). Most of these species are from the wet tropic and sub-tropic regions of Queensland and New South Wales, temperate regions of eastern Australia, and high-elevation regions in the Australian Alps. The Alpine Tree Frog *Litoria verreauxii alpina* has also suffered a substantial decline in distribution and abundance on the Baw Baw Plateau (and elsewhere across its range; Clemann & Gillespie in prep.). The decline of the Alpine Tree Frog on the Baw Baw Plateau may be concomitant with decline of the Baw Baw Frog. By contrast, the Common Froglet *Crinia signifera* and the Southern Smooth Froglet *Geocrinia victoriana* remain relatively common on the Baw Baw Plateau, showing little evidence of any decline.

Research on breeding activity, habitat use and movement activity show that the Baw Baw Frog is confined to a narrow range of ecological conditions, making it very sensitive to natural or anthropogenic influences (Hollis 2004). However, the causal mechanisms responsible for the decline of the Baw Baw Frog have not been formally established, although implementation of the previous Baw Baw Frog Recovery Plan (Hollis 1997) has contributed significantly to the identification of conceivable threatening processes and agents of decline. These factors are discussed in detail below:

<u>Climate Change</u>

Climate change, at a global scale (enhanced greenhouse), and a regional scale, are considered serious threats to the long-term survivorship of the Baw Baw Frog. Recent data indicate both warming trends and reduced rainfall in the region occupied by the Baw Baw Frog (see Hollis 2004). The impact of climate change is particularly relevant to the Baw Baw Frog, given that it is confined to sub-alpine and montane habitats in a very limited area. Bennett *et al*. (1991) predicted that the bioclimate of the Baw Baw Frog would disappear with a rise in temperature of only 1–3°C. Further support is given to the notion that the species is sensitive to climate change by Hollis (2004), including: (1) its climate-driven pattern of distribution and density; (2) its current decline and contraction in range from sub-alpine habitat; (3) recorded differences between sub-alpine and montane elevations in breeding activity and movement at; and (4) the use of a smaller subset of habitat by the extant population compared with habitats used historically. The breeding season also occurs within a relatively narrow climatic window. Malone (1985b) recorded mortality during embryonic and larval stages of development, measuring 74.0% and 70.3% respectively. Overall recruitment to the terrestrial stage was estimated to be 8%, although survivorship was noted to be extremely variable among breeding localities (Malone 1985b). Periodic drying of oviposition sites was considered to be responsible for the high mortality rates observed, but the observed rates are not dissimilar to mortality rates recorded for other anurans (Malone 1985b).

The confinement of most of the Baw Baw Frog population to the south-western escarpment of the Baw Baw Plateau, which is wetter and cooler than other areas within the distribution of the species (Hollis 2004), supports the hypothesis that a warming and drying climate may be a major factor in the population decline and distribution shift observed in the species. For example, at a regional scale, Helps (2001) reports that the long-term downward trend in total annual rainfall, and smoothing of fluctuations in annual rainfall, at Erica and Noojee may be as a result of the construction of the Thomson Reservoir in 1982. Research in China indicates that large volumes of water in mountainous areas, like the Thomson Reservoir, act as a temperature moderator, altering rainfall patterns due to changes in temperature range (Helps 2001). The filling of the Thomson reservoir in 1982, and subsequent downward trend in rainfall and smoothing of peaks of rainfall, coincides with the decline and contraction in range of the Baw Baw Frog after the surveys of Malone (1985a) in 1983 and 1984.

Habitat disturbance

A large portion of the habitat of the Baw Baw Frog remains in a relatively undisturbed condition. However, there has been some disturbance to habitat, including at the Mt Baw Baw Alpine Resort (~3 km^2) where buildings, walking tracks and ski runs have been constructed, and historical (1930–1950) and recent (post-1980) timber harvesting in State Forest around the plateau. The impact that vegetation clearance has on biology and ecology of the Baw Baw Frog is only partially understood. However, the structure of vegetation has been shown to significantly affect mortality of embryos and larvae, with mean embryonic and larval mortality rates significantly higher in disturbed habitats when compared with mortality rates in undisturbed habitats (Malone 1985a). These early stages of amphibian development are considered to be the most vulnerable phases of the anuran life cycle (Duellman & Trueb 1994). The impact that recreational activities, and the associated network of bushwalking and ski trails, has on the Baw Baw Frog is also unclear. The placement of some trails, particularly in wetland habitats, has resulted in damage to local vegetation communities through the removal of vegetation during construction, degradation through use, and altered drainage patterns (G. Hollis *pers. obs*.). This damage may be detrimental to local breeding populations, and large areas of cleared vegetation such as those used for down-hill skiing, may impede dispersal and movement, or result in increased predation on the species. The disappearance of the Baw Baw Frog from formerly known breeding sites within a small area comprising ski runs and building infrastructure in the Mt Baw Baw Alpine Resort is most likely due to clearance, modification and fragmentation of breeding and non-breeding habitat. This disturbance, however, does not explain the overall decline of the species. Potential changes to water quality and altered flow regimes from the Mt Baw Baw Alpine Resort may also pose a threat to remaining populations of the Baw Baw Frog on and below resort land.

Sambar deer and feral cattle occur on the Baw Baw Plateau, where their grazing and browsing on native vegetation and trampling and use of breeding habitat as wallows is a potential threat. Numbers of cattle on the Baw Baw Plateau were reduced significantly in 1989 (DCE 1991), although some remain. The activity of deer, particularly at montane elevations where they browse and wallow within the breeding habitats of the Baw Baw Frog, is considered a potential threat to the species. Few introduced plants occur on the Baw Baw Plateau (Walsh *et al*. 1984; J. Davies *pers. comm*.), with most restricted to the vicinity of areas subjected to vegetation clearance or ground disturbance (DCE 1992). Due to their invasive nature, exotic flora that may be of threat to the frog include Grey Sallow *Salix cinerea*, Blackberry *Rubus* sp. and Balbosus Rush *Juncus balbosus*. Incursions of weeds through forestry activities remains as a potential threat to the habitat of the Baw Baw Frog.

Increased UV-B Radiation

The greater intensity of UV-B radiation recorded in sub-alpine habitat compared with lower elevation montane habitats utilised by the Baw Baw Frog suggests that increased UV-B may in some way be linked to the decline of the species (see Hollis 2002, 2003.). However, given that the species has seemingly evolved a breeding strategy that mostly avoids exposure to UV-B (possessing unpigmented embryos and larvae), and that the post-metamorphic life-stage of the species appears to be mostly subterranean, it is difficult to comprehend how increased UV-B radiation might be directly related to the decline of the species. The breeding macro- and micro-

habitat of the species also indicates preference for habitats that are almost entirely protected from sunlight (Hollis 2004). If increased UV-B radiation is a threat to the Baw Baw Frog, its interaction with other stressors, or agents, is a more likely explanation.

Pathogens

Among amphibians reported by Speare and Berger (2000) to have been infected by Chytrid Fungus *Batrachochytrium dendrobatidis* on the east coast of Australia, three species (*Litoria spenceri, Pseudophryne corroboree* and *Pseudophryne pengilleyi*) occur in the Australian Alps, and all have suffered population declines (see Osborne *et al*. 1999; Gillespie 2001). Chytrid Fungus has been detected in some tissue samples from Baw Baw Frogs (G. Hollis unpubl. data) and in Common Froglets from the plateau, but its significance or impact on the Baw Baw Frog is not known. Given that *Batrachochytrium* is known to be virulent to post-metamorphic amphibians, and not larvae (Berger *et al*. 1999), the fungus should be considered a possible agent in the decline of the species. This is particularly relevant, given the noted presence of the fungus in high-elevation species, and its preference for cooler temperatures (Berger *et al*. 1999).

Forestry activities

Since the discovery of the Baw Baw Frog in montane habitats in State Forest in 1996, forestry activities (roading and timber harvesting) have been identified as a serious threat to the long-term survival of the species. The sensitivity of the Baw Baw Frog, due to its narrow ecological requirements, suggests that forestry activities may impact through: (1) direct destruction of frogs and habitat; (2) changes to climatic and hydrological conditions from activities in and adjacent to frog habitat; (3) sedimentation of breeding habitat following activities in and adjacent to frog habitat; and (4) fragmentation of populations, and/or destruction or modification of dispersal habitats. A study of forest rotation and stream-flow benefits in the water catchment for the Thomson Reservoir indicates that stream-flow water yields are reduced significantly in regenerating forest (through increased rates of transpiration) up to age of 25 years following timber harvesting, and thereafter decreases with age (Clarke 1994). This observation suggests that the hydrological and climatic requirements of the Baw Baw Frog could be adversely affected by substantial areas of re-growth forest following timber harvesting. Areas of re-growth forest, of an even age and uniform type, following timber harvesting may also be detrimental to the habitat requirements of the species. Logs and coarse woody debris, which are utilised for breeding purposes (see 3.2) and shelter, may become limited in re-growth forest as they pass beyond favourable decay classes. However, the potential threat of proposed timber harvesting within the montane habitat of the Baw Baw Frog no longer exists following protection of its habitat in permanent reserves established within State Forest.

Fire

Bushfires on the Baw Baw Plateau are uncommon due to its wet climate (DCE 1991), but may pose a threat to the Baw Baw Frog in particular circumstances. Current fire policy excludes burning on the plateau (sub-alpine) section of the Baw Baw National Park (DCE 1992). Historical records, although incomplete, indicate that the Baw Baw Plateau, or parts of it, have been burnt on a number of occasions previously, including 1851, 1898, 1926, 1932 and 1939 (DCE 1991). The plateau has been free of serious fires for the past 64 years. Fires that occur at a frequency higher than that which is normally expected in the habitats used by the Baw Baw Frog, or those that burn during spring, summer and autumn periods, are likely to have the greatest impact on the Baw Baw Frog. Fire protection responsibility, objectives and strategies put in place to prevent and control fire on State Forest, are contained in DCE (1990).

Atmospheric Pollution

Alterations to air quality through industrial and agricultural emissions have the potential to be detrimental to the Baw Baw Frog, and urban and industrial air pollution has been implicated as a suppressant of precipitation by influencing cloud properties (see Hollis 2004). Although airborne pollutants generated in the Latrobe Valley may be a threat to the Baw Baw Frog, the prevailing west to south-westerly winds in the vicinity would generally direct these away from the Baw Baw Plateau. Atmospheric studies indicate that pollutants originating from industrial activities in the Latrobe Valley are not contributing to acidification (see Hollis 2004). The Baw Baw Plateau is, however, situated within a pollution corridor commencing in the Melbourne

area and extending to the north-east of Victoria. Forest edges resulting from land management practices may also function as traps and concentrators for wind-borne nutrients and pollutants (see Hollis 2004). The high intensity of timber harvesting around the periphery of the Baw Baw Plateau over recent decades has resulted in multiple forest edges. The impact of potential atmospheric pollutants on the Baw Baw Frog population remains unclear.

Predation

Little is known about predation on the Baw Baw Frog. The Tiger Snake *Notechis scutatus* is known to consume adults (Spencer 1901; Hollis 2004), whilst other predators might include other reptiles, mammals, birds, spiders and the introduced Cat, Red Fox and feral Dog/Dingo. Predation on embryos and larvae appears minimal (Malone 1985b).

Multiple and Interacting Factors

Investigations into the decline of amphibian populations in the past have focused primarily on the direct effects of single factors (Blaustein & Kiesecker 2002). However, more recent studies on amphibians investigating multiple factors and their interactions indicate that amphibian losses are the result of interactions between a number of highly context-dependent causal factors (see Hollis 2004). The decline of the Baw Baw Frog may also be as a result of synergisms between factors, or multiple factors acting together. Synergisms or interactions between the following factors should be considered as potential threats to the Baw Baw Frog (see Hollis 2004 for further details).

1. Synergism between UV-B radiation and other factors including low pH, low pH and high nitrate levels, pathogens and pollutants;
2. Synergism between climate change and pathogens, and high temperature and low pH;
3. Multiple factors resulting in reduced precipitation, including global and regional climate change and atmospheric pollution.

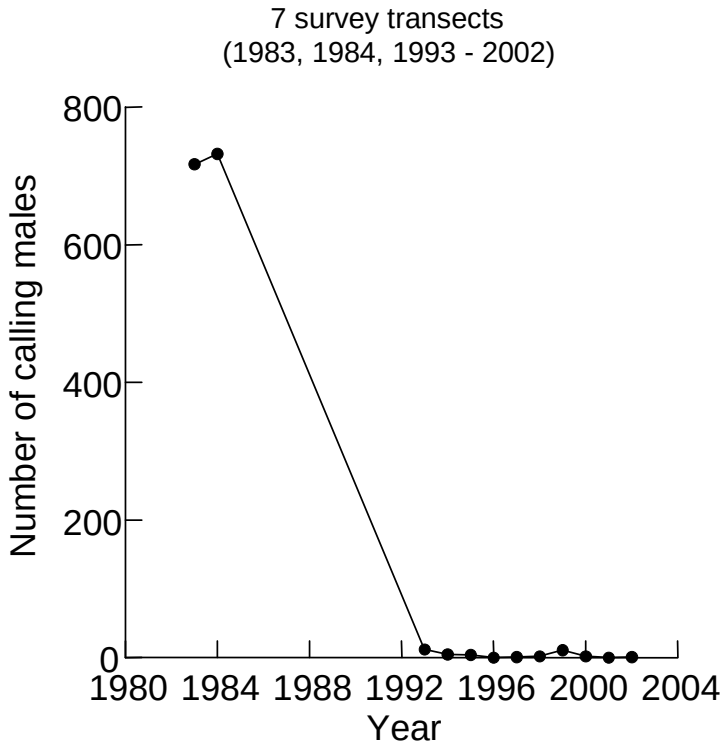

Figure 4. Calling male census data 1983–2002 at >1,400 m elevation

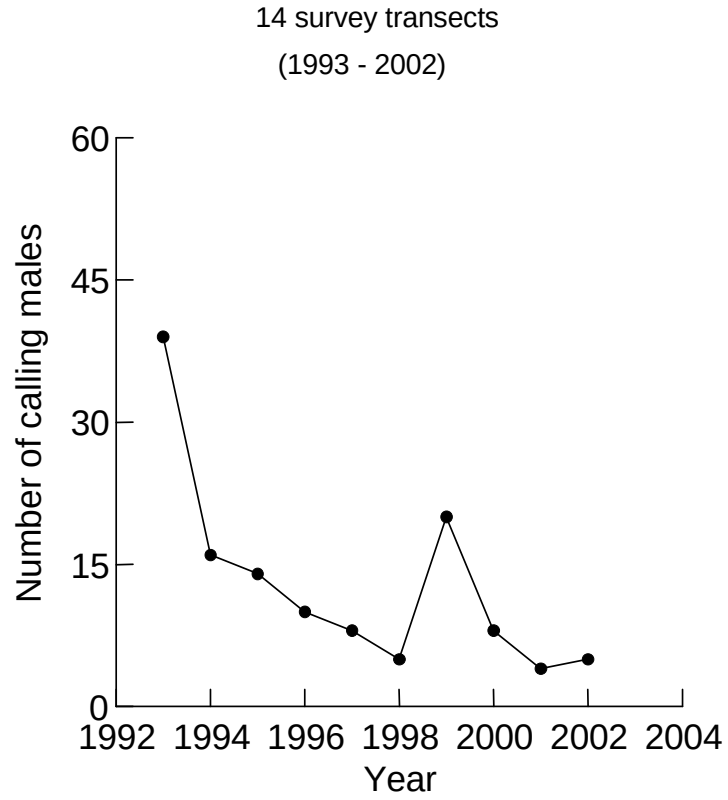

Figure 5. Calling male census data 1993–2002 at >1,400 m elevation

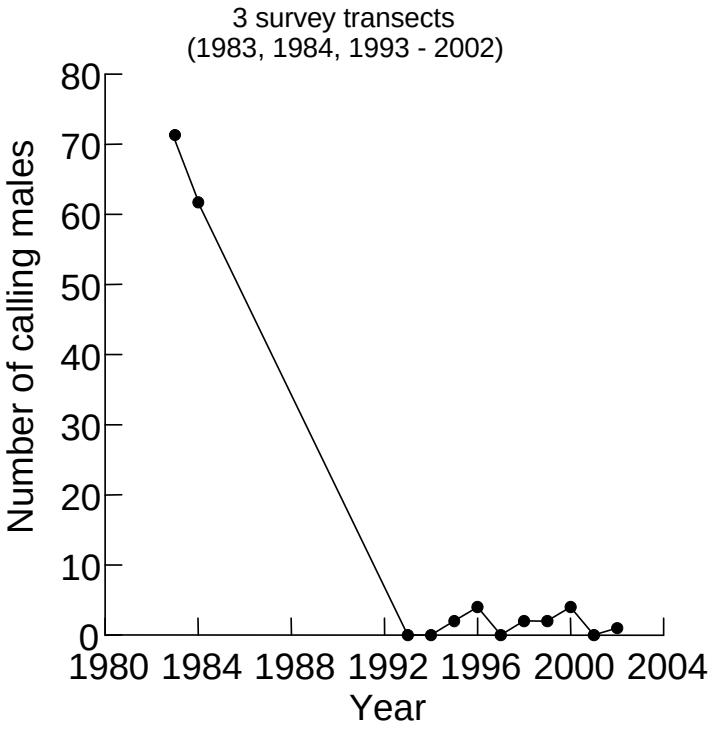

Figure 6. Calling male census data 1983–2002 at 1,300–1400 m elevation

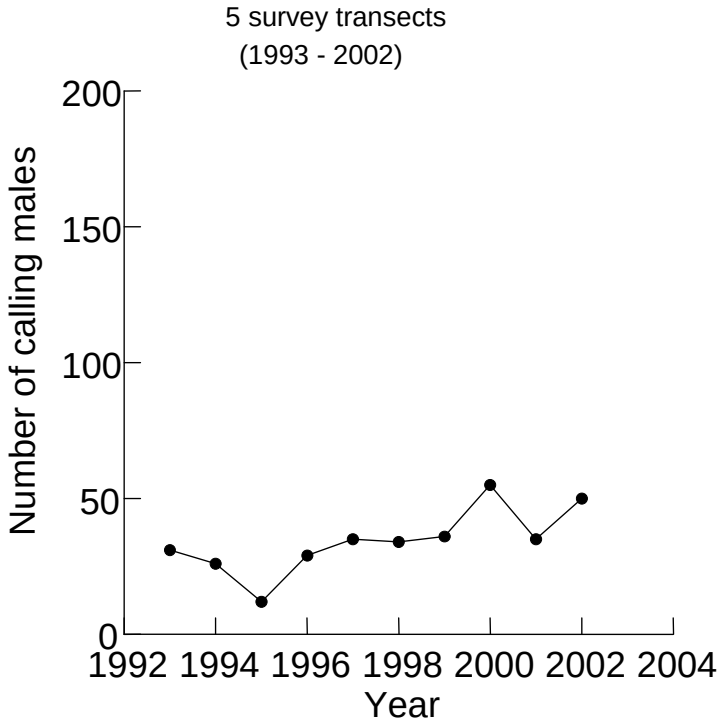

Figure 7. Calling male census data 1993–2002 at 1,300–1,400 m elevation

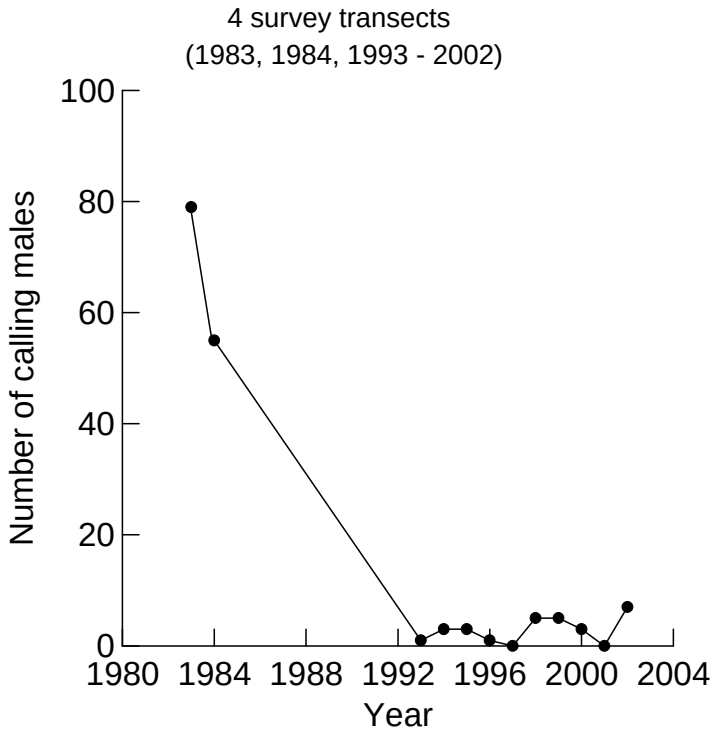

Figure 8. Calling male census data 1983–2002 at 960–1,300 elevation

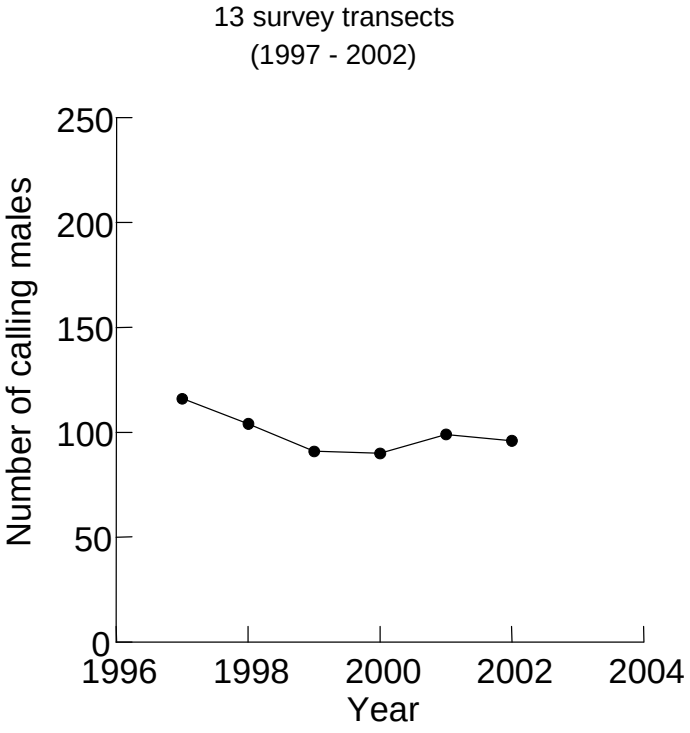

Figure 9. Calling male census data 1996–2002 at 960–1,300 elevation

Recovery Information

Previous Recovery Actions

Implementation of the Baw Baw Frog Recovery Plan (Hollis 1997) has significantly progressed knowledge on the natural history of the species as well as confirming its status and nature of decline. The plan has also identified conceivable agents of decline in context with the ecological requirements of the species, as well as providing a platform to commence decline-diagnosis. Information gathered on the ecology of the species was used to develop a conservation strategy for populations occurring on State Forest. Major achievements in the recovery program for the Baw Baw Frog to date include:

- Assessment of a number of perceived threats to the Baw Baw Frog population has been undertaken, including exotic predators (fox and dog - Hollis 2002), ultra-violet-B radiation (Hollis 2002) and climate change (Smith *et. al.* 1999).
- Annual monitoring of the Baw Baw Frog population has been conducted between 1993 and 2008 (16 years). Including base-line data collected in 1983 and 1984, a monitoring data set spanning 25 years exists (Osborne *et. al*. 1999; Hollis 2004; Hollis & Scroggie, unpublished data).
- Completed research projects on the Baw Baw Frog include studies on longevity, maturation and growth (Hollis 2004), population trends (Hollis 2004; Hollis & Scroggie unpublished data), breeding habitat attributes (Hollis 2004), habitat distribution (Liu & White 1999; Gang-Jun Liu and Hollis, unpublished data), calling behaviour (Hollis 2004), patterns of movement activity and habitat use (Hollis 2004), population model development (Todd *et. al*. 2007), genetics (Wheaton *et al.* 2008), disease (Hunter *et. al*. 2009) and natural disturbance history modelling (Gang-Jun Liu & Hollis, unpublished data).
- Liaison between government agencies (Department of Sustainability and Environment, Parks Victoria and the Mt Baw Baw Alpine Resort Management Board) has occurred at regular intervals since establishment of the Baw Baw Frog Recovery Team in 1996.
- Parks Victoria and the Mt Baw Baw Alpine Resort Management Board have undertaken re-alignment of some tracks considered to be inappropriately located within habitats utilised by the Baw Baw Frog. Prior to protection of Baw Baw Frog habitat in reserve within State Forest, roading associated with proposed timber harvesting was subject to established prescriptions (NRE 1998b) or was re-aligned to avoid the species breeding habitat.
- Programs to control and/or monitor fox, dog, rabbit, Sambar and cattle have been undertaken by Parks Victoria, Mt Baw Baw Alpine Resort Management Board and the Department of Sustainability and Environment.
- Information on the ecological requirements, habitat and current status of the Baw Baw Frog population has been provided to the Alpine Planning Unit, Department of Sustainability and Environment, for consideration during amendments to the Alpine Planning Scheme.
- Monitoring of introduced animals (cattle, Sambar, European Rabbit, Red Fox, dog, cat and weeds such as Grey Sallow *Salix cinerea* have been undertaken by the Department of Sustainability and Environment, Parks Victorian and the Mt Baw Baw Alpine Resort Management Board. A permanent weather station was established at Mt Baw Baw in 1994 to monitor weather conditions and climate change.
- Friends of Baw Baw National Park have assisted Parks Victoria to control weeds, conduct surveys for feral cattle and collected fox and dog scats for predator scat analysis on the Baw Baw Plateau. Green Corps Crew have assisted Parks Victoria with track maintenance works. Volunteers have participated in the annual monitoring survey for the species.
- The Baw Baw Frog Recovery Team has provided input into the management guidelines and actions contained in the Central Highlands Forest Management Plan (NRE 1998), Mt Baw Baw National Park Management Plan (PV 2005) and Mt Baw Baw Alpine Resort Management Board Environmental Management Plan (MBBARMB 2008).

- Development of protocols and husbandry methods for captive breeding have not been undertaken, however, protocols and husbandry techniques for raising eggs and larvae through to metamorphosis have been successfully achieved (Hollis 2002).
- Detailed population monitoring protocols have been successfully established and refined for the species (Malone 1985a; Hollis 2004). Further refinement of the monitoring strategy for the species is currently being undertaken (Hollis & Scroggie, unpublished data).
- Programs to control high-threat weeds within Baw Baw Frog habitat have been undertaken by Parks Victoria (Grey Sallow and Blackberry) and the Mt Baw Baw Alpine Resort Management Board (Blackberry, Balbosus Rush).
- Protection of habitat in State Forest in a Special Protection Zone.
- Parks Victoria and the Mt Baw Baw Alpine Resort Management Board have undertaken annual maintenance activities on access roads, walking tracks, ski trails and ski runs to minimise and control sedimentation. Developments and/or maintenance works involving earthworks have also been restricted to summer and autumn periods whilst erecting standard structures to intercept sediment.
- A population model for the species has been developed to allow for investigations of population viability (Todd *et al*. 2007). Habitat modelling has been conducted to identify refuge locations occupied by the species (Gang-Jun Liu & Hollis, unpublished data). Research was undertaken to demonstrate how to successfully raise eggs and larvae through to metamorphosis (Hollis 2002).

Recovery Objectives

Overall Objective

- to achieve a down-listing of the species from Endangered to a lower threat category based on 2000 IUCN Red List criteria of population size and trends, extent of occurrence, and probability of extinction.

Objectives

(1) ***to improve the viability of the Baw Baw Frog population (increased population size or areas of occurrence) so that it is no longer Endangered***

(2) ***to gain an understanding of the biology and ecology of the Baw Baw Frog that will enable effective management and sustainable use of natural resources within its habitat***

(3) ***to determine reasons for observed decline of the Baw Baw Frog across its geographic range***

(4) ***to address known or predicted threatening processes to the Baw Baw Frog and change or implement management practices where appropriate***

(5) ***to ensure that landuse activities will not impact upon the survival of the Baw Baw Frog***

Performance Criteria

1. Population numbers, trends and distribution are understood.

- Population monitored with established survey methodology to detect changes in population of less than 10% over next 5 years;
- Adult male population size increased by at least 40% of the population estimate made by Malone (1985a) at elevations above 1300 m, thereby changing the conservation status of the species to lower threat category.

2. The long-term viability of the Baw Baw Frog and its habitat on land managed for National Park, State Forest and alpine ski resort uses is understood.

- Completion of a population and habitat model using a spatially explicit, decision support tool to model the impact of various land use scenarios on population viability.

3. ***The influence of weather on short-term population fluctuations, and of the influence of enhanced greenhouse on the long-term survivorship of the species is understood.***

- Understanding of how weather contributes to natural population fluctuations; and
- Understanding of the potential influence of enhanced greenhouse on the long-term survival prospects of the species,

4. ***Impacts of introduced biota considered to be a threat to the Baw Baw Frog or its habitat are understood and managed.***

- Knowledge of the contribution of the introduced Chytrid Fungus to the decline of the species, and its susceptibility;
- Eradication of cattle remaining on the Baw Baw Plateau;
- Control of fox and rabbit within the Mt Baw Baw Alpine Resort and Baw Baw National Park;
- Continued control and monitoring of pest plants in alpine resort, National Park and State Forest; and
- Continued track maintenance, particularly of board-walks, and relocation of tracks away from sensitive wetland habitat.

Recovery Actions

Action 1. Population Monitoring

Well designed population and habitat monitoring is an integral part of any program designed to determine and monitor the status of threatened fauna over time. A method to survey the Baw Baw Frog population is well established, and surveys have been conducted in 1983 and 1984 (Malone 1985) and every year since 1993 (Hollis 2004; unpubl. data). It involves conducting diurnal censuses of calling males (audio strip transect) during the breeding season of the species (spring and early summer) at sub-alpine elevation (> 1,400 m), mid-elevation (1,300–1,400 m) and montane elevation (950–1,300 m). The method provides a relative abundance measure of the adult male population within established transects encompassing the distribution of the species. A retrospective analysis of the statistical power of the monitoring program for surveys conducted between 1983 and 2002 indicates that a sufficient number of transects have been examined to detect changes in population size of less than 10% at various elevations (Hollis 2004). Similarly, an evaluation of statistical power for transects censused within the Baw Baw National Park showed that there is little advantage in carrying out more intensive monitoring at a smaller number of transects over the current monitoring strategy, and that the present monitoring program should be employed whilst censusing as many transects as possible (M. Scroggie *unpublished data*, DSE, Arthur Rylah Institute). Variation in participation by calling males over the duration of a breeding season can result in underestimation of abundance of calling males along particular transects (Hollis 2004). By monitoring male participation at several breeding locations using automatic recording units, an estimate of male participation can be derived for each day of the breeding season. This estimate can then be used to derive an index of male participation for any time of the breeding season. This index (correction factor) will be obtained and used to correct census data that was not obtained during the peak in calling activity of the breeding season when male participation is highest.

Previous surveys show that the minimum number of personnel required to conduct each annual survey is six, for a period of approximately eight weeks. Due to the skills that are required to negotiate extremely rough terrain, and that adverse climatic conditions often prevail, it is not feasible to utilise volunteers for survey monitoring. Staff accommodation has previously been provided as an in kind project contribution by the Mt Baw Baw Alpine Resort Management Board.

This action will contribute significantly to other activities described below, including:

- monitoring the response of populations within areas used for experimental timber harvesting,
- the collection of tissue samples (toe clips) for conservation genetics,
- the provision of population data for population modelling analysis.

Responsibility: DSE (Flora and Fauna, Traralgon)

Action 2. Chytrid Fungus Survey and Research

The introduced Chytrid Fungus is now well established in a number of Australian amphibian populations, with the latest report identifying 46 species from which the pathogen has been recorded (Speare R, Berger L. Chytridiomycosis in amphibians in Australia: http://www.jcu.edu.au/school/phtm/PHTM/frogs/chyspec.htm). This includes montane, sub-alpine and alpine species such as Spotted Tree Frog *Litoria spenceri*, Southern Corroboree Frog *Pseudophryne corroboree* and Northern Corroboree Frog *Pseudophryne pengilleyi*. This pathogen has also been implicated as a proximate cause of the recent decline of some amphibian species (Berger *et al*. 1998). Given the detection of this pathogen in species that occupy high elevation environments, and that it has been recorded in the Central Highlands of Victoria, it is possible that this introduced pathogen could explain the decline and contraction in range of the Baw Baw Frog population from higher elevation, sub-alpine habitats some time after 1984.

This action involves a chronological survey of recently collected tissue (toe-clips) samples (1993 – 2000), and archived tissue samples (Museum of Victoria) for Baw Baw Frog to determine historic and contemporary infection status for *B. dendrobatidis*. This action will augment the work already undertaken by the Corroboree Frog Recovery Team for *Pseudophryne corroboree* and *P. pengilleyi*, and will complete the historic analysis for Australian alpine frogs. Understanding past patterns of disease is a necessary step in determining causes of decline. This type of investigation is now routine for researchers with an assurance of providing useful results.

A laboratory experiment will also be undertaken to investigate the relative susceptibilities of each of the alpine frogs (*C. signifera*, *G. victoriana*, *P. corroboree* and *P. pengilleyi*). This will include: (1) relative susceptibility to initial infection; and (2) relative developmental rates of disease and survival threshold for each species. Captive raised specimens will be individually housed, infected with a standard infective dose of Chytrid Fungus and be sampled for its presence and prevalence throughout the experiment. Experimental design will follow Ardipradja (2001). This action will provide data on intraspecies and interspecies variation in behavioural and physiological resistance to Chytrid Fungus. It will also provide valuable data for interpreting Australian alpine amphibian declines, with a high level of consistency with past chronological studies of Australian frogs. Techniques to undertake this work have only recently been developed and trialled and this will be a world first experiment of its kind for declining amphibians.

This action will be undertaken by the Amphibian Research Centre, Melbourne in collaboration with the James Cook University, School of Public Health and Tropical Medicine, with support from leading veterinarians and chytrid experts.

Responsibility: Amphibian Research Centre (ARC)

Action 3. Investigate the impact of climate change

Climate change in the form of enhanced greenhouse climate may be a potential threat to the Baw Baw Frog, given that the species is geographically localised, restricted to alpine and montane environments, and has specialised life history characteristics. Although the Baw Baw Frog was not included in their BIOCLIM analysis due to its very small distribution, Bennett *et al*. (1991) predicted that the bioclimate of the species would disappear with rise in temperature. Climate change has also been implicated as being responsible, in part, for the decline in the Corroboree Frog (Osborne 1990), another alpine species with a restricted distribution. Climate change, either due to long-term changes through enhanced greenhouse effects, or other shorter-term natural environmental fluctuations, may be responsible for the recent decline observed in the Baw Baw Frog population. One difficulty in assessing the influence of climate on populations is separating short-term fluctuations from longer-term trends. This action will firstly investigate how climate influences fluctuations in population numbers of the Baw Baw Frog, and secondly model the potential impact of climate change on the long-term survivorship of the species. Data collected previously on the influence of weather on the Baw Baw Frog, and the species micro-climatic preferences (actions within the previous Recovery Plan), will be used as

a guide to identifying tolerable climatic limits of the species. Data collected on the potential sensitivity of the Baw Baw Frog to forestry activities (Action 3) will also be used as data input in the analysis. Analytical details of this action are currently being developed.

Responsibility: DSE (Arthur Rylah Institute, Heidelberg)/Consultant

Action 4. Habitat Management
Management of habitat utilised by the Baw Baw Frog was an integral component of the previous Recovery Plan, and will continue in this Recovery Plan. This includes activities undertaken by land managers within the Baw Baw National Park (Parks Victoria) and Mt Baw Baw Alpine Resort (Mt Baw Baw Alpine Resort Management Board). Activities that will be conducted are considered to be important in maintaining and protecting Baw Baw Frog breeding and non-breeding habitat, and include:

Walking Track Maintenance
- Drainage undertaken by Parks Victoria staff and Friends of Baw Baw National Park on sections of the Alpine Walking Track near Mt St Phillack and Mt St Gwinear,
- Stonework and rehabilitation of heavily eroded section of track at Mt St Gwinear using stonemason from Scotland and offsider from Parks Victoria, North East,
- General maintenance of all tracks,
- Review of continued track access to Mustering Flat,
- The relocation of the 'Village Trail' from Pudding Basin (wetland habitat) to an alternative location within the Mt Baw Baw Alpine Resort. Options are currently being explored.

Pest Plant and Animal Control
- Willow control works will be undertaken utilising a helicopter to drop crews into remote sites, as in previous years. Crews will consist of one Parks Victoria and Alpine Resort staff member, and up to three friends/volunteers for a period of one week (in excess of 28 volunteer days),
- Assessment of treated willows from previous years,
- Update of mapping containing willow site locations,
- Control of other weeds (blackberry, roadside weeds),
- Monitoring of pest animals (rabbits, cattle, fox, dog, deer) during survey monitoring for Baw Baw Frog,
- Trialling of Pindone rabbit baits to test for potential in an ongoing control program,
- Continuation of fox baiting program at Mt St Gwinear,
- With a decline in cattle numbers evident to low levels, no further action will be undertaken to control cattle numbers, but monitoring will continue.

Rehabilitation of Native Vegetation
- Revegetation of eroded areas in Mt Baw Baw Alpine Resort,
- Reintroduction of native species to ski runs,
- A systematic closure and revegetation of all the old walking tracks around the ski resort,
- Propagation of native species for regeneration purposes (Mt Baw Baw Alpine Resort),
- Introduction of a resort specific nursery to be constructed at the transfer station at Neulynes Mill.

General
- Development of Alpine Resort Environmental Guidelines and Workplace Practices document,
- Review of Baw Baw National Park Management Plan.

Responsibility: Parks Victoria, Mt Baw Baw Alpine Resort Management Board, DSE

Action 5. Captive Management
In the absence of current treatments for the primary threats of disease and climate change, the capacity to produce a captive insurance population for the species needs to be developed. An

insurance population for the species will be required if current negative population trajectories continue in the long-term, with the potential for captive breeding for reintroduction or population reinforcement.

Responsibility: DSE, Amphibian Research Centre

Action 6. Community Awareness
Community awareness about the conservation status of and recovery program for the Baw Baw Frog will be maintained. Fact sheets, websites and display material to inform stakeholders and the community about the plight of the Baw Baw Frog and progress with the recovery program will be updated or developed. As the species is largely cryptic and occupies a specialised and generally remote habitat, direct community involvement in recovery will necessarily be limited. However, current involvement by groups including Friends of Baw Baw National Park will continue, especially in support activities such as monitoring and control of pest plants and animals.

Responsibility: Parks Victoria, Mt Baw Baw Alpine Resort Management Board, DSE

Estimated Cost of Recovery

Action	*Description*	*Priority*	*Cost estimate*					
			Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
1	**Monitoring**	1	$60,000	$60,000	$60,000	$60,000	$60,000	$300,000
2	**Disease**	1	$0	$50,000	$50,000	$25,000	$0	$125,000
3	**Climate change**	1	$0	$0	$0	$100,000	$50,000	$150,000
4	**Habitat mgt**	1	$125,000	$125,000	$125,000	$125,000	$125,000	$625,000
5	**Captive mgt**	2	$0	$10,000	$20,000	$50,000	$50,000	$130,000
6	**Awareness**	3	$2,000	$2,000	$2,000	$2,000	$2,000	$10,000
		Totals	$187,000	$247,000	$257,000	$362,000	$287,000	$1,340,000

Implementation and Evaluation

The Baw Baw Frog Recovery Team will be responsible for monitoring and evaluating the Recovery Plan program. This team comprises representatives from all stakeholders, as well as expertise from government, university institutions, and external consultants. The team has successfully overseen the implementation of the previous Baw Baw Frog Recovery Plan and will oversee the implementation of this Recovery Plan. The Recovery Team has previously met one to two times per year to discuss, evaluate and make recommendations on overall progress, as well as progress made on individual actions. Monitoring and evaluation will continue to be undertaken by the Recovery Team. Individual actions will be coordinated, monitored and evaluated by designated management teams, consultants, or officers (see details on each action). Progress on individual actions will be forwarded to the Recovery Team for discussion and comment by designated personnel. The Department of Sustainability and Environment will be responsible for collating information on progress and submitting progress and annual reports. The recovery plan will be evaluated within five years from the date of its adoption under the EPBC Act.

Management Practices

State Forest
The initial discovery of the Baw Baw Frog in State Forest areas on the south-western and north-eastern escarpments of the Baw Baw Plateau in 1996 led to the establishment of interim

management guidelines to manage forestry activities in State Forest in the species habitat (NRE 1998). This was followed by the establishment of a Special Protection Zone over the area to protect the species and its habitat from the impacts of logging.

Lands upon which the Baw Baw Frog occurs in State Forest are also used for water catchment purposes. The Tyers, Tanjil and Thomson Rivers are identified as Special Water Supply Catchment Areas under the *Catchment and Land Protection Act* 1994, for which there is a Special Area Plan that specifies how particular land management issues are to be addressed (NRE 1998). The Special Area Plan identifies limitations to forestry activities, including seasonal closure, slope restrictions and buffers on streams and filters (NRE 1998). The Code of Forest Practices for Timber Production sets minimum standards for water quality protection in General and Special Management Zones (NRE 1998). The Code will continue to be implemented to protect catchment and water values, and the frog's habitat area will continue to be protected by the Special Protection Zone.

Baw Baw National Park

The details of management practices implemented by Parks Victoria within the Baw Baw National Park are identified in the Baw Baw National Park Management Plan (PV 2005). Those management practices that contribute to the protection and continued existence of the Baw Baw Frog and its habitat are listed above under Action 4 – Habitat Management (above).

Mt Baw Baw Alpine Resort

The Mt Baw Baw Alpine Resort Management Board is committed to embracing the key management approaches of biodiversity in line with Victoria's Biodiversity Strategy, complying with the Board's Environmental Management Plan (ARC 1997), State legislation and Department of Infrastructure Alpine Planning Scheme, and the Commonwealth *EPBC Act* 1999 (Mt Baw Baw Alpine Resort Management Board Environmental Management Plan 2008–2011). Specific environmental goals and performance measures for the resort are identified in the Board's Corporate Plan. Specific management practices that contribute to the protection and continued existence of the Baw Baw Frog and its habitat are listed above under Action 4 – Habitat Management (above).

Biodiversity Benefits

The Baw Baw Frog is one of Australia's most threatened amphibians, and Victoria's only endemic amphibian. Its unusual life history, small distribution, and mountain-top habitat, makes it one of Australia's most celebrated species. The dramatic decline of the species in recent years coincides with a global decline in amphibian populations. Further to this, some of the other recorded declines and disappearances have also been associated with high-elevation amphibians occurring in relatively pristine habitats, such as the Baw Baw Frog. The decline and disappearance of amphibian populations corresponds with the overall global biodiversity crisis. This recognition has been supported by a global biodiversity convention, and as well as legislation and strategies developed by governments to address the precipitous decline of biodiversity. The factors contributing to the decline or disappearance of the Baw Baw Frog and other amphibians remain unclear in most cases. With their biphasic life-history, and skin that is permeable to both liquids and gases, amphibians are considered to be ideal organisms for measuring and monitoring environmental health. By identifying, ameliorating and managing decline-agents and threatening processes, this Recovery Plan contributes significantly to efforts being made by other amphibian biologists to identify causes of declines.

The localities of a number of Australian amphibians reported to have declined are restricted to alpine, sub-alpine, montane and mountain-top environments in relatively pristine habitats. The factors contributing to the decline or disappearance of these amphibians remains largely unknown. Monitoring, research and management actions identified within this Recovery Plan will provide the bases for identifying and ameliorating the causal agents responsible for the decline of this unusual sub-alpine species, and contribute to efforts being made by other amphibian biologists and conservation agencies in identifying causes of declines in other high-elevation amphibian taxa.

Conservation and management outcomes resulting from the implementation of this revised Recovery Plan are likely to benefit the habitats of a substantial number of other threatened species and communities that occur with the Baw Baw Frog, including Leadbeaters Possum, Sooty Owl, Spot-tailed Quoll, Broad-toothed Rat, Alpine Bog Skink, Baw Baw Stonefly, Cool Temperate Rainforest, Sub-alpine Wet Heathland, Baw Baw Berry, Victorian Richea, Tree Geebung, Spreading Clubmoss, Turquoise Coprosma, Mountain Broom-heath and Snow Drop Wood-sorrel. The Baw Baw Plataeu area is a site of global zoological significance (Mansergh & Norris 1982), has national, state and regional botanical significance (Gullan *et al*. 1984; Moorrees & Molnar 1992) and is a site of national geological and geomorphological significance (Rosengren *et al*. 1981).

The distribution of the Baw Baw Frog encompasses the headwaters of the water catchment for the Thomson Reservoir (water supply of Melbourne), Moondarra Reservoir and Blue Rock Reservoir. Conservation outcomes involving adequate protection and management of Baw Baw Frog habitat are likely to be beneficial to water supply and quality.

Social and Economic Impacts

Among vertebrate fauna, amphibians are particularly valued because of their functional importance for ecosystem energy-flow and nutrient cycling, and as indicators of environmental health. This importance has brought about an increased awareness by the general community of their value and current plight. Both State and Federal governments have also recognised the importance of the continued survivorship of threatened amphibians by funding the development and implementation of recovery and management plans, as well as instigating programs such as Frog Watch to increase public awareness about the general value of amphibians.

Potential restrictions on development of recreational activities and associated infrastructure within the Mt Baw Baw Alpine Resort, due to conservation and management measures implemented to protect the habitat of the Baw Baw Frog, may result in social and economic impacts. Due largely to constraints imposed by the FFG and EPBC Acts, proclaimed water supply catchments covering most of the Baw Baw Plateau and adjacent escarpments, and policy relating to the clearing of native vegetation in Victoria (Victoria's Native Vegetation Framework), planning and development of recreational activities within the Mt Baw Baw Alpine Resort are restricted predominantly to existing developed areas. The Mt Baw Baw Alpine Resort Management Board is committed to embracing the key management approaches of biodiversity in line with Victoria's Biodiversity Strategy, complying with the Board's Environmental Management Plan (ARC 1997) and State and Commonwealth legislation (Mt Baw Baw Resort Management Board Corporate Plan 2002 - 2004). Accessibility to pristine, natural areas, such as the Baw Baw Plateau, are important for ecological or nature-based tourism, which is considered the fastest growing tourist segment in the Australian Alps (Buckby *et al*. 1993).

Role and Interests of Indigenous People

It is likely that Aboriginal people previously lived in the Thomson Catchment and were able to utilise a wide range of environments, including the Baw Baw Plateau area (DCE 1992). No archaeological surveys to determine extent of use by Indigenous people have been conducted on the Baw Baw Plateau, although some stone axes have been reported to have been found on the spur between Tanjil Bren and Mt Whitelaw (Waters 1966). It is unclear whether the area encompassed by the Baw Baw National Park was associated with the Braiakaulung or Wurundjeri people (DCE 1992). It is reported by an early surveyor (W. Dawson) that the Traralgon Aborigines believed in legends of a ferocious species of yellow snake, and a boiling pool into which they could be sucked, near the Baw Baw mountains, and consequently avoided the area (Waters 1966).

All lands identified as potential habitat for the Baw Baw Frog in this Recovery Plan are subject to a Native Title Determination application lodged in the Federal Court by the Gunai/Kurnai aboriginal people (NRE 2002). The actions identified in this revised Recovery Plan are therefore subject to provisions outlined under the Commonwealth *Native Title Act* 1993

(NTA). The NTA, in Division 3 of Part 2, allows for certain acts, (termed "future acts"), to be carried out provided that certain procedural rights are observed. The relevant NTA provisions for this Recovery Plan rest in Sections 24JA and 24JB. Given that all lands subject to this Recovery Plan are lands reserved prior to 23 December 1996, the Recovery Plan can be validly created under Section 24JA of the NTA, subject to observance of procedural arrangements. Procedural notice was forwarded to the existing registered claimants and to the Mirimbiak Nations Aboriginal Corporation regarding comment on the actions contained in this Recovery Plan. Subsequent comments were received without objection. Requirements under the NTA for this Plan have been satisfied.

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