

Action Statement

Flora and Fauna Guarantee Act 1988

No. 55 (Revised in 2004)

Baw Baw Frog

Philoria frosti

Description and distribution

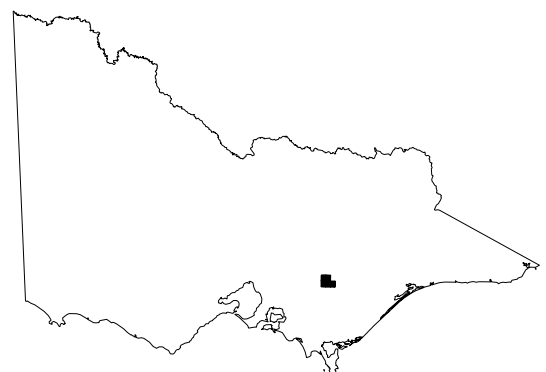
The Baw Baw Frog (*Philoria frosti*) is predominantly dark brown flecked with black, with some lighter patches. Its underbelly and groin are cream or yellowish and heavily mottled with brown. A prominent black, lobe-shaped parotoid gland, located behind the eye, extends back over each shoulder. Small tubercles or 'warts' exist on the sides and rump. The belly and throat are smooth (Cogger 2000). Adult female frogs are larger than males, measuring on average about 52 and 45 mm, respectively (Malone 1985a).

Eggs are large (4 mm diameter) and unpigmented (Littlejohn 1963; Malone 1985a, b; Anstis 2002). Larvae are unpigmented following hatching, but increase in pigmentation up until metamorphosis (Littlejohn 1963; Anstis 2002). Larvae are also non-feeding, hatching with a large residual yolk to support them nutritionally through to metamorphosis (Malone 1985a; Anstis 2002). 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.

The Baw Baw Frog is restricted to the Baw Baw Plateau and adjacent escarpment, approximately 120 km east of Melbourne (Hollis 1997; Hollis 2004). It occurs in the Baw Baw National Park, Mt Baw Baw Alpine Resort and State Forest at elevations between 900 and 1564 m, encompassing a total area of 135 km² (Hollis 2004).



Baw Baw Frog (*Philoria frosti*) Photo: Greg Hollis



Distribution in Victoria (source: Atlas of Victorian Wildlife)

Habitat

The Baw Baw Frog utilises sub-alpine wet heathland, sub-alpine woodland, montane riparian thicket, cool temperate rainforest, cool temperate mixed forest and montane wet forest vegetation types for breeding and non-breeding purposes (Hollis 2004). Breeding activity occurs along seepage and drainage lines on sloping terrain within frost hollows and gullies at sub-alpine elevation and gullies at montane elevation. Eggs are deposited in natural cavities constructed from vegetation, logs, rocks and soil that act as catchments for water (Malone 1985a). During the non-breeding season, frogs may occupy terrestrial habitats adjacent breeding sites where they shelter in damp localities beneath vegetation, in and under logs, under rocks, and in soil cavities between vegetation roots (Hollis 2004).

Life history and ecology

The Baw Baw Frog belongs to a group of amphibians (the genus *Philoria*, or *Kyarranus* in some texts) restricted to high-elevation, mountain or plateau environments (Cogger 2000; Anstis 2002; Knowles *et al.* in press). All species are considered to be naturally rare due to their restricted distributions and narrow ecological requirements (Malone 1985a; Hines *et al.* 1999). Members of the taxon are considered to be relics, with their ancestors having a more continuous distribution along the Great Dividing Range at a time when Australia had a wetter climate (Tyler 1992).

Calling activity by the Baw Baw Frog occurs between September and December (Malone 1985a; Hollis 2004), although some individuals have been heard in January and March (J. Coventry *pers. comm.*, G. Hollis *pers. obs.*). Egg laying appears to be confined to a shorter interval, coinciding with a peak in calling activity (Malone 1985a, b; Hollis 1995; Hollis 2004). The length of the breeding season is influenced by prevailing weather conditions, with increased duration of season occurring with greater rainfall and cool temperatures (Hollis 2004). Calling activity may occur at any time of the day or night, with most activity occurring during the day when conditions are warmer (Hollis 2004). The structure of the advertisement call of the male is highly variable, and may be described as a short 'clunk' (Littlejohn 1963), repeated in sequences of up to 160 notes during the calling activity peak (Hollis 2004). Males also broadcast another type of call during the breeding season that can be described as a 'growl'. This type of calling also occurs most commonly during the peak in calling activity, although its actual purpose is not clear (Hollis 2004).

Egg masses are deposited in a transparent foam nest (8 cm diameter and 3 - 4 cm high; Littlejohn 1963) at the calling site, or nearby. The foam nest is produced by the female beating air bubbles into the mucous and eggs with flanged fingers during egg laying (Littlejohn 1963). Egg clutch sizes range from 50 - 185 (see Littlejohn 1963; Malone 1985a, b; Tyler 1992). More than one clutch may be deposited at a single site (Malone 1985b; G. Hollis *pers. obs.*). The embryonic period varies from 5 - 8 weeks, with individuals hatching at Gosner stages 22 - 23 (Malone 1985a, b). The ability of non-feeding larvae (with a residual yolk reserve) to swim has been retained (Malone 1985a, b), although development usually takes place at the oviposition site with very little water (G. Hollis *pers. obs.*). Larval development varies from 5 - 10 weeks, at which time individuals metamorphose at an average length of 6.72 mm SVL (Malone 1985a).

Longevity of the Baw Baw Frog has been identified as 14.5+ years, with males and females becoming sexually mature at mostly 3.5 and 4.5-5.5 years, respectively (Hollis 2004). Further details on the calling activity, habitat use and adult movement patterns are documented in Hollis (2004).

Conservation status

National conservation status

The Baw Baw Frog is listed as endangered under the Commonwealth **Environment Protection and Biodiversity Conservation Act 1999**.

The Baw Baw Frog is listed as endangered in the Action Plan for Australian Frogs (Tyler 1997).

Victorian conservation status

The Baw Baw Frog is listed as threatened under the **Flora and Fauna Guarantee Act 1988**.

The Baw Baw Frog is listed as critically endangered in Victoria (Victorian Department of Sustainability and Environment 2003).

Decline and threats

Annual monitoring of the Baw Baw Frog between 1993 and 2002 indicates that the relative abundance of the population at sub-alpine elevations (above ~1300 m) has declined by 98% since the survey of Malone (1985a) in 1983 and 1984 when it was estimated that 10,000 - 15,000 adult males were present (Hollis 1995; Osborne *et al.* 1999; Hollis 2004). Survey data also indicate a continuation of the decline of the population at sub-alpine elevations in recent times (Hollis 2004; G. Hollis unpublished data). In association with the species decline, a contraction in distribution range from the drier north-eastern side of the Baw Baw Plateau to the wetter south-western side has also

occurred (Hollis 1995; Osborne *et al.* 1999; Hollis 2004). Recently discovered populations at lower, montane elevations on the south-western escarpment (950 - 1300 m) and north-eastern escarpment (above 1200 m) may have also declined, but not to the same extent as the population at sub-alpine elevations (Hollis 2004). Including recently discovered populations at montane elevations, the total adult male population is estimated to be approximately 7000 (Hollis 2004).

Potential threats to the Baw Baw Frog include:

- global and regional climate change,
- forestry activities within areas of State Forest occupied by the frog,
- the introduction of an exotic pathogen (Chytrid Fungus - *Batrachochytrium dendrobatidis*),
- increased UVB-radiation due to depletion of stratospheric ozone,
- atmospheric pollution from the Latrobe Valley or city of Melbourne,
- inappropriate development and/or management of land or infrastructure associated with recreational activities within the Mt Baw Baw Alpine Resort and Baw Baw National Park,
- introduced pest plants and animals, including cattle, sambar deer, rabbit, fox, dog, cat, and willow (*Salix cinerea*),
- interacting threats, or multiple factors acting together.

Hollis (2004) provides more details on potentially threatening processes.

Existing conservation measures

- The Baw Baw Frog is protected under the Wildlife Act 1975, Flora and Fauna Guarantee Act 1988 and Environment Protection and Biodiversity Conservation Act 1999.
- Approximately one third of the Baw Baw Frog population is estimated to occur within reserve in the Baw Baw National Park (Hollis 2004), which is managed primarily for conservation purposes. The park is managed according to the Baw Baw National Park Management Plan (PV 2003), including activities to support the protection and maintenance of frog habitat (e.g., control and eradication of pest plants and animals, maintenance of walking and ski tracks, closure of unwanted tracks and drainage maintenance).
- A small proportion (~ <10%) of the total population of the Baw Baw Frog occurs on land managed by the Mt Baw Baw Alpine Resort Management Board (Hollis 2004), which is managed primarily for winter and summer

recreational activities. The Mt Baw Baw Alpine Resort Management Board is required to provide sound environmental management of the resort by taking due regard of State and Commonwealth legislation (Mt Baw Baw Resort Management Board Corporate Plan 2002 - 2005). This includes regard for objectives outlined in the Flora and Fauna Guarantee Act 1988 for threatened species and the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (ARC 1997; Mt Baw Baw Resort Management Board Corporate Plan 2002 - 2005). The Alpine Resorts Act 1983 also requires management of the Mt Baw Baw Alpine Resort to plan the proper establishment, development, promotion and use of the resort having high regard to environmental considerations (ARC 1997).

- Approximately two-thirds of the Baw Baw Frog population is estimated to occur in State Forest (Hollis 2004), which is managed primarily for forestry activities (see NRE 1998). Populations of the Baw Baw Frog in State Forest are managed according to the Central Highlands Forest Management Plan (NRE 1998), including an interim management guideline that excludes forestry operations from within 200 m of known frog habitat. This interim management guideline was to be implemented whilst additional survey and research were being undertaken to assist with the development of long-term protection measures for the species. A review of this management guideline was recently undertaken in 2003 (see 'Intended management actions' below).
- In 1997, a Recovery Plan was prepared under the Commonwealth **Endangered Species Protection Act 1992** (later replaced by the **Environment Protection and Biodiversity Conservation Act 1999**), and referred to the period from 1997 to 2001. Implementation of this Recovery Plan was completed in 2001 and a review of progress was undertaken in the same year. A revised Recovery Plan was prepared in 2002 and referred to the period 2002-2006. This revised plan has yet to be formally adopted under the **Environment Protection and Biodiversity Conservation Act 1999**.

Conservation objectives

Long term objective

To ensure that the Baw Baw Frog can survive, flourish and retain its potential for evolutionary development in the wild.

Objectives of this Action Statement

(The following objectives are intended to be achieved within 5 years of the date of this Action Statement. Refer to targets under each action.)

1. Accurately measure and analyse trends in population and habitat.
2. Fill key knowledge gaps regarding the biology and ecology of the Baw Baw Frog.
3. Determine the threatening processes responsible for the decline of the Baw Baw Frog.
4. Reduce the impact of processes threatening the Baw Baw Frog.
5. Effectively co-ordinate efforts to conserve Baw Baw Frog.

Intended management actions

Objective 1. Accurately measure and analyse trends in population and habitat.

1. Undertake population and habitat monitoring.

A statistically defensible, long-term population monitoring program is required to distinguish natural population fluctuations from declines in amphibians. Population monitoring is also required to investigate potentially adverse agents in the decline of the Baw Baw Frog, as well as to measure the effectiveness of implemented management actions or programs involving adaptive management (see experimental timber harvesting below). The survey monitoring program to date has yielded valuable information on the distribution, habitat use and abundance of the species over time. Its continuation is considered vital for monitoring population trends, and future studies investigating the species decline and sensitivity to land management practices.

Target: annual census of calling males undertaken using methodology and established survey transects identified by Hollis (2004)

Responsible: DSE, Parks Victoria, Mt Baw Baw Alpine Resort Management Board, VicForests.

Objective 2. Fill key knowledge gaps regarding the biology and ecology of the Baw Baw Frog

2. Investigate conservation genetics of the Baw Baw Frog

Knowledge of the movement patterns and potential for dispersal by adult Baw Baw Frogs has been examined previously (Hollis 2004). However, movement patterns of adults may be a poor basis for predicting the behaviour of dispersing juveniles. The potential for movement by non-adult age classes (juveniles and sub-adults) and overall dispersal potential,

remains unknown. Knowledge of overall dispersal potential of the Baw Baw Frog is required to gain an understanding of metapopulation dynamics of the species. An understanding of metapopulations is considered necessary to effectively assess population declines (Alford and Richards 1999), as well as providing useful information for interpreting research investigating the potential impact of land-use activities on the species. Due to the rarity, cryptic nature and endangered conservation status of the Baw Baw Frog, conservation genetics appear to be the only feasible method available to determine overall, dispersal potential of the species. Such an analysis will provide: (1) an ecologically relevant estimate of dispersal rates, or effective neighbourhood size; (2) an estimation of metapopulation structure; (3) insight into potential sex-bias in dispersal rates; and (4) insight into effective population size.

Targets: tissue samples collected; genetic analysis completed

Responsible: DSE, consultant

3. Undertake population modelling

Sufficient life history and demographic information on the Baw Baw Frog population is now available to undertake population modelling analyses to investigate the long-term viability of the species. The primary objective of this analysis is to identify the amount of breeding and non-breeding habitat required to ensure long-term viability of the Baw Baw Frog population. The model will also be used to explore and rank the impact of various timber harvesting practices on the long-term survivorship of the species. This modelling will only be able to commence once data from Actions 2 and 6 have been acquired. Modelling will aim to build a decision support tool that is spatially explicit, and will include: (1) habitat specific demography; (2) dispersal and migration rates; and (3) dispersal paths. The development of these models will include defining threatening processes and explicitly including them in the modelling process.

Target: objectives and appropriate modelling procedures determined; population modelling completed

Responsible: DSE, consultant

4. Conduct analysis of natural disturbance history in habitat utilised by the Baw Baw Frog

Traditionally practiced, existing silvicultural practices do not incorporate landscape and stand-level complexity characteristics of natural disturbance regimes, tending to be more aligned with agricultural models (Lindenmayer

and Franklin 2002). Differences between natural and human disturbances can be inferred by comparing the types, quantities, and spatial arrangements of biological legacies (Lindenmayer and Franklin 2002). Biological legacies are features and traces of the original community following a natural disturbance, and are essential components for wildlife (Lindenmayer and Franklin 2002). These legacies can be totally eliminated from areas subject to forestry activities (Lindenmayer and Franklin 2002), suggesting a need for greater congruence between natural and human disturbance regimes within areas of Baw Baw Frog habitat identified for timber harvesting. Wildfire is the primary form of natural disturbance within these habitats. Knowledge of the natural variability in intensity and frequency of wildfire within different sub-catchments/catchments encompassing the distribution of the Baw Baw Frog will provide information necessary to consider temporal and prescriptive modification of forestry practices in some areas to benefit the long-term survival of the species.

Target: analysis of natural-disturbance history completed

Responsible: DSE

Objective 3. Determine the threatening processes responsible for the decline of the Baw Baw Frog.

5. Investigate the presence of Chytrid Fungus (*Batrachochytrium dendrobatidis*) and epidemiology in the Baw Baw Frog

The introduced Chytrid Fungus (*Batrachochytrium dendrobatidis*) is now well established in a number Australian amphibian populations, and has been implicated as a proximate cause of the recent decline of some amphibian species (Berger *et al.* 1999). Given the detection of this pathogen in other Australian Alps amphibians, it is possible that this pathogen could explain the decline and contraction in range of the Baw Baw Frog following survey for the species in 1983 and 1984 Malone (1985a). Archived specimens of the Baw Baw Frog in the Museum of Victoria and tissue samples taken from live specimens between 1993 and 2000 can be used to determine the presence of *B. dendrobatidis* in the population, and the timing of possible introduction. Additional research is also required to determine the relative susceptibility of the Baw Baw Frog to initial infection, relative developmental rates of disease and survival threshold. This research will provide data on variation in behavioural and physiological resistance of the species to *B. dendrobatidis*.

Target: research experiment to investigate susceptibility of Baw Baw Frog to Chytrid Fungus completed; chronological survey for presence of Chytrid Fungus completed

Responsible: DSE, consultants

6. Conduct experimental timber harvesting to determine relationship to Baw Baw Frog and its habitat

Habitat of the Baw Baw Frog occurring on State Forest (above 950 m a.s.l. on the south-western escarpment of the Baw Baw Plateau, and above 1200 m on the north-eastern escarpment) also coincides with a large amount of high-value timber resource. Timber harvesting may potentially impact directly upon both breeding and non-breeding frog habitats, and indirectly by affecting hydrology, micro-climate and soil properties up-stream and up-slope from areas known to be occupied by frogs. For forestry operations to occur in the habitat of the Baw Baw Frog, it must be first determined if the frog, and its habitat requirements, can coexist with forestry activities in the long-term. Research is therefore required to assess the likely impact of timber harvesting operations on populations of the Baw Baw Frog and their habitat. This research can be undertaken in the form of an adaptive management project. Adaptive management is the systematic acquisition and application of reliable information to improve natural resource management over time (e.g., Wilhere 2002). The approach aims to reduce uncertainty underlying ecological relations to environmental variation by monitoring biotic responses to management actions, and by comparing responses to predictions generated by alternative hypotheses (Irwin and Freeman 2001). The information from this work will be used develop a sound conservation strategy for the species in State Forest.

Target: experimental design completed and field-based electronic equipment installed; experimental timber harvesting completed; data analysis completed on the initial findings in the first 5 years post-harvesting; long-term monitoring regime established

Responsible: DSE, Victorian Forests

7. Investigate the relationship between climate change, weather and Baw Baw Frog population decline and fluctuations

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 not included in their BIOCLIM analysis due to its

very small distribution, Bennett *et al.* (1991) predicted that the bioclimate of the Baw Baw Frog would disappear with a rise in temperature. There have been warming climate trends in south-eastern Australia (Smith *et al.* 1999) and reduced rainfall in the vicinity of the Baw Baw Plateau (Helps 2001) in recent times. Climate change, either due to long-term changes through enhanced greenhouse effects, or from regional influences such as land use, may be responsible for the decline of the Baw Baw Frog. One difficulty in assessing the influence of climate on populations is separating short-term fluctuations from longer-term trends. This analysis will investigate how weather influences population numbers of the Baw Baw Frog, and model the potential impact of enhanced greenhouse on the long-term survivorship of the species given its specialised habitat requirements.

Target: investigation into understanding of relationship between population fluctuations and weather completed, methods for climate modelling determined

Responsible: DSE, consultant

Objective 4. Reduce the impact of processes threatening the Baw Baw Frog.

Management and protection of habitats utilised by the Baw Baw Frog continues to be an integral component of activities undertaken by Park Victoria and the Mt Baw Baw Alpine Resort Management Board within the Baw Baw National Park and Mt Baw Baw Alpine Resort, respectively.

These activities include:

8. Continue to undertake track maintenance, including:
 - drainage undertaken 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,
 - general maintenance of all tracks,
 - review of continued track access to Mustering Flat,
 - review and relocation of the village trail from Pudding Basin (wetland habitat) to an alternative location within the Mt Baw Baw Alpine Resort.

Target: annual maintenance or rehabilitation of tracks subject to erosion undertaken within habitats used by Baw Baw Frog; planning completed for relocation of village trail from Pudding Basin in Mt Baw Baw Alpine Resort

Responsible: Parks Victoria, Mt Baw Baw Alpine Resort Management Board

9. Continue to undertake pest plant and animal control
 - continuation of willow (*Salix cinerea*) control works,
 - evaluation of treated willows from previous years,
 - mapping of locations of willow sites and establishment of data base,
 - control of other weeds (blackberry, roadside weeds)
 - monitoring of pest animals (rabbits, cattle, fox, dog, deer) during survey monitoring for Baw Baw Frog,
 - trialing of Pindone rabbit baits to test for potential in an ongoing control program,
 - continuation of fox baiting program at Mt St Gwinear,
 - monitoring of decline in cattle numbers.

Target: annual evaluation and control of priority pest plant and animals completed

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

10. Continue to undertake rehabilitation of native vegetation
 - revegetation of eroded areas in the Mt Baw Baw Alpine Resort,
 - reintroduction of native species to ski runs,
 - systematic closure and revegetation of all the old walking tracks around the Mt Baw Baw Alpine Resort,
 - propagation of native species for regeneration purposes within the Mt Baw Baw Alpine Resort,
 - establishment of a native vegetation nursery by the Mt Baw Baw Alpine Resort Management Board.

Target: native vegetation nursery established; unused paths and tracks closed and rehabilitated

Responsible: Mt Baw Baw Alpine Resort Management Board

11. Protect existing Baw Baw Frog habitat: develop environmental guidelines and workplace practice protocols to avoid or minimise any potential impacts on Baw Baw Frog habitat of works involving vegetation removal, revegetation/earthworks, drainage line management and vehicle use.

Target: draft environmental guidelines and workplace protocols completed accurate records maintained to demonstrate avoidance and/or minimisation of impacts net gain in Baw Baw Frog habitat

Responsible: Mt Baw Baw Alpine Resort Management Board

12. Continue to manage State Forest to conserve the Baw Baw Frog

Following the discovery of populations of the Baw Baw Frog in State Forest in 1996, an interim management guideline was incorporated into the Central Highlands Forest Management Plan (NRE 1998) to protect the habitat of the species. Additional information collected on the ecology, biology, habitat and distribution of the frog (Hollis 2002; Hollis 2004) has resulted in the revision of this interim management guideline. In 2003, an interim conservation strategy for the Baw Baw Frog in State Forest was drafted by the Department of Sustainability and Environment to progress the management and protection of the species whilst further research is conducted to determine the potential impact of forestry activities on the viability of the frog and its habitat (DSE internal document). This strategy provides for:

- the establishment of a management zone encompassing the potential habitat envelope of the Baw Baw Frog, based on the distribution of known frog localities (Atlas of Victorian Wildlife) and modelling of the distribution of breeding habitat (Liu and White 1999),
- the exclusion of areas and volumes of timber resource within the management zone from the timber industry for the next license period,
- within the management zone, the undertaking of a limited amount of timber harvesting under restricted conditions incorporating experimental design to determine the impact of timber harvesting on populations of the Baw Baw Frog and its ecological requirements (see Action 6),
- modification of forestry practices to accommodate the conservation of the taxon, in light of the findings of experimental timber harvesting.

Target: interim conservation strategy implemented

Responsible: DSE, VicForests

13. Refine conservation strategy for Baw Baw Frog populations in State Forest

Incorporate findings of actions involving experimental timber harvesting, conservation genetics, population modelling and analysis of natural disturbance regimes to refine the conservation strategy for the Baw Baw Frog in State Forest.

Target: all relevant findings addressed and refinements made

Responsible: DSE

Objective 5. Effectively co-ordinate efforts to conserve Baw Baw Frog

14. Maintain a Recovery Team which represents stakeholders and includes people with relevant expertise.

Target: Recovery Team convened; six-monthly recovery team meetings held

Responsible: DSE

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Compiled by Greg Hollis, Gippsland Region,
Department of Sustainability and Environment.

Further information can be obtained from
Department of Sustainability and Environment
Customer Service Centre on 136 186.

Flora and Fauna Guarantee Action Statements are
available from the Department of Sustainability and
Environment website: <http://www.dse.vic.gov.au>

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