

Draft Revision (2009)

Flora and Fauna Guarantee Action Statement No. 55

Baw Baw Frog *Philoria frosti*

Description

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.

Distribution

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).

Annual monitoring of the Baw Baw Frog population between 1993 and 2002 indicates that the relative abundance of the population at sub-alpine elevations (above approximately 1300 m) has declined by 98 percent 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). Annual monitoring data collected between 2003 and 2008 indicates a continuation of this pattern of decline at sub-alpine elevations, with no frogs recorded from sub-alpine survey transects above 1400 m since 2005 (Hollis 2004; G. Hollis, unpublished data). 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).

Populations of Baw Baw Frog discovered at lower, montane elevations on the south-western escarpment (950 to 1300 m) and north-eastern escarpment (above 1100 m) of the Baw Baw Plateau after 1995 appear to have also declined since detection, but not to the same rate as the population at higher, sub-alpine elevations (Hollis 2004). The results of more detailed analyses of the 1993–2008 annual monitoring data set using Bayesian techniques support the patterns of population decline and range contraction noted above (Hollis and Scroggie, unpublished data). In addition to these patterns, Hollis and Scroggie (unpublished data) also found that declines in frog abundance occurred across all catchments, but at different rates, with little variation in rates of decline recorded among sites within catchments.

Hollis (2004) estimated the total adult male Baw Baw Frog population size to be 7000 from density indices derived for different geographic areas classified by catchment and elevation using 1996–1999 census data. The current adult male population size, however, is currently likely to be significantly less than this estimate given the continued decline in abundance that has occurred in all populations between 2000 and 2008 (Hollis and Scroggie, unpublished data).

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.* 2004) and sometimes described as sphagnum frogs (Knowles *et al.* 2004). 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 (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. 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 snout-vent length (Malone 1985a).

Longevity of the Baw Baw Frog has been identified as over 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).

Mitochondrial DNA (mtDNA) and microsatellite genetic analyses were conducted on tissue samples obtained from 126 Baw Baw Frogs located across the distributional extent of the species to examine population structure and dynamics and to provide an ecologically relevant estimate of dispersal rates (Donnellan and Wheaton 2007). Details of the panel of microsatellite markers developed for the molecular genetic analyses are contained in Wheaton *et al.* (2008). A comparison of the phylogenetic relationships among ND4 mtDNA sequences of all six species of *Philoria* has been undertaken by (Donnellan and Wheaton 2007). Both mtDNA and microsatellite analyses found little evidence of significant differences in haplotype or allele frequencies between the sites examined, respectively and statistical analysis did not reject the presence of only a single population. A significant pattern of isolation-by-distance suggests that the estimated relatively high overall rate of gene flow between sites is driven mainly by gene flow among adjacent sites. This result suggests that this pattern of gene flow is likely to have persisted prior to the decline of the Baw Baw Frog (some time after 1984) and that insufficient time has elapsed for genetic drift to erode this pattern (Donnellan and Wheaton 2007).

Conservation status

National conservation status

The Baw Baw Frog has been listed as “endangered” under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Victorian conservation status

The Baw Baw Frog has been listed as “threatened” under the *Flora and Fauna Guarantee Act 1988*.

The Baw Baw Frog is considered “critically endangered” in Victoria according to DSE’s *Advisory List of Threatened Vertebrate Fauna in Victoria - 2007* (DSE 2007).

Threats

The introduction of an exotic pathogen (chytrid fungus) and climate change have been identified as agents considered to be the primary threat to the future survival prospects of the Baw Baw Frog population. The potential threat of proposed timber harvesting activities within the habitat of the species no longer exists following protection of the species habitat in reserve within State Forest areas (see Past Management Actions below). Other potential threats to the Baw Baw Frog include:

- 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 animals and plants, including foxes (*Vulpes vulpes*), dogs (*Canus lupus familiaris*), rabbits (*Oryctolagus cuniculus*), sambar deer (*Cervus unicolor*) cats (*Felis catus*) and cattle (*Bos taurus*) willow (*Salix cinerea*) and balbosus rush (*Juncus balbosus*).
- Interacting threats, or multiple factors acting together.

Hollis (2004) provides further discussion on potentially threatening processes.

<i>Standard threat</i>	<i>Source Of Threat</i>	<i>Explanation</i>
Disease	Disease - Chytrid Fungus	<p>It is considered that the introduced chytrid fungus (<i>Batrachochytrium dendrobatidis</i>) entered the Australian environment only three decades ago (Skeratt <i>et al.</i> 2007). This pathogen is now well established in a number of Australian amphibian populations, and has been implicated as a proximate cause of the recent decline of some species (Berger <i>et al.</i> 1999). There is now considerable evidence implicating chytrid fungus as the cause of population declines in species of amphibian confined to the Australian Alps (Hunter <i>et al.</i> 2009; Hunter in press). Climate conditions in the Australian Alps may present ideal conditions for chytrid fungus given the pathogens preference for cool temperatures and moist conditions (Berger <i>et al.</i> 2004).</p> <p>Chytrid fungus has now been detected in tissue samples taken from live specimens of Baw Baw Frog in 1997 and 1999 (G. Hollis unpublished data) whilst screening for infection by chytrid fungus in the Common Froglet (<i>Crinia signifera</i>) from the Baw Baw Plateau found that 29% of screened specimens contained the disease (Hunter <i>et al.</i> 2009). Populations of Common Froglet are considered not to have declined as with other amphibian species confined to the Australian Alps, including the Baw Baw Plateau (Hunter <i>et al.</i> 2009, G. Hollis pers. obs.). However, the positive screening results and mostly high spore count levels recorded by Hunter <i>et al.</i> (2009) for the Common Froglet suggests that the species has a high level of resilience to the disease. This resilience to the chytrid fungus confirms the Common Froglet as a likely reservoir host for the disease (Hunter <i>et al.</i> 2009). The greater rate of decline recorded for Baw Baw Frog populations from higher elevation, sub-alpine habitats coincides with the primary habitat, distribution and population of the Common Froglet on the Baw Baw Plateau. The persistence of Baw Baw Frog populations within lower elevation, montane habitats together with lower recorded rates of decline, correlates with the noted absence of the Common Froglet from montane areas except in disturbed localities (G. Hollis pers. obs.).</p>
Weather	Weather - climate change	<p>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 sub-alpine and montane environments, and has specialised life history characteristics. Although not included in their BIOCLIM analysis due to its very small distribution, Bennett <i>et al.</i> (1991) predicted that the bioclimate of the Baw Baw Frog would disappear with a small rise in temperature. There have been warming climate trends in south-eastern Australia (Smith <i>et al.</i> 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 threaten the future survivorship of the Baw Baw Frog population.</p>

Important populations

<i>Location name</i>	<i>Land manager</i>	<i>Catchment</i>	<i>Bioregion</i>
Baw Baw National Park	Parks Victoria	West Gippsland	Victorian Alps
Mount Baw Baw Alpine Resort	Mt Baw Baw Alpine Resort Management Board (ARMB)	West Gippsland	Victorian Alps Highlands - Southern Fall
State Forest	DSE Land and Fire Services - Central Area	West Gippsland	Highlands - Southern Fall Victorian Alps

Past management actions

<i>Action</i>	<i>Explanation</i>
Develop, publish and distribute educational, technical or publicity material and/or displays.	Recovery plans, action statements, fact sheets, websites and display material have been produced for educational purposes since commencement of the recovery program for the species.
Assess threats.	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 <i>et al.</i> 1999).
Undertake detailed population monitoring and collect demographic information.	Annual monitoring surveys 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 <i>et al.</i> 1999; Hollis 2004; Hollis and Scroggie, unpublished data).
Conduct priority research projects as specified.	Completed research projects on the Baw Baw Frog include studies on longevity, maturation and growth (Hollis 2004), population trends (Hollis 2004; Hollis and Scroggie unpublished data), breeding habitat attributes (Hollis 2004), habitat distribution (Liu and 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 <i>et al.</i> 2008), genetics (Donnellan and Wheaton 2007; Wheaton <i>et al.</i> 2008), disease (Hunter <i>et al.</i> 2009) and natural disturbance history modelling (Gang-Jun Liu and Hollis, unpublished data).
Liaise with government agencies.	Liaison between government agencies (DSE, 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.
Realign tracks and roads.	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 1998) or was realigned to avoid the species breeding habitat.
Control introduced animals.	Programs to control and/or monitor fox, dog, rabbit, sambar deer and cattle have been undertaken by Parks Victoria, Mt Baw Baw Alpine Resort Management Board and DSE.
Provide information and advice to local government authorities for inclusion in planning processes.	Information on the ecological requirements, habitat and current status of the Baw Baw Frog population has been provided the Alpine Planning Unit, DSE, for consideration during amendments to the Alpine Planning Scheme.
Prepare/revise Recovery Plan.	Recovery Plans (Hollis 1997; Hollis 2003) have been prepared and revised for the Baw Baw Frog.
Undertake threat monitoring.	Monitoring of introduced animals (cattle, sambar deer, rabbit, fox, dog, cat (<i>Felis catus</i>) and weeds such as willow (<i>Salix cinerea</i>) have been undertaken by DSE,

	Parks Victoria 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.
Involve community groups and volunteers in recovery activities.	Friends of Baw Baw National Park have assisted Parks Victoria to control weeds, for example, blackberry (<i>Rubis sp.</i>), conduct surveys for cattle populations 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.
Develop, provide input to or implement park, reserve or land management plan.	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 Environmental Management Plan (MBBAR 2007).
Prepare/revise Action Statement.	Action Statements (CNR 1993; DSE 2004) have been prepared and revised for the Baw Baw Frog.
Prepare a plan for reintroduction / translocation.	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).
Develop detailed population monitoring protocols.	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 and Scroggie, unpublished data).
Manage environmental weeds.	Programs to control high-threat weeds within the habitat of the Baw Baw Frog have been undertaken by Parks Victoria (willow and blackberry) and the Mt Baw Baw Alpine Resort Management Board (blackberry, balbosus rush (<i>Juncus balbosus</i>)).
Develop/revise management prescriptions and/or zoning for State forest.	DSE has recommended that all key areas of habitat for Baw Baw Frog in State Forest be protected in a Special Protection Zone. These proposed changes will be finalised in late 2009 following public consultation as part of a package of changes to forest zoning.
Manage sedimentation.	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.
Undertake research into management requirements.	An adaptive experimental management research project to investigate the potential negative impact of forestry activities on the Baw Baw Frog and its habitat in State Forest was initiated in 2004 prior to the project being discontinued in 2007. A population model for the species has been developed to allow for investigations of into population viability (Todd <i>et al.</i> 2007). Habitat modelling has been conducted to identify refugial locations occupied by the species (Gang-Jun Liu and Hollis, unpublished data). Research was undertaken to demonstrate how to successfully raise eggs and larvae through to metamorphosis (Hollis 2002).

Conservation objectives

Long term objective

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

Objectives of this Action Statement

- To increase the number of populations or individuals.
- To maintain or improve condition of habitat.
- To secure populations or habitat from potentially incompatible land use or catastrophic loss.

- To increase knowledge of biology, ecology or management requirements.
- To maintain or increase community awareness and support.

Intended management actions

The intended management actions listed below are further elaborated in DSE's Actions for Biodiversity Conservation (ABC) system. Detailed information about the actions and locations, including priorities, is held in this system and will be provided annually to land managers and other authorities.

<i>Standard objective</i>	<i>Targets</i>	
To increase the number of populations or individuals.	A captive population of the Baw Baw Frog has been established and is being maintained. The population is sufficiently large to encompass the natural levels of genetic variation and managed to maintain these levels.	
<i>Action</i>	<i>Details</i>	<i>Responsible agents</i>
Undertake captive breeding for reintroduction or reinforcement.	Establish an insurance population for the species if current negative population trajectories continue in the long-term.	DSE Statewide Services - Gippsland region (DSE SwS – Gippsland)

<i>Standard objective</i>	<i>Targets</i>	
To maintain or improve condition of habitat.	<ul style="list-style-type: none"> • Threats have been assessed annually. • Management has been undertaken (where necessary) in response to significant threats including: <ul style="list-style-type: none"> ○ Controlling pest animals ○ Controlling existing weeds (e.g., blackberry, willow) or eradicating new weeds (e.g., balbosus rush); ○ Managing sedimentation by standard sediment control techniques and/or road and track rationalisation. 	
<i>Action</i>	<i>Details</i>	<i>Responsible agents</i>
Control introduced animals.	Monitor, control and/or eradicate introduced animals (sambar deer, cattle, rabbit, fox/dog, cat) considered to be potential threat to the Baw Baw Frog or its habitat.	Parks Victoria, Mt Baw Baw ARMB DSE SwS – Gippsland
Manage environmental weeds	Monitor, control and/or eradicate environmental weeds: willow, balbosus rush, blackberry and other weeds considered to be potential threat to the habitat of the Baw Baw Frog.	Parks Victoria, Mt Baw Baw ARMB, DSE Land and Fire - Central Area
Manage sedimentation	Undertake annual maintenance activities on access roads, walking tracks, ski trails and ski runs to minimise and/or control sedimentation. Adopt standard operating procedures during works involving disturbance to soil to prevent or minimise sedimentation.	Parks Victoria, Mt Baw Baw ARMB
Realign tracks and roads	Realign roads, tracks or ski trails that may result in degradation of habitat utilised by the Baw Baw Frog (e.g., boundary track through Pudding basin and Long Plain within the Mt Baw Baw Alpine Resort).	Parks Victoria, Mt Baw Baw ARMB

<i>Standard objective</i>	<i>Targets</i>	
To secure populations or habitat from potentially incompatible land use or catastrophic loss.	<ul style="list-style-type: none"> • Changes to forest management zoning have been implemented. • Research and management actions have been reviewed, updated and communicated to relevant government agencies. 	
<i>Action</i>	<i>Details</i>	<i>Responsible agents</i>
Develop/revise	Implement changes to forest zoning following completion	DSE Forests & Parks

management prescriptions and/or zoning for State forest.	of public consultation in 2009.	Division
Liaise with government agencies.	Continue to provide up-to-date information to government agencies and land managers on progress and evaluation of the Baw Baw Frog recovery program and the species conservation requirements.	Parks Victoria, Mt Baw Baw ARMB, DSE SwS – Gippsland
Prepare/revise Action Statement.	Revise the Action Statement for Baw Baw Frog, incorporating new information on the conservation and management requirements of the species.	DSE Biodiversity & Ecosystem Services , DSE SwS – Gippsland
Prepare/revise Recovery Plan.	Revise National Recovery Plan.	DSE Biodiversity & Ecosystem Services

<i>Standard objective</i>	<i>Targets</i>	
To increase knowledge of biology, ecology or management requirements.	<ul style="list-style-type: none"> Knowledge of the threats to Baw Baw Frog increased to identify and prioritise management actions. Increased capacity for establishment of a stock or insurance population. 	
<i>Action</i>	<i>Details</i>	<i>Responsible agents</i>
Conduct priority research projects as specified.	<p>Undertake investigation of modelling to determine potential impact of climate change on the long-term viability of the Baw Baw Frog population.</p> <p>Contribute to the national research and management program on the exotic Chytrid Fungus for purpose of gaining an understanding of mechanisms contributing to the introduction and spread of the pathogen as well as factors influencing the susceptibility and immune response of amphibians.</p> <p>Undertake research to determine husbandry regimes for successfully raising eggs, larvae and frogs in captivity.</p>	Melbourne Zoo, DSE SwS – Gippsland
Undertake detailed population monitoring and collect demographic information.	Undertake annual census of Baw Baw Frog using established survey methodology and protocols to measure population trends.	Parks Victoria, DSE SwS – Gippsland
Undertake threat monitoring.	Monitor recreational visitor impact on Baw Baw Frog population and habitat by annual population monitoring and continual assessment of track and pathway management by land manager.	Parks Victoria, Mt Baw Baw ARMB

<i>Standard objective</i>	<i>Targets</i>	
To maintain or increase community awareness and support.	<ul style="list-style-type: none"> Increased community awareness about the conservation status of the Baw Baw Frog and support for the recovery program of the species, based on periodic monitoring. 	
<i>Action</i>	<i>Details</i>	<i>Responsible agents</i>
Develop, publish and distribute educational, technical or publicity material and/or displays.	Continue to develop and/or update 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.	Parks Victoria, Mt Baw Baw ARMB, DSE SwS – Gippsland
Involve community groups and volunteers in recovery activities.	When appropriate, involve community groups and/or volunteers in activities that will support efforts to protect the Baw Baw Frog and its habitat.	Parks Victoria, Mt Baw Baw ARMB, DSE SwS – Gippsland

Personal Communications

John Coventry, Herpetologist, formerly National Museum of Victoria

Personal Observations

Greg Hollis, Senior Flora and Fauna Officer, DSE Statewide Services, McCarthys Spur Road, Noojee, VIC, 3833.

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