

**Southern Bell Frog
(*Litoria raniformis*)
Recovery Plan**



Draft for Public Comment

February 2005



**Department of
Environment and
Conservation (NSW)**

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Cover illustration: Southern Bell Frog (*Litoria raniformis*)

Photographer: M. LeBreton

This plan should be cited as follows:

Department of Environment and Conservation (2005) Southern Bell Frog (*Litoria raniformis*)
Draft Recovery Plan.

ISBN 0 7313 6142 3

Southern Bell Frog
(Litoria raniformis)
Draft Recovery Plan

Prepared in accordance with the New South Wales
Threatened Species Conservation Act 1995

February 2005

Acknowledgments

The preliminary draft of this plan was written by Robyn Molsher, and was extensively revised by Melanie Bannerman, Threatened Species Officer of the Department of Environment and Conservation, Threatened Species Unit, Northwest Branch. Matt Cameron and Peter Christie edited the plan and contributed to the development of the recovery actions.

Some of the information pertaining to the biology of the species is based on information collated by Alistair Glen, Institute of Wildlife Research, University of Sydney under contract to DEC. Many thanks to Skye Wassens and Graham Pyke who were particularly helpful in providing information that was useful in the preparation of this Recovery Plan. Thanks also to Michelle Christy, Michael Mahony, Lee Berger, Mat LeBreton, James Val, Glen Muir, Mark Robb, Arun Tiwari and Nick Sheppard.

Executive Summary

Introduction

The Southern Bell Frog (*Litoria raniformis*) has suffered a considerable reduction in abundance and distribution throughout NSW in recent years (Tyler 1993, Sadler and Pressey 1994, Mahony 1996, Osborne *et al.* 1996, Ehmann and White 1996). Once abundant along the Murray and Murrumbidgee Rivers and their tributaries from the Southern Tablelands to the South Australian border, the species is now only found in scattered locations throughout their former range. Suspected threats to the Southern Bell Frog include loss or fragmentation of habitat through draining of wetlands and prolonged periods of drought, predation on eggs and tadpoles by introduced fish species, infection by pathogens, particularly Chytrid fungus, degradation of habitat from pollution, salinisation and chemical use.

Legal Status

The Southern Bell Frog is listed in NSW as ‘Endangered’ under the NSW *Threatened Species Conservation Act* 1995 (TSC Act). It is also listed nationally as ‘Vulnerable’ under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) and is listed as ‘Endangered’ under the IUCN (2000) Red List of Threatened Species.

Legislative Context

The TSC Act provides a legislative framework to protect and encourage the recovery of threatened species, endangered populations and endangered ecological communities in NSW. Under this legislation the Director-General of the Department of Environment and Conservation (DEC) has a responsibility to prepare Recovery Plans for all species, populations and ecological communities listed as Endangered or Vulnerable on the TSC Act schedules. Similarly, the EPBC Act requires the Commonwealth Minister for the Environment to ensure the preparation of a Recovery Plan for nationally listed species and communities or adopt plans prepared by others including those developed by State agencies. Both Acts include specific requirements for the matters to be addressed by Recovery Plans and the administrative process for preparing Recovery Plans.

Recovery Plan Preparation

This Recovery Plan has been prepared to satisfy the requirements of the TSC Act only and is the NSW State Recovery Plan for *Litoria raniformis*. The Victorian Department of Sustainability and the Environment is currently preparing a National Recovery Plan for the species.

Recovery Objectives

The overall aim of this Recovery Plan is to promote the recovery of the Southern Bell Frog throughout New South Wales.

Specific objectives of this Recovery Plan are to:

- 1) determine the current range and distribution of the Southern Bell Frog in NSW and determine the extent of decline throughout its range in the state;
- 2) improve our knowledge and understanding of the species' biology, ecology, genetics and causes of decline;
- 3) identify and alleviate, where possible, any current or potential threats to the species;
- 4) protect and monitor populations; and
- 5) raise awareness of the conservation significance of the Southern Bell Frog and involve the community in the recovery program.

Recovery Criteria

Recovery criteria for the Southern Bell Frog are that:

- 1) the current range, distribution and extent of decline of the species in NSW is determined;
- 2) the biology and ecology of the species is better understood;
- 3) genetic differences or similarities between separate populations are determined;
- 4) threats and causes of decline are identified and, where possible, alleviated;
- 5) populations are protected and regularly monitored;
- 6) the community is more aware of the species and involved in recovery actions.

Recovery Actions

Recovery actions for the Southern Bell Frog will involve:

- 1) surveying areas of known and potential habitat across the historic range of the species;
- 2) regular monitoring of all known Southern Bell Frog populations;
- 3) active management and monitoring of selected populations;
- 4) encouraging research into the species' biology, ecology, habitat requirements, causes of decline and genetic diversity;
- 5) educating the community with regards to the Southern Bell Frog and encouraging them to participate in recovery actions for the species;
- 6) identifying current and potential threats to the species and implementing appropriate management strategies to alleviate the threats, including:

- 7) encouraging the protection of natural and artificial habitat on private and public lands in the species' range;
- 8) promoting the protection and restoration of natural wetlands in line with the NSW Wetlands Management Policy (1996);
- 9) controlling introduced fish species, particularly the Plague Minnow (*Gambusia holbrooki*) in Southern Bell Frog habitat; and
- 10) minimising the spread of disease, particularly Chytrid fungus, within and between populations.

Biodiversity benefits

The preparation and long term implementation of recovery plans for threatened species, populations and ecological communities contributes to, and highlights the importance of conserving all biodiversity. The conservation of biodiversity has a number of wider community benefits. These include:

- provision and maintenance of a range of ecosystem functions on which we and all other species depend;
- contributing to increased biological and ecological knowledge of species, communities, habitats and ecosystems;
- potential medical, economic, agricultural and industrial products; and
- cultural, aesthetic and spiritual values.

The conservation of Southern Bell Frog populations and the habitat in which they occur will also benefit other species that share the same habitat and have similar biology, particularly other frog species. This recovery plan will increase public awareness of the Southern Bell Frog and hence raise the profile of all threatened species. This, in turn, will lead to greater opportunities for the conservation of threatened species and increased protection of biodiversity.

I now invite you to make a written submission to the DEC regarding this draft recovery plan by 6th May 2005. Please refer to Appendix 2 for details on how to make a submission. Following consideration of comments the plan will be finalised by the DEC and submitted to the Director General and the Minister for the Environment.



SIMON A Y SMITH
Deputy Director General
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1 Introduction

The Southern Bell Frog (*Litoria raniformis*) has suffered a considerable reduction in abundance and distribution throughout New South Wales in recent years (Tyler 1993, Sadler and Pressey 1994, Mahony 1996, Osborne *et al.* 1996, Ehmann and White 1996). Once abundant along the Murray and Murrumbidgee Rivers and their tributaries from the Southern Tablelands to the South Australian border, the species is now only found in scattered locations throughout its former range.

The species is listed as “endangered” in New South Wales under the *Threatened Species Conservation Act*, 1995. It is also listed nationally as “vulnerable” under the *Environment Protection and Biodiversity Conservation Act*, 1999.

Suspected threats to the Southern Bell Frog include loss or fragmentation of habitat through draining of wetlands, altered flow regimes of the Murray and Murrumbidgee Rivers and their tributaries and prolonged periods of drought. Predation on eggs and tadpoles by introduced fish species, infection by pathogens, particularly Chytrid fungus and degradation of habitat from pollution, salinisation and chemical use are also suspected threats to the species.

Most of the known remaining populations of the Southern Bell Frog occur on private land. Therefore, all efforts to conserve the species must involve sympathetic management from the landholders. The intent of this Recovery Plan is to work cooperatively with landholders to protect the Southern Bell Frog from threats and ensure its continued existence in the wild.

2 Legislative Context

2.1 Commonwealth and State Legislation

2.1.1 *Environment Protection and Biodiversity Conservation Act 1999*

The Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) regulates actions that may result in a significant impact on nationally listed threatened species and ecological communities. It is an offence to undertake any such actions in areas under State or Territory jurisdiction, as well as on Commonwealth-owned areas, without obtaining prior approval from the Commonwealth Environment Minister. The Southern Bell Frog is listed as ‘vulnerable’ under the EPBC Act.

2.1.2 *Threatened Species Conservation Act 1995*

The NSW *Threatened Species Conservation Act* 1995 (TSC Act) provides for the protection and recovery of threatened species; the declaration of critical habitat for those species; the proper assessment of any action affecting threatened species, or their habitat; and the licensing of actions that are likely to result in harm to a threatened species or damage to its habitat. The Southern Bell Frog is listed as ‘endangered’ under the TSC Act.

2.1.3 *National Parks and Wildlife Act 1974*

The *National Parks and Wildlife Act* 1974 (NPW Act) provides for the reservation, protection and management of natural areas and the protection of native fauna and flora. It includes

provisions for conservation agreements with other landholders and provisions for licensing of scientific investigation of threatened species. The NPW Act has been amended with regard to threatened species by the TSC Act 1995. Any scientific investigation regarding the species, whether it occurs in or outside a National Park, must be licensed under the NPW Act.

2.1.4 *Environmental Planning and Assessment Act 1979*

Land use and development in NSW is subject to evaluation in accordance with the *Environmental Planning and Assessment Act 1979* (EP&A Act). Threatened species are to be taken into account by consent authorities when they are considering development applications under Part 4, and by determining authorities undertaking or approving activities under Part 5 of the Act. Under the *Western Lands Act 1901*, the Department of Infrastructure, Planning and Natural Resources may be the determining authority under the EP&A Act. The TSC Act amendments to the environmental assessment provisions of the EP&A Act require that consent and determining authorities consider relevant Recovery Plans when exercising a decision making function under Parts 4 and 5 of the EP&A Act. Clearing and development applications under consideration by Local Government and other public authorities, which are within the predicted range of the Southern Bell Frog and contain suitable habitat, will need to consider the impact of the proposal on the species.

2.1.5 *Native Vegetation Act 2003*

The *Native Vegetation Act 2003* (NV Act) replaced the *Native Vegetation Conservation Act 1997* (NVC Act). The NV Act has the following objectives:

- (a) to provide for , encourage and promote the management of native vegetation on a regional basis in the social, economic and environmental interests of the State,
- (b) to prevent broadscale clearing unless it leads to better environmental outcomes,
- (c) to protect native vegetation of high conservation value having regard to its contribution to such matters as water quality, biodiversity, or the prevention of salinity or land degradation,
- (d) to improve the condition of existing native vegetation, particularly where it has high conservation value, and
- (e) to encourage the revegetation of land, and the rehabilitation of land, with appropriate native vegetation,

in accordance with the principles of ecologically sustainable development.

Under the NV Act, native vegetation must not be cleared except in accordance with a development consent or a property vegetation plan (PVP) approved by the Minister in accordance with the Act. In determining whether to approve a PVP the Minister must have regard to Catchment Action Plans produced by Catchment Management Authorities. The Minister must not approve a PVP that proposes broadscale clearing of native vegetation unless the clearing will improve or maintain environmental outcomes.

2.2 *Recovery plan preparation*

The TSC Act provides a legislative framework to protect and encourage the recovery of threatened species, endangered populations and endangered ecological communities in NSW. Under this legislation the Director-General of the Department of Environment and Conservation (DEC) has a responsibility to prepare Recovery Plans for all species,

populations and ecological communities listed as endangered or vulnerable on the TSC Act schedules. Similarly, the EPBC Act requires the Commonwealth Minister for the Environment to ensure the preparation of a Recovery Plan for nationally listed species and communities or adopt plans prepared by others including those developed by State agencies. Both Acts include specific requirements for the matters to be addressed by Recovery Plans and the administrative process for preparing Recovery Plans.

This Recovery Plan has been prepared to satisfy the requirements of the TSC Act only and is the NSW State Recovery Plan for *Litoria raniformis*.

2.3 Recovery plan implementation

Public authorities, including councils, identified as responsible for the implementation of Recovery Plan actions must take all appropriate measures available to implement the actions for which they have agreed to be responsible. They are also required by the TSC Act to report on the measures taken to implement those actions. In addition, the Act specifies that public authorities must not make decisions that are inconsistent with the provisions of the Plan. Similarly, the EPBC Act specifies that a Commonwealth agency must not take any action that contravenes a Recovery Plan.

The public authority responsible for the implementation of this Recovery Plan is the Department of Environment and Conservation.

2.4 Critical Habitat

The TSC Act makes provision for the identification and declaration of Critical Habitat. Under the TSC Act, Critical Habitat may be identified for any endangered species, population or ecological community occurring on NSW lands. Once declared, it becomes an offence to damage Critical Habitat (unless the action is exempted under the provisions of the TSC Act) and a Species Impact Statement is mandatory for all developments and proposed activities that may affect declared Critical Habitat.

To date, Critical Habitat as defined by the TSC Act has not been declared for the Southern Bell Frog. The declaration of Critical Habitat in NSW is not considered to be a priority for the species, at this stage, as other mechanisms provide for its protection.

2.5 Key Threatening Processes

‘Predation by *Gambusia holbrooki* – The Plague Minnow’ is listed as a Key Threatening Process on Schedule 3 of the TSC Act. *G. holbrooki* predation on the tadpoles and spawn masses of a number of frog species, including the Green and Golden Bell Frog, *Litoria aurea*, a close relation of the Southern Bell Frog, is well known and has been demonstrated both in the field and under laboratory conditions (Morgan and Buttemer 1996, Webb and Joss 1997). A Threat Abatement Plan has been prepared for this Key Threatening Process.

In NSW, ‘Infection of frogs by amphibian chytrid, causing the disease chytridiomycosis’ is listed as a Key Threatening Process under schedule 3 of the TSC Act. The EPBC Act also lists “Infection of amphibians with chytrid fungus resulting in chytridiomycosis” as a Key Threatening Process. This disease is known to affect and cause death in the closely related

Green and Golden Bell Frog, *Litoria aurea* and is likely to also affect the Southern Bell Frog. The disease has been recognised as a serious infectious disease of amphibians on a global scale.

Other Key Threatening Processes listed under Schedule 3 of the TSC Act and that may affect the Southern Bell Frog include:

- *Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands*, which affects the availability and flooding regimes of habitat of the Southern Bell Frog;
- *Clearing of native vegetation*, which includes the removal of the understorey and groundcover that may provide shelter and refuge for the Southern Bell Frog; and
- *Human-caused climate change*, which may further alter flooding regimes and habitat availability of the Southern Bell Frog.

Under Schedule 6 of the *NSW Fisheries Management Act 1994* the following Key Threatening Processes have also been listed that may affect the Southern Bell Frog:

- The installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams;
- Degradation of native riparian vegetation along NSW waterways;
- The removal of large woody debris from waterways; and
- The introduction of fish to fresh waters within a river catchment outside their natural range.

Further details regarding Key Threatening Processes under the *NSW Fisheries Management Act 1994* can be obtained from NSW Fisheries or at www.fisheries.nsw.gov.au.

2.6 Environmental Assessment

The New South Wales *Environmental Planning and Assessment Act 1979* (EP&A Act) requires that consent and determining authorities, and the Director-General of DEC, as a concurrence authority, consider relevant Recovery Plans when exercising a decision-making function under Parts 4 and 5 of the EP&A Act. Decision-makers must consider known and potential habitat, biological and ecological factors and the regional significance of individual populations when determining a development application within the predicted range of the Southern Bell Frog.

Activities as defined under the EP&A Act require the approval of the Director-General. Any other action not requiring approval under the EP&A Act, and which is likely to have a significant impact on the Southern Bell Frog, will require a Section 91 Licence from the Director-General of DEC under the provisions of the TSC Act. Such a licence may be issued with or without conditions, or can be refused.

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) regulates actions that may result in a significant impact on nationally listed threatened species and ecological communities. It is an offence to undertake any such actions in areas under State or Territory jurisdiction, as well as on Commonwealth-owned areas, without obtaining prior approval from the Commonwealth Environment Minister. As the Southern

Bell Frog is listed nationally under the EPBC Act, any person proposing to undertake actions likely to have a significant impact on this species should refer the action to the Commonwealth Minister for the Environment for consideration. The Minister will then decide whether the action requires EPBC Act approval.

Administrative guidelines are available from Commonwealth Department of Environment and Heritage to assist proponents in determining whether their action is likely to have a significant impact. In cases where the action does not require EPBC Act approval, but will result in the death or injury of a Southern Bell Frog and the animal is in or on a Commonwealth area, a permit issued by the Commonwealth Minister under the EPBC Act will be required.

3 Current Conservation Status

The Southern Bell Frog (*Litoria raniformis*) is listed as ‘endangered’ in NSW under the TSC Act. It is also listed nationally as ‘vulnerable’ under the Commonwealth EPBC Act.

In South Australia and Tasmania it is also listed as ‘vulnerable’ and in Victoria it is listed as ‘endangered’ under their respective wildlife conservation acts.

4 Description and Taxonomy

Scientific Nomenclature:	<i>Litoria raniformis</i> (Kerferstein 1867)
Family:	Hylidae
Common Name:	Southern Bell Frog
Other Names:	Green or Warty Swamp Frog, Warty Frog, Growling Grass Frog.

The Southern Bell Frog is a member of the *Litoria aurea* complex (*sensu* Courtice and Grigg 1975) or Bellfrogs. The complex contains six described species, three of which occur in New South Wales including *Litoria aurea*, *Litoria castanea* and *Litoria raniformis*.

4.1 Description

4.1.1 Adult Frogs

The Southern Bell Frog is one of the largest frog species in Australia, reaching up to 104 mm in length, with females usually larger (60-104 mm) than males (55-65mm) (Barker *et al.* 1995, Tyler 1978, Tyler and Barrie 1996). Animals vary greatly in colour and pattern but are typically olive to bright emerald green, with irregular gold, brown, black or bronze spotting (Figure 1). The skin on their back and sides is warty and there is usually a pale green mid-dorsal stripe. The tympanum (eardrum) is distinct and a cream or often yellow stripe underlined by a dark brown stripe runs from the nostril, through the eye, above the tympanum and down the sides of the body to the groin as a dorso-lateral fold (Barker and Grigg 1977, Robinson 1993). Underneath, animals are white and coarsely granular, although during the breeding season males may become yellow or dark grey/black under the throat. The groin and posterior of the thighs are turquoise blue. Southern Bell Frogs lack webbing on their fingers but the toes are almost fully webbed. Toe discs are small and approximately equal in width to the digits. Animals possess small vomerine teeth that are attached to a bone in the roof of the mouth and are situated between the choanae (internal openings of the nostrils in the roof of

the mouth). These teeth are used for holding prey, which is then swallowed whole (Barker *et al.* 1995).

Males mostly call while floating in water among reeds between August and April (Robinson 1993). The call is a growling “waaah waaah waaah” that is similar to the sound of a distant motor boat or motorbike and is usually of about one second duration. When bellfrogs are initially picked up or handled they may also emit an anguished scream or “distress” call and often release large amounts of acrid mucous presumably as a protective mechanism against potential predators.

In general, Bellfrogs are largely aquatic and move overland mostly during prolonged periods of rain and localised flooding (Barker *et al.* 1995, Wassens, pers. comm.). However, animals have often been observed making large moves in dry conditions, possibly in response to habitat drying (S. Wassens, pers. comm.). The Southern Bell Frog is semi-aquatic and is well adapted for swimming, having a streamlined head, powerful hind legs, webbed toes and small toe pads. Although called “tree frogs” these animals seldom climb trees and have only very small adhesive pads on the fingers and toes (Barker *et al.* 1995). However, they do possess some features characteristic of a more terrestrial lifestyle. They have a capacity for rapid rehydration, with the ventral skin being specialised for water uptake and they excrete ammonia in the form of urea (Cree 1985). They are one of the few frogs that are known to be active by day and bask in sunlight, although basking is rare in hotter regions (S. Wassens, pers. comm.).

4.1.2 Similar Species

The Southern Bell Frog is similar in appearance to the Green and Golden Bell Frog (*Litoria aurea*) but may be distinguished by the following features. The dorsal skin of *L. raniformis* has a covering of large warts, tubercles and skin folds, while *L. aurea* has a smooth back (Cogger 2000). *L. raniformis* has a green mid-dorsal stripe, which is not present in *L. aurea*. *L. raniformis* also has more developed toe webbing than *L. aurea* and although both species have blue skin on the groin and posterior surface of the thighs, *L. raniformis* is less brilliant (Courtice and Grigg 1975).

L. castanea is also similar in appearance to *L. raniformis* but may be distinguished by the presence of large yellow spots in the groin and thigh, which gives *L. castanea* its common name as the Yellow-spotted Bell Frog.



Photo: D. Parker

Figure 1. Southern Bell Frog (*Litoria raniformis*)

4.1.3 Tadpoles

Tadpoles of the Southern Bell Frog can grow to a total length of 110mm but more commonly measure around 85-90mm. Their bodies are large and cylindrical, often dark in early stages of development but developing a translucent yellow body wall with shiny green pigment over the vertebral region, brain and abdomen. The sides of the body, over the gills and abdomen are opaque white with a copper sheen. Tailfins are deeply arched and similar in shape. The entire tail has a yellowish tinge with lightly pigmented venation on the fins (Anstis 2002).

Southern Bell Frog tadpoles usually hide amongst vegetation at the edges of large water bodies, where the water is shallower and warmer. Tadpoles cruise in the midwater to surface areas to feed but will dive down to deeper water if disturbed. Metamorphosis occurs in summer and autumn, with metamorphlings emerging from the water at approximately 25-34mm in length and closely resembling the adults in their colouring (Anstis 2002).

4.2 Taxonomic Significance

The taxonomy of the Southern Bell Frog, and in particular, its similarity to the Green and Golden Bell Frog (*Litoria aurea*) makes this species of considerable taxonomic interest. Conservation, management and research of the Southern Bell Frog may provide an insight into the requirements of not only this species but of the *L. aurea* complex in general and may assist in guiding the recovery of other Bellfrog species. Furthermore, the differences in geographical distribution between similar threatened bell frog species provides a potential insight into the adaptations of these frogs to various climatic conditions throughout their ranges, as well as the extent and impact of threats on various species within the complex.

5 Distribution

5.1 Current and Historic Distribution

The Southern Bell Frog formerly occurred in south-eastern South Australia, most of Victoria (except the western deserts and eastern alpine region), the ACT, southern NSW and northern and eastern Tasmania (Hero *et al.* 1991, Tyler 1997) (Figure 2). In New South Wales and the Australian Capital Territory, the species was distributed mainly along the Murray and Murrumbidgee Rivers and their tributaries, the southern slopes of the Monaro district and the central southern tablelands as far north as Tarana, near Bathurst (White and Pyke 1999).



Figure 2. The distribution of the Southern Bell Frog in Australia prior to recent declines (Cogger 2000).

Recent surveys for the Southern Bell Frog have been conducted throughout parts of its historic range. From these surveys it appears that the species has disappeared along parts of the Murray River, as well as most of the Murrumbidgee River, the south-west slopes and southern tableland localities (Figure 3). The only currently known populations for the species in New South Wales include Coleambally Irrigation Area and the Lowbidgee floodplain. Other areas where the species has been reported from during recent years but require further surveying include Lake Victoria and the Murray Irrigation Area, particularly around Wakool, Moulamein and Berrigan. The species had also been recorded in Cocoparra and Willandra National Parks prior to 1986 but has not been recorded in either of these parks since these records.

In other states the species has also declined. In the Australian Capital Territory and highland areas immediately to the north of Canberra it has disappeared. In the southeast of South Australia it has become scarce and has disappeared from several locations, although it still occurs at scattered locations in parts of the Murray River Valley. In Victoria there have been massive declines in the geographic range of the species, although some large populations still remain around metropolitan Melbourne and in regional Victoria (Tyler 1997, N. Clemann, pers. comm.). In Tasmania, its range has contracted in the north-west, central and southern parts of the state within the last 15 years (Tyler 1997), although further surveys are necessary before the post-decline distribution can be accurately depicted.

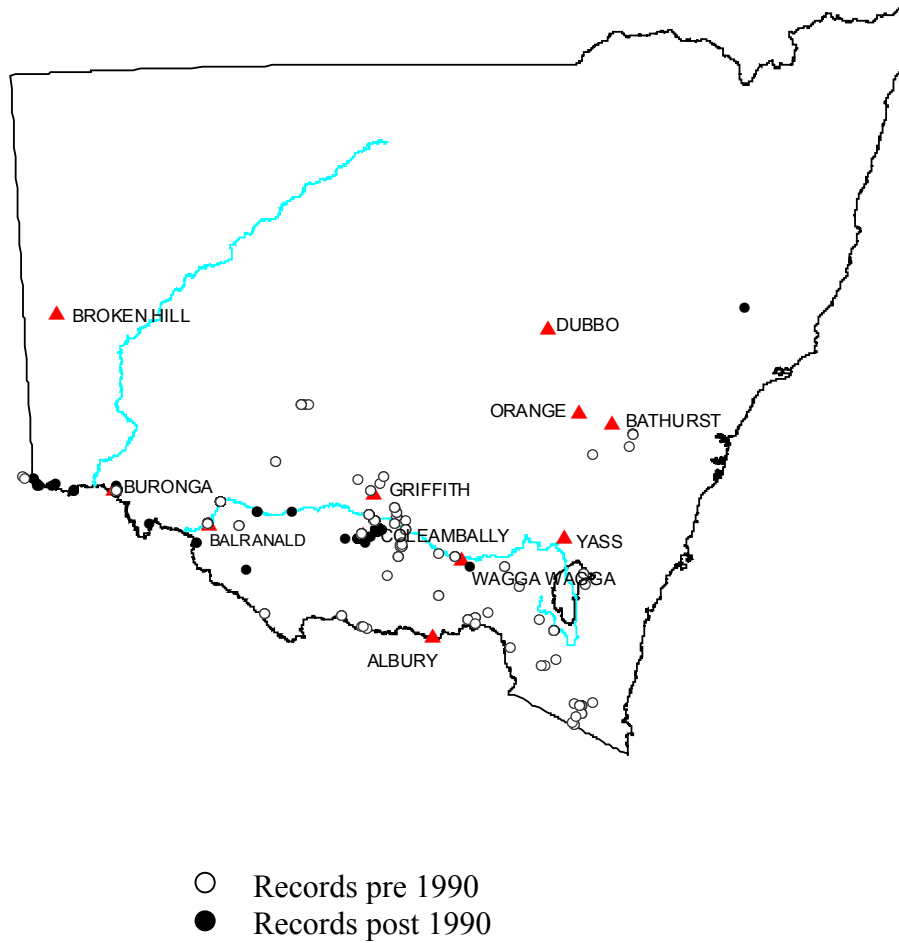


Figure 3. Distribution of the Southern Bell Frog (*Litoria raniformis*) in New South Wales (DEC Wildlife Atlas).

The decline of the Southern Bell Frog has been greatest in New South Wales, although other states have suffered some range contraction. Extensive land clearing, changes in land use, altered flooding regimes and inadequate floodplain management and widespread irrigation development have occurred in the historic range of the Southern Bell Frog. These activities may have impacted on the species' distribution over the past century. Potential habitat, both natural and artificial, still remains in the historic range of the species and may be supporting extant populations.

The Southern Bell Frog has been recorded in NSW from six Catchment Management Areas. These are Lower Murray Darling, Murrumbidgee, Murray, Lachlan, Central West and South East.

5.2 Tenure

The Southern Bell Frog has been recorded across a suite of land tenures including freehold, leasehold, Crown land, Department of Environment and Conservation estate, State Forests estate and Department of Infrastructure, Planning and Natural Resources (DIPNR) estate.

In the past, the species has been recorded from Willandra and Cocoparra National Parks. However, there have been no recent records in any conservation reserves in NSW. The species has also previously been recorded from Boomanoomana, Mulwala, Bondi, Berry Jerry, Buckingham, Euston and Lake Victoria State Forests.

6 Ecology

6.1 Life Cycle

Southern Bell Frogs generally breed between November and March, following local flooding and a marked rise in water levels, from rain or other sources, which triggers calling in breeding males. Breeding usually occurs in still or slow moving water. Most breeding sites located in recent surveys in NSW were overflow areas, for example, oxbows, billabongs or levee swamps, which were subject to excessive disturbance by grazing (sheep and cattle) or agricultural run-off (Ehmann and White 1996), and irrigated crops.

Females have been recorded laying up to almost 4000 eggs (Anstis 2002). Eggs are pigmented and contained within a floating jelly raft that eventually breaks up and sinks. Egg laying occurs within days of flooding and tadpoles hatch 2-4 days later. Metamorphosis of tadpoles generally takes around 3 months but may take up to 12 months in some circumstances (Anstis 2002, Pyke 2002) and metamorphs closely resemble the adults in colouration (Anstis 2002).

6.2 Diet

The diet of the Southern Bell Frog is varied and consists primarily of terrestrial invertebrates, including beetles, termites, cockroaches, moths, butterflies and various insect larvae (M. Christy, pers. comm). They are also known to prey on other frogs and younger frogs of their own species (Barker and Grigg 1977, Hero *et al.* 1991) as well as other vertebrates such as lizards, snakes and small fish (Martin and Littlejohn 1982). Southern Bell Frogs are considered to be a "sit-and-wait" predator (M. Christy, pers. comm). This means that they do not actively hunt for food but sit and wait for live prey to come into feeding range. They are also generally thought to be nocturnal predators (G. Pyke, pers. comm.).

6.3 Habitat

The Southern Bell Frog is usually found amongst emergent vegetation (Robinson 1993) such as typha, phragmites and eleocharis within or at the edges of still or slow-flowing water bodies such as lagoons, swamps, lakes, ponds, and farm dams (Figure 4). In the Lowbidgee Irrigation Area animals have been found in a series of small waterbodies, where they are thought to retreat to during dry periods (usually between January and August). During the wet season, when this area is flooded, these small waterbodies become linked to form a large,

continuous wetland, which is used by the frogs for breeding, tadpole habitat and metamorphosis (S. Wassens, pers. comm.). The Southern Bell Frog also commonly occurs in irrigation channels and crops in the Coleambally Irrigation Area (Figure 5). It is also common in lignum shrublands, black box and river red gum woodlands (S. Wassens, pers. comm.) and at the periphery of rivers in the southern parts of NSW. Apart from breeding and foraging habitat, refuge areas for this species may include soil cracks, fallen timber, debris and dense vegetation on low, frequently inundated floodplains (Cogger 2000, S. Wassens, pers. comm.).



Photo: M. LeBreton

Figure 4. Habitat of the Southern Bell Frog near Wentworth in NSW.

The habitat of the Southern Bell Frog is usually devoid of outcropping rock and the soil-type is mostly clays or well-watered sandy soils (Ehmann and White 1996). Vegetation types in which this species occurs include open grassland, open forest, and ephemeral and permanent non-saline marshes and swamps. Forest types include montane eucalypt forest, dry sclerophyll forest and river red gum forest along the Murray Valley, and wet sclerophyll forest in coastal Victoria (Ehmann and White 1996). Water edges may be steep banked (e.g. ditches and drains) but are more commonly gently graded with the edges containing some fringing plants. The Southern Bell Frog was formerly found at high altitudes, with the highest recorded elevation being 1300m (Osborne *et al.* 1996).

The Southern Bell Frog can readily colonise agricultural and moderate to higher rainfall pastoral lands provided that both permanent and ephemeral water sites are available with dense emergent or fringing vegetation (Ehmann and White 1996, S. Wassens, pers. comm.). The ability of metamorphs, sub-adults and adults to disperse to nearby areas during prolonged wet weather assists colonisation of new areas.



Photo: M. Bannerman

Figure 5. Southern Bell Frog habitat in rice crops in the Coleambally Irrigation Area of NSW.

6.4 Behaviour

During the day in summer the Southern Bell Frog is often found basking on grassy banks near water (Courtice and Grigg 1975). All members of the Bellfrog complex are known to bask in filtered sunlight, either under partly cloudy conditions or in deep vegetation (Ehmann and White 1996). The behaviour of the species during the cooler months is unknown. It has been speculated though that animals may hibernate in warm, moist areas including the mud at the bottom of ponds, under logs, rocks and debris or beneath thick vegetation (Ayers *et al.* 1996, G. Pyke, pers. comm., S. Wassens, pers. comm.). Recent radio-tracking of some individuals have shown that they overwinter under dense vegetation (S. Wassens, pers. comm.). Animals are also thought to be very mobile and may move considerable distances in a single night (S. Wassens, pers. comm.).

7 Current Ex-situ Programmes

There are no current captive breeding programs for the Southern Bell Frog in NSW and no populations exist in captivity in the state. Other states, however, have a number of captive populations held in various zoos and in the Amphibian Research Centre in Victoria.

8 Management Issues

8.1 Threats and Reasons for Decline

Causes of the decline of the Southern Bell Frog have not been fully investigated. However, factors that are under consideration include: habitat loss, fragmentation and degradation, altered flooding regimes of natural waterbodies, predation on eggs and tadpoles by

introduced fish, the effects of drought and salinisation, chemical pollution of waterbodies and infection by the amphibian chytrid fungus. In addition, the impact of foxes and feral cats on Southern Bell Frog populations is not certain and may also require further investigation.

8.1.1 Habitat loss and fragmentation

Habitat loss and fragmentation are considered to be the leading threat to existing Southern Bell Frog populations. Although the frogs inhabit a wide range of wetland types, the common feature of these wetlands is that they are large and continuous during the spring and summer when flooding connects both the permanent and ephemeral waterbodies. It has been suggested that Southern Bell Frogs utilise the permanent waterbodies as refuge during dry conditions and rapidly colonise and breed in ephemeral ponds during flooding events (S. Wassens, pers. comm.). The draining and infilling or, conversely, the flooding of both permanent and ephemeral wetlands, their vegetation and adjoining watercourses removes essential movement corridors, refuges and breeding habitat and displaces animals from their natural environment. Artificially irrigated areas and farm dams have replaced some habitat, however, these areas usually do not provide the shelter and foraging habitat also required by the species.

8.1.2 Habitat degradation

Habitat degradation is also considered to be a significant threat to Southern Bell Frog populations. Overgrazing by domestic livestock around the edges of wetlands disturbs significant habitat by destroying the surrounding vegetation and impacting on the quality of the water (Jansen and Healey 2003, Tyler 1997). The removal of aquatic vegetation removes significant refuge and shelter for tadpoles. Whilst the clearing of terrestrial vegetation, fallen timber and other ground debris around wetlands removes essential shelter for adult frogs (Ehmann and White 1996). These disturbances contribute to the degradation and/or loss of significant wetland habitat required by the Southern Bell Frog for breeding, foraging, shelter and movement.

8.1.3 Altered flooding regimes

The number of potential breeding sites along natural drainage systems have been reduced through local changes in land contours as a result of drainage earthworks. In addition, river regulation influences the timing, frequency and size of flooding episodes and reduces the likelihood that local flooding will fill billabongs and swamps, which is a trigger for breeding in this species. In some areas along the Murray River, breeding sites have also been lost as a result of low-lying depressions being filled to stop water from accumulating after rain. The filling of these depressions was carried out presumably to prevent build-ups of mosquitoes after flooding (Ehmann and White 1996).

8.1.4 Predation by introduced fish

The introduced Mosquito Fish or Plague Minnow (*Gambusia holbrooki*) has long been implicated in the decline of amphibian species, in particular members of the Bellfrog complex (Mahony 1996, Morgan and Buttemer 1996, Pyke and White 2000). *G. holbrooki* have been shown to prey on the eggs, fry and tadpoles of the Green and Golden Bell Frog (*L. aurea*) in controlled laboratory and field experiments (Morgan and Buttemer 1996, Pyke and

White 2000) and potentially may prey on the eggs and tadpoles of the Southern Bell Frog (Sadler and Pressey 1994, Ehmann and White 1996).

In New South Wales, *G. holbrooki* are widespread and common (McKay *et al.* 2001). They occur in rivers, creeks, lakes, swamps and drains (Cadwallader and Backhouse 1983) and are commonly found in slow-flowing areas at the edge of waterbodies up to depths of 10cm (Faragher and Lintermans 1997). In the NSW Rivers survey, 80 sites were surveyed for fish over four periods from 1994 to 1996 (Faragher and Lintermans 1997). *G. holbrooki* were recorded at 27 of these sites, being most widely distributed in the Darling and North Coast regions. The species was also recorded at four sites on the South Coast and two sites in the Murray region (Faragher and Lintermans 1997). They were found at altitudes ranging from 20 to 1120m, although the majority of sites were below 300m.

Although *G. holbrooki* are known to prey on the tadpoles of the Bellfrog complex and have a large overlap in range and habitat requirements with the complex, there is no direct evidence for *G. holbrooki* alone causing population declines in Bellfrogs (review in McKay *et al.* 2001). However, there is strong evidence to show that the impact of predation by *G. holbrooki* is higher in combination with factors, such as habitat structure and salinity, than without. Using controlled laboratory experiments, Morgan and Buttemer (1996) examined the predatory impact of *G. holbrooki* on the survival of *L. aurea* and *L. dentata* tadpoles. They found that *G. holbrooki* could significantly reduce tadpole survival of both species within 24 hours. However, they also found that when macrophytes were provided the effect was substantially reduced and the magnitude differed between the species. This indicated that habitat structure and tadpole behaviour was influencing the predatory impact. Similarly, Christy (2001) examined the cumulative effects of salinity and *G. holbrooki* on the survival of *L. aurea* tadpoles and found that an interaction between the two factors was far more detrimental to tadpoles than either factor in isolation.

Recent studies on the Southern Bell Frog in the Coleambally Irrigation Area and the Lowbidgee recorded four fish species in the area. These were European Carp (*Cyprinus carpio*), Mosquito Fish (*G. holbrooki*), Shortfin Eel (*Anguilla australis*) and Bony Bream (*Nematalosa erebi*). Preliminary analyses have shown no relationship between the presence of fish and Southern Bell Frog density at any of the study sites. This may be due to the high density of aquatic vegetation and aquatic invertebrates at the sites (S. Wassens, pers. comm.).

8.1.5 Drought

Extended periods of drought, although a natural phenomenon, may act in concert with other threats to contribute to the decline of the Southern Bell Frog. In the Southern Tablelands of NSW, the decline of the *L. aurea* complex coincided with a series of severe droughts between 1978 and 1980 (Osborne *et al.* 1996). Unusually dry weather may desiccate the eggs of frogs, dry up pools and delay breeding. During these droughts, many ponds in the region shrunk or disappeared and water quality may have deteriorated. Although the Southern Bell Frog has a strong dispersal ability, habitat fragmentation may have prevented colonisation of new areas. Similarly, the decline of the species in Victoria was coincident with drought (Tyler 1997).

Drought, however, is not the sole cause of the declines. Some of the sites in the ACT and surrounding areas from which the *L. aurea* complex disappeared did not become dry during the drought (e.g. sewerage treatment ponds, permanent ponds, and large pools and lakes)

(Osborne *et al.* 1996), indicating that other factors are also contributing to the decline of the species.

8.1.6 Chemical pollution of water bodies

Chemical substances such as herbicides or insecticides that may be either inadvertently or intentionally introduced into wetlands, farm dams, irrigated crops and other potential areas of habitat, may be lethal to frogs and tadpoles (Robertson *et al.* 1994, Ehmann and White 1996). In particular, herbicides that contain dispersants or surfactants and are used in and around waterbodies can affect spawn, tadpoles and frogs. Studies in Western Australia revealed acute toxicity to tadpoles of *Litoria moorei*, a close relative of the Southern Bell Frog, from the surfactants used in the herbicides rather than the active ingredient glyphosate (Bidwell and Gorrie 1995 in Tyler 1997). Given that most of the currently known NSW populations of the Southern Bell Frog are largely restricted to irrigated rice crops, the application of chemical substances to these crops pose a significant threat to the species and should be further investigated.

8.1.7 Salinisation

Salinisation of key water bodies, including some billabongs along the Murray River, has been considered a threat to the species (Ehmann and White 1996). Research has shown that Green and Golden Bell Frog (*L. aurea*) tadpoles are unable to survive in salinity levels higher than 8-9 ppt (seawater is 35 ppt) (Christy and Dickman 2002, G. Pyke, pers. comm.). Southern Bell Frog tadpoles are likely to be similarly affected. Salinity may be a concern for the species in the future as it may affect the survival of tadpoles and recruitment within populations in areas where rising salinity in water bodies is an issue.

8.1.8 Disease

Recent research has implicated a water borne fungal pathogen, *Batrachochytrium*, as the possible specific causative agent for some frog declines in Australia and elsewhere (Berger *et al.* 1998, 1999, Bosch *et al.* 2001). This agent is commonly known as the Chytrid fungus and is responsible for the disease Chytridiomycosis (Berger *et al.* 1999). The disease is thought to be a significant cause of death in some Australian frog species in recent years and is also found in a small proportion of apparently healthy frogs and tadpoles (Berger *et al.* 1999). Chytrid is widespread in frog populations in eastern Australia (Mahony and Werkman 2001) but it is not currently known whether it occurs in western New South Wales. Chytrid has recently been detected in the Southern Bell Frog and the closely related Green and Golden Bell Frog (Bishop 2000, Mahony and Werkman 2001), although there has been no evidence of the existence of the disease in the Coleambally population that is currently being studied.

8.1.9 Other Threats

The loss of frogs due to road kills is considered to be significant in some areas (Daly 1996, M. Robb, pers. comm.). Southern Bell Frogs frequently cross roads, particularly in rice growing areas, where rice bays and supply channels are adjacent to roads and major highways. The loss of animals as a result of road kills may be small compared with other causes of loss, however, the impact on a population may be significant where numbers are declining rapidly.

Predation by foxes and cats is also considered, by some, to be a threat to the species. However, there is currently no evidence to show that predation by the feral cat (*Felis catus*) is a threat to the Southern Bell Frog. Additionally, in the NSW Threat Abatement Plan for Predation by the Red Fox (*Vulpes vulpes*), the Southern Bell Frog is considered to be a species with a low sensitivity rating, which indicates that population impacts are unlikely to result from predation by the Red Fox.

8.2 Social and Economic Issues

8.2.1 Economic Considerations

The majority of locations from which the Southern Bell Frog has been recorded in NSW occur on areas of private land, where grazing and cropping present a threat to the species. This Recovery Plan does not propose the regulation of these activities. Rather, where the species occurs on private land, a cooperative approach to management is advocated. In addition, this Plan makes provision for incentive funding for landholders to protect Southern Bell Frog habitat. This suggests that the economic costs to landholders in the recovery of the species will be minimal.

Where Southern Bell Frogs are located on public land, the DEC will seek the assistance of the relevant government agencies in the conservation of the species. State Forests of NSW have, as a stated objective, the conservation of wildlife living in State Forests and the maintenance of biodiversity values. Prescriptions designed to protect the habitat of the Southern Bell Frog in State Forests have been developed by both State Forests and DEC and are currently being implemented by State Forests (see Section 8.3).

8.2.2 Social Considerations

The maintenance of biodiversity is becoming an increasingly significant social issue as today's society places a greater value on species, ecological communities and ecosystem function. Because of this change in priorities, environmental considerations now have equal standing to social and economic issues in the decision-making process of Government. From these changes society aims to reach certain goals from which they obtain benefits. Social benefits associated with the recovery of the threatened Southern Bell Frog include the sense of well being derived from the knowledge that the species is conserved for both current and future generations.

Other benefits that may result from the implementation of this Recovery Plan include increased public awareness and understanding of threatened species and the threats that affect them, as well as the benefits associated with the maintenance of biodiversity and sustainable ecosystems. Such benefits may include increased tourism, enhanced water quality and improved environmental function. The Southern Bell Frog and its habitat also provide aesthetic value for members of the public who have an interest in the natural environment.

Furthermore, the benefits gained from implementing specific actions, such as excluding stock from wetlands, not only protect Southern Bell Frog populations, but also allow the areas to regenerate. These areas may be of increased value to the landholder in the long term through added conservation value and the long term benefits of soil and water conservation

Submissions from the community regarding other likely social and economic consequences of implementing the actions in this Recovery Plan are welcome during the draft exhibition period.

8.3 Biodiversity Benefits

The native amphibian fauna of New South Wales has experienced severe and rapid decline in recent years and is a cause of serious concern for biodiversity conservation. In view of this decline, the biodiversity value of the remaining taxa, including the Southern Bell Frog, is significant and the conservation of any remaining amphibian species will assist with the maintenance of biodiversity.

The actions in this Recovery Plan will not only aid the Southern Bell Frog in its recovery, but also have benefits for biodiversity in general. Actions such as the long-term protection of natural wetlands and the control of predatory fish, particularly the Mosquito Fish (*Gambusia holbrooki*), will have benefits for a range of native species. In addition, surveys and ongoing monitoring of the Southern Bell Frog will generate data that will be useful in the management of other native species and their habitats.

There are a number of frog species that overlap in range with the Southern Bell Frog and therefore may benefit from the conservation of the Southern Bell Frog and its habitat. These species include the Barking Marsh Frog (*Limnodynastes fletcheri*), the Spotted Marsh Frog (*L. tasmaniensis*), the Giant Burrowing Frog (*L. interioris*), Peron's Tree Frog (*Litoria peronii*), the Eastern Sign-bearing Froglet (*Crinia parinsignifera*), the Common Eastern Froglet (*C. signifera*) and Sloan's Froglet (*C. sloanei*). Other threatened species that use similar wetland habitats and will also benefit from actions detailed in this Recovery Plan include the Blue-billed Duck (*Oxyura australis*), Freckled Duck (*Stictoneta naevosa*) and Australasian Bittern (*Botaurus poiciloptilus*). Habitat would also be provided for a number of other species, many of which may prey upon insect pests, thus benefiting surrounding pastures by keeping invertebrate pest numbers in check.

Moreover, the protection of Southern Bell Frog habitat along the Murray River may assist in the conservation of the aquatic ecological community in the natural drainage system of the Lower Murray River Catchment that is listed as endangered under Schedule 4 of the NSW Fisheries Management Act 1994.

Through awareness of the fate of the Southern Bell Frog, the profile of all threatened species will be raised in the general community. This in turn will lead to greater opportunities for the conservation of threatened species and increased protection of biodiversity.

8.4 Roles and Interests of Indigenous Communities

Indigenous communities involved in the region affected by this plan have not yet been identified. Implementation of recovery actions under this plan will include consideration of the role and interests of indigenous communities in the region.

9 Previous Actions Undertaken

9.1 Survey

The Frog and Tadpole Study (FATS) Group of NSW conducted surveys for Southern Bell Frogs in NSW between 1991 and 1996 as part of the “ENDFROG” project. This project was designed to collect baseline data on 25 species of endangered and rare frogs in New South Wales (Ehmann 1996). Southern Bell Frog surveys involved searches of historic and potential new sites during wet weather or flooding conditions within or near the known range of the species (Ehmann and White 1996). At night, sites were visited to listen for male choruses and to search for active animals by torchlight. Active frogs were also located in drives along roads during wet weather. During the day, suitable habitat for sheltering and basking frogs were examined. Breeding aggregations were recorded after heavy rains at Berrigan, Kyalite, Wakool and Moulamein in 1993 and at Howlong, Mulwala, Balranald, Wakool, Urana and Moulamein again in 1995. Southern Bell Frogs were also observed at Hay and Coleambally.

In 1998 and 1999, Jansen and Healey (2003) surveyed a number of wetlands on the floodplain of the Murrumbidgee River between Gundagai and Hay. No Southern Bell Frogs were located during these surveys despite six other species of frogs being identified.

A road-based survey for Southern Bell Frogs was conducted in the Coleambally Irrigation Area in February and March 2001 (Pyke unpub. data). A total distance of 253km was surveyed with Southern Bell Frogs being detected at 32 widely scattered sites. Another survey in the Coleambally Irrigation Area was conducted by the Australian Museum in November 2001. This survey involved road-based searches, spotlighting, call identification and tadpole counts. Adult Southern Bell Frogs and tadpoles were again found to be widespread on farms throughout the area.

Parts of the historic range of the Southern Bell Frog have been recently surveyed during various projects. These areas include the mid Murrumbidgee River from Gundagai to Hay, Willandra and Cocoparra National Parks, the Murrumbidgee and Coleambally Irrigation Areas, the Lowbidgee region, parts of the Murray River and parts of the Darling Anabranch from Lake Cawndilla to Wentworth.

Southern Bell Frogs, although previously recorded from the Murrumbidgee Irrigation Area, Cocoparra and Willandra National Parks and along most of the Murrumbidgee River, were no longer found in these areas. Small populations were found around Coleambally, the Lowbidgee, Lake Victoria and Wakool.

9.2 Research and Monitoring

A detailed review of the biology of the Southern Bell Frog across all states is currently being prepared by Dr Graham Pyke of the Australian Museum, who has extended his research program on the Green and Golden Bell Frog to include the Southern Bell Frog. The broad goals of this work are to determine what factors control the distribution and abundance of the Southern Bell Frog and how these factors operate. This information will be used to facilitate the recovery and management of the species, and to promote public awareness of this and other frog species. A survey of the historic range of the species, coupled with an assessment

of past and current threats, is expected to be part of the overall program and an assessment of the habitat requirements of the species is also expected to occur. Parts of this research program will be carried out in partnership with the Coleambally Irrigation Corporation (G. Pyke, pers. comm.).

A number of other research projects on the Southern Bell Frog are also currently being conducted in New South Wales. The majority of these projects are being carried out in the rice growing areas of the state, particularly in the Coleambally Irrigation Area. These projects include:

1. An investigation into the impacts of rice growing on the ecology of a Southern Bell Frog population by the Australian Museum (A. Tiwari, pers. comm., G. Pyke, pers. comm.);
2. A toxicological study to examine pesticide impacts on the survival of the Southern Bell Frog by CSIRO Land & Water, Adelaide (A. Tiwari, pers. comm.); and
3. A PhD project at Charles Sturt University examining the conservation biology of the Southern Bell Frog and investigating dispersal, spatial dynamics and habitat use by the species (S. Wassens, pers. comm.).

Research is also being conducted in other states. In South Australia, The Southern Bell Frog is being studied by Dr Harold Ehmann (National Parks and Wildlife). In Victoria research is being carried out by Gerry Marantelli (Amphibian Research Centre), Peter Robertson and Geoff Heard (Wildlife Profiles Pty Ltd), Dr Michael Scroggie (Department of Sustainability and Environment) and Heath Butler (Melbourne Zoo).

9.3 State Forests Surveys and Forestry Prescription

Prescriptions aimed at mitigating the impacts of forestry operations on the Southern Bell Frog have been jointly prepared by State Forests of NSW and the Department of Environment and Conservation (DEC). The adequacy of these prescriptions in protecting Southern Bell Frogs and their habitat within state forests will be subject to ongoing review and amendments will be made as required through negotiations between State Forests and DEC.

A targeted survey for the Southern Bell Frog was conducted in numerous state forests and other crown-timber lands in south-western NSW in 1994/1995 as part of a general threatened fauna species survey (Webster *et al.* unpubl., D. Leslie, pers. comm.). The species was recorded in a permanent lagoon vegetated with grasses (Poaceae) and sedges (Cyperaceae) in Euston State Forest and an opportunistic record was made at Lake Victoria State Forest (Webster *et al.* unpubl.).

In addition, surveys for the Green and Golden Bell Frog (*L. aurea*) were conducted by State Forests at 16 sites in eastern NSW (Lemckert 1996). Three of these sites were within the range of the Southern Bell Frog. However, neither the Southern Bell Frog nor the Green and Golden Bell Frog were found.

9.4 Frog Hygiene Protocol for the Control of Disease

To reduce the impact of disease in frogs within the State, DEC has prepared a “Hygiene Protocol for the Control of Disease in Frogs” (NSW NPWS 2001). This protocol provides

workable strategies to reduce disease-causing pathogens being transferred within and between wild populations of frogs and assists with the proper identification and management of sick and dead frogs in captivity and the wild.

The Hygiene Protocol has been implemented by frog study and interest groups and researchers in an effort to limit the spread of disease between and within populations. Frog hygiene protocols must continue to be adhered to in order to ensure that disease-free populations are not inadvertently infected during the course of further research. A copy of the protocols can be obtained from all DEC offices and are also available on the NPWS website (www.nationalparks.nsw.gov.au).

At present, investigations into the development of monoclonal antibody techniques for the field detection of frogs infected with Chytrid fungus are being conducted (R. Haering, M. Mahony, L. Berger, pers. comms., NSW NPWS 2002). Such a technique would be beneficial for detecting the presence of the fungus in Southern Bell Frog populations in the field.

9.5 Community Liaison

An information brochure and a species profile of the Southern Bell Frog have been made available to landholders in the south west of NSW (Appendices 1a and 1b). The brochures are available from the Department of Environment and Conservation, the Department of Infrastructure, Planning and Natural Resources and the Murray Darling Basin Commission. These brochures have prompted a number of people to ring DEC and report sightings of the Southern Bell Frog. In addition, DEC has produced a “Wildlife Management Manual for the Riverine Plains” which has a species profile for the Southern Bell Frog. This manual has been made available to landholders in the Riverina region.

10 Species Ability to Recover

The Southern Bell Frog is highly fecund and has an excellent ability to disperse and colonise where suitable habitat is available (Ehmann and White 1996). Therefore, the species has a high potential of recovering and being downlisted in the long term, provided remaining habitat and wetlands are protected and threats minimised. Furthermore, a better understanding of the species ecology and habitat requirements will enable populations to be appropriately managed, which will enhance the species’ chances of survival and assist in its recovery.

Provided the recovery actions are implemented and a precautionary approach is taken to management of the species, the chances of the Southern Bell Frog persisting in the wild should be improved.

11 Recovery Objectives and Performance Criteria

11.1 Objectives of the Recovery Plan

The overall aim of this Recovery Plan is to promote the recovery of the Southern Bell Frog throughout New South Wales.

Specific objectives of this Recovery Plan are to:

- 1) determine the current range and distribution of the Southern Bell Frog in NSW and determine the extent of decline throughout its range in the state;
- 2) improve our knowledge and understanding of the species' biology, ecology, genetics and causes of decline;
- 3) identify and alleviate, where possible, any current or potential threats to the species;
- 4) protect and monitor populations; and
- 5) raise awareness of the conservation significance of the Southern Bell Frog and involve the community in the recovery program.

11.2 Recovery Performance Criteria

Recovery criteria for the Southern Bell Frog are that:

- 1) the current range, distribution and extent of decline of the species in NSW is determined;
- 2) the biology and ecology of the species is better understood;
- 3) genetic differences or similarities between separate populations are determined;
- 4) threats and causes of decline are identified and, where possible, alleviated;
- 5) populations are protected and regularly monitored;
- 6) the community is more aware of the species and involved in recovery actions.

12 Recovery Actions

12.1 Action 1 – Survey of Historic Range

Surveys will be conducted in areas throughout the historic range of the Southern Bell Frog that have not recently been surveyed for the species. These areas will include the Murray River from Albury to the South Australia border, as well as its tributaries, particularly throughout the Murray Irrigation Area, Southern Tableland localities and other areas where the species is likely to persist.

To assist in locating extant populations, the public will be informed of searches and encouraged to contact the DEC with suspected sightings. Reported sightings may assist in guiding survey efforts prior to surveys being conducted.

In addition to surveys, site-specific habitat characteristics and current or potential threats will be recorded from each survey location and from currently known sites.

Outcome

The current range, distribution and abundance of the species in NSW are clarified. General habitat characteristics and threats to populations are identified, which will assist in guiding management decisions. Suitable populations for further management and/or monitoring will also be identified.

Agency responsible for implementation

Department of Environment and Conservation

12.2 Action 2 – Habitat Protection

Loss and/or degradation of Southern Bell Frog habitat has been a major factor in the decline of the species. The protection of suitable habitat, whether natural or artificial, is required to prevent further loss. This action will include the identification and protection of both permanent and ephemeral waterbodies as well as terrestrial habitat that provides shelter for the animals.

The DEC will liaise with private landowners to secure sympathetic management and protection of Southern Bell Frog habitat where it occurs on their land. The DEC will also liaise with relevant councils to ensure adequate protection of habitat for the species where it occurs on land owned or managed by councils and will provide advice to DIPNR regarding adequate environmental flows for the protection of Southern Bell Frog habitat.

In addition, DEC will regularly liaise with SFNSW to ensure that the prescriptions negotiated between SF and DEC are providing adequate protection for Southern Bell Frogs and their habitats within state forests during harvesting operations.

Outcome

Southern Bell Frog habitat, both natural and artificial, on private and public lands is protected.

Agency responsible for implementation

Department of Environment and Conservation

12.3 Action 3 – Habitat Management and Monitoring

To ensure that current populations of the Southern Bell Frog do not decline, habitat management and monitoring will occur at a number of Southern Bell Frog sites. The adaptive management and monitoring of these sites will provide valuable information that will enable further sites to be managed appropriately. Sites will be selected based on the information gained from recent and proposed surveys. At least five sites will be protected through appropriate management measures within 5 years from the commencement of this Recovery Plan. Management and monitoring of these sites will only occur with the consent of the relevant landholders.

Management will be aimed at maintaining or enhancing shelter, foraging and breeding habitat. This may include but is not limited to the exclusion of stock from wetlands, wetland regeneration and weed removal, alterations to flooding and draining regimes (to ensure adequate water levels and fluctuations), removal of introduced fish from waterbodies, signage and fencing of roadside habitats and measures to minimise chemicals from entering waterbodies. The DEC understands that the appropriate management of sites will depend upon the circumstances and preferences of individual landowners.

The managed sites will be monitored regularly to assess the success or otherwise of the management techniques. These techniques will be adaptive in order to enable the most appropriate management regime to be developed.

Outcome

Successful management techniques for the adequate protection of Southern Bell Frog populations are identified and selected Southern Bell Frog populations and their habitats are appropriately protected.

Agency responsible for implementation

Department of Environment and Conservation

12.4 Action 4 – Monitoring

Monitoring of Southern Bell Frog populations throughout its range will assist in determining trends in the decline of the species and in identifying further populations that require active management.

Monitoring of populations will be undertaken regularly at an appropriate time of the year. A strategic and systematic monitoring regime will be developed that will be used across all sites

and will enable the collection of comparative data. As well, any changes in habitat and threats to each site will be recorded.

DEC will liaise with relevant Irrigation Corporations, DIPNR and Murray Darling Basin Commission regarding monitoring in their respective areas. Where possible, the DEC will also seek volunteers to assist in the monitoring. This will not only reduce monitoring costs but also promote an awareness and understanding of the species amongst the local communities and encourage local frog and wetland conservation groups to assist in recovery actions.

Outcome

A systematic and strategic monitoring system is developed and Southern Bell Frog populations are regularly monitored throughout the state, which will enable the early identification of further population declines, should they occur.

Agency responsible for implementation

Department of Environment and Conservation

12.5 Action 5 – Wetland Protection

Wetland loss is likely to have been a major factor in the decline of the Southern Bell Frog and many other frog species. Therefore, wetland management and protection is essential for the recovery of the Southern Bell Frog. To prevent further decline of the species, no loss of natural wetlands, either permanent or ephemeral, known to be occupied or used by the Southern Bell Frog should occur. In addition, no further loss of natural wetlands throughout the range of the species in NSW should occur, except where no net loss of wetland habitat can be demonstrated.

These actions are consistent with the NSW Wetlands Management Policy (1996) which requires the ecologically sustainable use, management and conservation of wetlands in NSW for the benefit of present and future generations. The NSW Wetlands Management Policy (1996) adopts nine principles that aim to minimise any further loss or degradation of wetlands and, where possible, restore degraded wetlands. This policy is consistent with the objectives of the *Water Management Act 2000*.

DEC will actively liaise with key State and Commonwealth agencies and committees responsible for implementing the Water Reform process. DEC will advise on the current status and habitat requirements of the Southern Bell Frog in NSW in order to ensure direct environmental benefits for the species.

Outcome

Natural wetlands and Southern Bell Frog habitat are protected from further losses.

Agency responsible for implementation

This action does not require any public authority to undertake a specific task but rather, establishes a principle that should be adhered to in relation to proposals to destroy wetland areas within the range of the Southern Bell Frog.

12.6 Action 6 – Scientific Research

Presently there is very little known about the Southern Bell Frog. A number of key areas are currently being investigated (see Section 7). However, further studies are still required into the biology and ecology of the species, habitat requirements, dispersal and movement patterns, key threats, causes of decline and conservation biology. Genetic research is also vital, particularly with regard to comparisons between populations and stronghold areas.

Experimental research into identifying causes of population declines may assist in halting the decline of this species. Emphasis should be placed on identifying lethal, sublethal, interactive and cumulative impacts of major potential threatening processes on the species. Studies to investigate the impact of introduced fish species, including *G. holbrooki* on the Southern Bell Frog should be developed in conjunction with those being conducted under the draft Threat Abatement Plan for Predation by *Gambusia holbrooki*.

The DEC will strongly encourage and support the continuation of current research and the development of further research on the Southern Bell Frog by the Australian Museum, academic institutions and other relevant government organisations. These research institutions will be responsible for communicating their research results with other institutions and with DEC. The DEC may also provide funding to assist post-graduate study in key areas of research.

Outcome

Overall knowledge and understanding of many aspects of Southern Bell Frog ecology and their decline is improved. A better understanding of the impacts of threats on the species in general and on individual populations is achieved and genetically isolated populations are identified. These outcomes will guide conservation and management actions and benefit the species in the long term.

Agency responsible for implementation

Department of Environment and Conservation

12.7 Action 7 – Community Education

The Southern Bell Frog is poorly recognised by the general community, despite its close relationship and resemblance to the very well known Green and Golden Bell Frog. Thus, there is a need to promote this species and raise the community's awareness and understanding of it. In order to do this, the DEC will seek to jointly undertake or support a number of actions with researchers and other organisations to promote the species. These actions may involve the use of print and radio media, community presentations, the distribution of brochures or newsletters, encouragement and training of interest groups to assist in monitoring, the erection of signs in areas of significant frog habitat and liaison with various government and non-government agencies to assist in their understanding of the species.

As the Southern Bell Frog occurs predominantly on private and leasehold land and is well adapted to disturbed habitats, such as farm dams, landholders can play a key role in the conservation of this species. DEC will encourage interested landholders to become involved in the conservation of the species through the appropriate recovery actions.

Outcome

Community awareness of and support for the conservation of the Southern Bell Frog is enhanced.

Agency responsible for implementation

Department of Environment and Conservation

12.8 Action 8 – *Gambusia holbrooki* control

Predation by *Gambusia holbrooki* on Southern Bell Frog tadpoles may be a significant threat to the species. Therefore, removal of *G. holbrooki* from infested sites and management of uninfested sites to prevent invasion by *G. holbrooki* may prove to be a key recovery action. This recovery plan and the draft Threat Abatement Plan (TAP) for ‘Predation by *Gambusia holbrooki* – The Plague Minnow’ will work in tandem to determine and, if necessary, minimise the impact of *G. holbrooki* on the Southern Bell Frog.

The draft Threat Abatement Plan for ‘Predation by *Gambusia holbrooki* – The Plague Minnow’ outlines a number of actions aimed at ameliorating the impacts of *G. holbrooki* on threatened frog species. Actions that will be undertaken jointly through the TAP and this recovery plan include surveys to determine the presence or absence of *G. holbrooki* in Southern Bell Frog habitat; removal of *G. holbrooki* at selected Southern Bell Frog sites and the monitoring of these sites to determine the response of the frogs to this action.

Selection of sites for the removal of *G. holbrooki* and subsequent monitoring will be based on site characteristics, suitability and landholder consent. Assistance will be sought from landholders and the community for the monitoring of populations.

Outcome

Gambusia will be removed from selected Southern Bell Frog habitats, which may reduce the impact of *G. holbrooki* on Southern Bell Frog populations.

Agency responsible for implementation

Department of Environment and Conservation

12.9 Action 9 – Disease Control

The spread of disease, particularly, Chytrid fungus, through frog populations could be detrimental to the survival of the species and all efforts to control the spread should be undertaken. DEC requires all recovery actions for the Southern Bell Frog to be implemented in accordance with measures outlined in the DEC Frog Hygiene Protocols. DEC will ensure

that copies of the protocol are distributed to public authorities, researchers, consultants and other groups or individuals implementing specific recovery actions or conducting research or surveys on the species. All relevant agencies and researchers are expected to be responsible for the implementation of the frog hygiene protocols to ensure that the potential for spread of the disease is minimised.

Outcome

The potential for the spread of disease between and within Southern Bell Frog populations is minimised.

Agency responsible for implementation

Department of Environment and Conservation

12.10 Action 10 - Recovery Plan Co-ordination

Effective coordination of this plan is essential to ensure its implementation is conducted in a timely, cost-effective and efficient manner. Coordination of this plan will involve liaison with other recovery programs to ensure that actions do not adversely impact upon other threatened species. Coordination will also involve effective liaison with relevant NSW, interstate and Commonwealth government agencies, landholders and other stakeholders.

Outcome:

The Recovery Plan is implemented in an efficient and coordinated manner to achieve the stated objectives.

Agency responsible for implementation:

Department of Environment and Conservation

13 Alternative Management Strategies

This section considers alternative options for the recovery of the Southern Bell Frog and reasons for their exclusion as recovery actions in this plan.

13.1 Option 1. No management action taken

As this species is abundant in some areas within its range, it could be argued that there is no requirement for 'recovery' actions for the Southern Bell Frog. However, in NSW the Southern Bell Frog has suffered a considerable reduction in abundance and distribution in recent years throughout its range and has disappeared from some areas where it was once abundant. Although several potential causes of the decline of Southern Bell Frog distribution and abundance have been identified, no definitive supporting evidence has been provided, and the relative contributions of these potential causes to the decline remain unknown. Failure to undertake actions to manage the species, identify the causes of decline and address them is likely to result in the continued decline and eventual extinction of the species. Therefore, this approach is not considered appropriate.

13.2 Option 2. Establish a Captive Breeding Population

The establishment of a captive breeding population of the Southern Bell Frog would provide insurance against the loss of the species in the wild. The establishment of a captive colony that is representative of the species in the wild would require considerable resources and time that are not available at this stage. At present, more cost-effective and practical actions are available to promote the recovery of the species without the need to establish an ex-situ breeding population.

13.3 Option 3. Habitat creation

The creation of artificial habitat for the Southern Bell Frog would provide extra habitat for the species and enable it to expand its range, either naturally or through translocation or reintroduction. The development and enhancement of habitat for the Southern Bell Frog may be possible given that the species has been found in habitats that are highly disturbed by human activities and, in some cases, completely artificial (Pyke 2002). Like the closely related Green and Golden Bell Frog, this species may be adapted to a natural disturbance regime, which may be possible to replicate (Pyke 2002).

However, the creation of habitat, introduction of artificial disturbances and translocation of the species are not considered appropriate actions at this stage for a number of reasons. First, there is currently sufficient habitat for the species to be protected in-situ and no identified need to create habitat and/or translocate the species to new sites. Second, there are currently no definitive guidelines for the creation of suitable Southern Bell Frog habitat. And, finally, as many of the threats acting on the species have not yet been quantified or ameliorated, the creation of habitat may prove to be a costly yet ineffective action in protecting the species. For these reasons the creation of artificial habitat is not considered to be an appropriate action within this plan.

13.4 Option 4. Declaration of Critical Habitat

Declaration of critical habitat for the Southern Bell Frog would provide added protection for the species and its habitat. However, the Southern Bell Frog is thought to be a generalist species that inhabits a wide range of environments. Habitat requirements have not been defined for the species and the identification of critical habitat would therefore be difficult and is not considered to be a priority at this stage.

14 Preparation details

This recovery plan was prepared by Melanie Bannerman, Threatened Species Officer and Robyn Molsher of the Threatened Species Unit, Department of Environment and Conservation, Dubbo.

14.1 Date of last amendment

No amendments have been made to date.

14.2 Review

This Recovery Plan and the conservation status of the Southern Bell Frog will be reviewed by DEC within five years of the date of publication. In evaluating the success or otherwise of the Recovery Plan, DEC will liaise with other relevant stakeholders including the Commonwealth Department of Environment and Heritage, State Forests NSW and the relevant landholders of the properties where the Southern Bell Frog occurs.

Table 1: Costing Table

Action No:	Description	Priority	Estimated Cost/yr					Total Cost	Responsible party/funding source	In-kind	Cash
			Year 1	Year 2	Year 3	Year 4	Year 5				
10.1	Surveys of historic range	1	\$36,000					\$36,000	DEC		\$36,000
10.2	Habitat Protection	1	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	DEC	Ψ	
10.3	Habitat Management										
	i. fencing	1	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$15,000	DEC		\$15,000
	ii. regeneration	1	\$5,000		\$5,000			\$10,000	DEC		\$10,000
10.4	Monitoring:										
	i. Lake Victoria	1	\$3,000	\$9,000	\$9,000	\$9,000	\$9,000	\$39,000	DEC		\$39,000
	ii. Lowbidgee	1	\$3,000	\$9,000	\$9,000	\$9,000	\$9,000	\$39,000	DEC		\$39,000
	iii. Coleambally	1	\$3,000	\$9,000	\$9,000	\$9,000	\$9,000	\$39,000	DEC		\$39,000
	iv. Other	1		\$3,000	\$10,800	\$21,600	\$21,600	\$57,000	DEC		\$57,000
10.5	Wetland protection	1	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	DEC	Ψ	
10.6	Scientific research	1	\$10,000	\$10,000	\$10,000			\$30,000	DEC		\$30,000
10.7	Community education:										
	i. brochures/newsletters	1	\$750	\$750	\$750	\$750	\$750	\$3,750	DEC		\$3,750
	ii. media releases	2	\$350		\$350		\$350	\$1,050	DEC		\$1,050
	iii. community liaison	2	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	DEC		Ψ
	iv. signage	2	\$600	\$600	\$600			\$1,800	DEC		\$1,800
10.8	Gambusia control	1		\$6,000	\$5,000			\$11,000			\$11,000
	Monitoring	1		\$2,000	\$8,500	\$10,000	\$7,500	\$28,000	DEC		\$28,000
10.9	Disease control	1	Ψ	Ψ	Ψ	Ψ	Ψ	Ψ	DEC	Ψ	
10.10	Recovery Plan Coordination	1	\$1,750	\$1,750	\$1,750	\$1,750	\$1,750	\$8,750	DEC	\$8,750	
Total			\$66,450	\$54,100	\$72,750	\$64,100	\$61,950	\$319,350		\$8,750	\$310,600

Priority ratings are: 1- Action critical to meeting plan objectives, 2- Action contributing to meeting plan objectives, 3-Desirable, but not essential action.

'In-Kind' Funds represent salary component of permanent staff and current resources.

'Cash' Funds represent the salary component for temporary staff and other costs such as the purchasing of survey and laboratory equipment.

Ψ No direct cost as action is liaison

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Appendix 1a: Southern Bell Frog Flyer



HAVE YOU SEEN THE SOUTHERN BELL FROG?



Photo M. LeBreton

The Southern Bell Frog (*Litoria raniformis*) is a large frog reaching up to 85 mm in length and is often found in bulrushes and emergent vegetation in or at the edges of permanent water. Lakes, dams and ponds may all provide suitable habitat. This species feeds on insects at night and basks during the day, often on grassy banks.

The Southern Bell Frog was widespread and abundant twenty years ago but is now a threatened species in NSW, that is, a species at risk of extinction. The species was formerly distributed along the Murray and Murrumbidgee Rivers and their tributaries. As well it was recorded from the southern slopes, and the central southern highlands. The species has now undergone serious decline and become extinct in some areas. Its present distribution is uncertain. Possible threats to this species include the destruction of habitat (through clearing of wetland vegetation, trampling by grazing animals, alteration of flood regimes by weirs and channels, clearing of fallen timber), predation on eggs and tadpoles by exotic fish species, pesticides and increased salinity.

If you see a Southern Bell Frog please contact your nearest NPWS Office, or Robyn Molsher (Southern Bell Frog Recovery Plan Coordinator) at NPWS Dubbo on 02 688 35342. If possible please take a photo of the frog and record location, time and date that it was seen.

January 2000

Appendix 1b: Southern Bell Frog Profile Sheet

THREATENED SPECIES INFORMATION



The Southern Bell Frog

Litoria raniformis Keferstein, 1867

Conservation status

The Southern Bell Frog *Litoria raniformis* is listed as an **endangered species** on Schedule 1 of the New South Wales *Threatened Species Conservation Act 1995* (TSC Act). It is also listed as **vulnerable** on the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and as endangered in the IUCN (2000) Red List of Threatened Species.

Description

The Southern Bell Frog is one of the largest frog species in Australia with females reaching up to 100mm in length and males up to 70mm. Animals vary greatly in colouration but may be olive to bright green above with irregular gold or bronze spotting. The skin is often warty and there is a pale green mid-dorsal stripe. There is also a cream stripe underlined by a black or dark brown stripe that runs from the nostril, through the eye, above the eardrum and down the sides of the body to the groin. The belly is white and the groin and posterior of the thighs are turquoise blue. Fingers lack webbing but toes are almost fully webbed and the finger and toe discs are equal in width to the digits (Barker *et al.*, 1995). The call of the Southern Bell Frog is a growling "waaah, waaah, waaah" that has been described as being similar to a motorbike in the distance.

Tadpoles are very difficult to identify but are usually large and translucent with darker areas over their brain, abdomen and vertebral region. Tails have a yellowish tinge with lightly pigmented venation (Anstis, 2002).

Distribution

The Southern Bell Frog occurs across a number of states including South Australia, Victoria, the ACT, NSW and Tasmania. In NSW the species is found in scattered locations throughout the Murray River Valley and the Murrumbidgee Rivers including the Coleambally Irrigation Area, the Lowbidgee floodplain and Lake Victoria.

March 2003

Recorded occurrences in conservation reserves

The Southern Bell Frog has been previously recorded in Willandra and Cocoparra National Parks. However, there have been no recent records of the species in conservation reserves in NSW.



Southern Bell Frog
M. LeBreton



Southern Bell Frog habitat
M. LeBreton

Habitat

The Southern Bell Frog is usually found amongst emergent vegetation within or at the edges of still or slow-flowing waterbodies. Animals have been found in both natural and artificial waterbodies including lagoons, swamps, lakes, ponds, farm dams, inundated floodplains, irrigation channels and flooded rice crops.

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Ecology

Southern Bell Frog breeding usually occurs in spring or summer after local rain events and flooding. Egg laying occurs within days of flooding and hatch 2-4 days afterwards. Tadpoles hide amongst vegetation at the edges of large water bodies where the water is shallower and warmer. They usually cruise in the midwater or surface areas where they feed on algae and sediment and dive down to deeper water when disturbed. Tadpoles may take between 3 and 12 months to develop or metamorphose into frogs (Anstis, 2002; Pyke, pers. comm.) and emerge from the water at around 30mm in length and closely resembling the adult in their colouring (Anstis, 2002).

The diet of the Southern Bell Frog is varied and consists primarily of terrestrial invertebrates including beetles, termites, cockroaches, moth and butterfly larvae and adults as well as other small frogs (M. Christy, pers. comm.; Barker and Grigg, 1977). The species forages at night and is a sit-and-wait predator (G. Pyke, pers. comm.).

Threats

There is one Key Threatening Process that is relevant to the Southern Bell Frog:

- Predation by *Gambusia holbrooki* – The Plague Minnow

Exotic fish including *Gambusia holbrooki* are known to prey on frog's eggs and tadpoles (Morgan and Buttemer, 1996) and is a potential threat to the Southern Bell Frog. A draft Threat Abatement Plan is currently being prepared for the above Key Threatening Process.

Other threats to the Southern Bell Frog include:

- loss, fragmentation or degradation of wetland habitat through altered flooding regimes and regulated river flows, clearing, cropping, grazing, salinisation and weed invasion;
- adverse impacts from development and/or agricultural activities, including physical disturbance, altered flooding regimes, runoff, drift or direct application of pesticides and other chemicals;
- possible infection from pathogens including the Chytrid fungus and;
- road kills.

Management

Management of the Southern Bell Frog should attempt to:

- protect populations and minimise habitat loss and/or degradation from direct or indirect human disturbance;
- manage and monitor selected populations;
- remove exotic fish species in Southern Bell Frog habitat;
- control the spread of pathogens within and between populations and;
- minimise road kills where possible.

Recovery Plans

A Recovery Plan is currently being prepared for the Southern Bell Frog.

For further information or to report any new sightings of the Southern Bell Frog contact:

NSW National Parks and Wildlife Service Western Directorate Threatened Species Unit, PO Box 2111, Dubbo NSW 2830 or telephone 6883 5342.

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Thankyou to Michelle Christy and Graham Pyke for their advice regarding the species.

IMPORTANT DISCLAIMER

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March 2003

Appendix 2: Making a submission on this Draft Recovery Plan

You are invited to make a written submission to the DEC regarding this draft recovery plan. To make your submission as effective as possible, please:

- refer to the section or action of the plan you wish to address;
- briefly explain the reasons for your comments;
- provide source information or examples where possible; and
- provide your name and address to enable receipt of your submission to be acknowledged.

The DEC will consider all written submissions received during the period of public exhibition and must provide a summary report of those submissions to the Minister for the Environment prior to final approval of this recovery plan.

Please note, that for the purposes of the NSW *Privacy and Personal Information Protection Act 1998* any comments on this draft recovery plan, including your personal details, will be a matter of public record and will be stored in the DEC records system. Following approval of the plan by the Minister, copies of all submissions, unless marked “confidential”, will be available, by arrangement, for inspection at the DEC office responsible for the preparation of the recovery plan.

Should you not wish to have your personal details disclosed to members of the public once the recovery plan has been adopted, please indicate below that you wish your personal details to remain confidential to DEC and not available for public access. Further information on the *Privacy and Personal Information Protection Act 1998* may be obtained from any office of the DEC or from the website: www.environment.nsw.gov.au

Submissions should be received no later than the advertised date. Submissions should be addressed to:

The Director General
Department of Environment and Conservation (NSW)
c/- Southern Bell Frog Recovery Plan Coordinator
Threatened Species Unit
PO Box 2111,
Dubbo NSW 2830
Ph: (02) 6883 5342



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