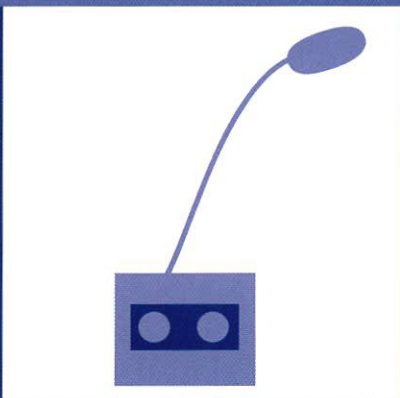
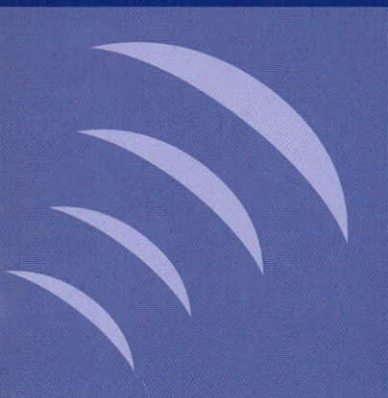


Frog Census

Community monitoring of water quality and habitat condition in South Australia using frogs as indicators



FROG CENSUS 2001

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and habitat condition in South Australia using frogs
as indicators



Government
of South Australia

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The media again promoted the FROG CENSUS, through various channels on television and radio, and in newspapers. Without their support, many participants and the wider public would not have been aware of the program.

Thanks also to those people who kindly gave their permission for the use of their photographs on the web page and in the discussion section of this document.

Thanks to Waterwatch for forwarding inquiries about the FROG CENSUS to us.

Once again, the Adelaide Zoo Education Department was supportive of the FROG CENSUS and promoted it as part of their education program.

This program is fully funded by the Environment Protection Authority.

SUMMARY

The Frog Census is a long-term community survey of frogs throughout South Australia, initiated and coordinated by the Environment Protection Authority (EPA). The Frog Census provides a 'snapshot' of the distribution and abundance of frogs in South Australia, based upon the collection of frog recordings from as many different locations as possible over a one-week period.

The aims of the FROG CENSUS are to:

- increase public awareness of the health of South Australian waterways
- encourage public involvement in monitoring the water quality in the State
- assess the current and long-term health of the State's waterways
- assess the impact of EPA policies on water quality in this State
- improve knowledge of the distribution and abundance of frogs in South Australia.

This program is now starting to build a good picture of the distribution and abundance of each of the frog species in the State. Future directions will include overlaying other data collected around the State regarding river and catchment condition, to help identify problem areas in the State.

Frogs recorded

The distribution of recordings in 2001 was similar to that of previous censuses, with sites concentrated around the Adelaide metropolitan area and the South East. The range of recordings extended from as far north as Pandie Pandie Station in the North East, south to Germein Reserve at Port MacDonnell, east to the SA-Victoria border in the South East and west as far as Scrubby Peak in the Gawler Ranges, Eyre Peninsula.

The 2001 FROG CENSUS recorded 16 of the 28 frog species found in South Australia. The highest number of species recorded at a single location was six, from two sites near Mannum on the River Murray – Lake Carlet and Sec 52, Hd Younghusband.

The Common Froglet (*Crinia signifera*) was the most commonly recorded species, being present on 85% of recordings. The next most common species were the Spotted Grass Frog (*Limnodynastes tasmaniensis*) on 38.5%, Brown Tree Frog (*Litoria ewingi*) on 30.7% and the Eastern Banjo Frog (*Limnodynastes dumerili*) on 29.5% of recordings. These proportions are similar to previous years.

Species recorded at low frequencies were Peron's Tree Frog (*Litoria peroni*), Southern Bell Frog (*Litoria raniformis*), Desert Tree Frog (*Litoria rubella*), Eastern Sign Bearing Froglet (*Crinia parinsignifera*), Streambank Froglet (*Crinia riparia*), Smooth Frog (*Geocrinia laevis*), Long Thumbbed Frog (*Limnodynastes fletcheri*), Brown Striped Marsh Frog (*Limnodynastes peroni*), Trilling Frog (*Neobatrachus centralis*), Painted Frog (*Neobatrachus pictus*), Sudell's Frog (*Neobatrachus sudelli*) and Bibron's Toadlet (*Pseudophryne bibroni*).

Bibron's Toadlet was heard calling near Port Lincoln on the Eyre Peninsula. This record is significant because the species has not previously been known to occur in the region.

Fifty-two sites were visited that had no frogs calling, 4.1% of all recordings. This result represents a big drop from the 82 sites with no frogs calling in the 2000 FROG CENSUS.

Forty sites have been visited in all censuses. There have been slight fluctuations in the number of species recorded at these sites between years, but overall frog diversity and abundance appears to be relatively stable.

Observer participation

The FROG CENSUS has grown considerably since its inception in 1994, with a total of 759 groups taking part in 2001 (155 involved for the first time). They made 1280 recordings of frogs from 1182 different locations.

Each group in the 2001 FROG CENSUS was sent personalised results of their recordings. These included:

- a summary of each site visited by the group and the species recorded, as well as a brief description of each species
- a table listing the sites visited and species recorded by the group during each census that they have contributed recordings
- an information sheet summarising all data collected in the 2001 census.

The 2000 FROG CENSUS report was published and posted to all schools involved in the 2000 census and all major public libraries. The report was also included in digital format on the EPA FROG CENSUS web page <www.epa.sa.gov.au/frogcensus/> which has information, calls and keys to identifying the frogs present in South Australia.

1. INTRODUCTION

FROG CENSUS is a survey of frogs throughout South Australia initiated and coordinated by the Environment Protection Authority (EPA) and undertaken by members of the public. The survey was developed as an extension of the State Frogwatch program (Bayly, Hunwick, Hutchinson and Mahony 1990; Hunwick 1991), that was developed for schools in 1991. FROG CENSUS provides a 'snapshot' of the distribution and abundance of frogs in the waterways of South Australia.

The EPA FROG CENSUS aims are as follows:

- increase public awareness of the health of South Australian waterways
- encourage public involvement in monitoring the water quality in the State
- assess the current and long-term health of the State's waterways
- assess the impact of EPA policies on water quality in this State
- improve knowledge of the distribution and abundance of frogs in South Australia.

Frogs are the highest forms of life to lay a naked egg in water (Tyler 1994). This characteristic makes them sensitive biological indicators because any aquatic pollutant that comes in contact with the egg can pass directly through the jelly coating to the developing embryo. Pollution can cause the death of the embryo or have more subtle effects, such as producing skeletal abnormalities or altering the behaviour of tadpoles, which may make them more vulnerable to predation. Accordingly, to complete their life cycle successfully, frogs require a habitat free of environmental pollutants. Changes to the presence and abundance of frog populations may mirror those that occur to other organisms in the environment. Consequently, the census provides a simple assessment of the health of aquatic environments using the assumption that healthy catchments provide appropriate conditions for a diverse and abundant range of frog populations and, conversely, unhealthy habitats have correspondingly reduced frog populations. In this way, the ecological health of waterways can be inferred.

Every species of frog has a distinctive mating call and this allows frogs vocalising at a location to be accurately identified, making frogs a useful biological monitor.¹ This distinctiveness is particularly useful in a community-based program that embraces the valuable resource of public involvement, whereby participants do not require any previous experience in collecting samples or propensity for identifying frogs in the field.

The diversity of the frog fauna of South Australia is relatively low, compared with the rest of Australia: only 28 out of the more than 210 described species have been recorded in this State (Johnston 1990). The Streambank Froglet (*Crinia riparia*) from the Flinders Ranges is the only endemic species (Tyler 1994). This low diversity generally means there are few species that occur together at each site, which reduces the possibility of misidentifying calls. Of the frogs found in South Australia, all can be distinguished, despite the similarity of calls within some genera (for example, *Pseudophryne* and *Neobatrachus*), by subtle differences in their calls and reference to the location where they were recorded. Of those species recorded in South Australia, 15 are likely to be found in the southern part of the State where most people live and where most FROG CENSUS recordings are likely to be taken.

In South Australia, many of our rivers, creeks and wetlands have been degraded by different sorts of

¹(see <www.epa.sa.gov.au/frogcensus/>)

human impacts. These impacts include: the excessive clearance of vegetation, flood mitigation activities (including draining swamps, re-channeling urban streams), stormwater and drainage disposal schemes, poor riparian management activities (for example, spraying and removal of aquatic plants, excessive grazing), invasion by exotic species and inappropriate flood plain and catchment development. These impacts have reduced the habitat available for aquatic and riparian fauna and flora and have increased erosion and nutrient and salt inputs into waterbodies. Government agencies, catchment management authorities, Landcare and Waterwatch groups have been very active in recent years tackling many of the issues relating to aquatic and riparian management, largely through revegetation and public education programs. The FROG CENSUS provides a monitoring tool that can help assess the success of efforts being made to improve the condition of freshwater habitats in this State.

The FROG CENSUS also provides an exposure of local environmental conditions to the community. Participation in urban wildlife projects is known to increase personal awareness of both the local surroundings and history (Mostyn 1984). Community environmental monitoring also gives participants a sense of responsibility towards environmental health through their direct involvement in different projects (Alexandra, Haffenden and White 1996). Involving the community in monitoring also allows a large number of samples to be collected over a broad area in a short space of time, usually at a small cost to agencies. This sampling can lead to the discovery of new species records (Gynther 1995) and range extensions; as was the case for the Brown Tree Frog, Peron's Tree Frog and the Eastern Banjo Frog, which were recorded outside of their known range in the 2000 FROG CENSUS (Walker and Goonan 2001).

This report provides details of the FROG CENSUS carried out in 2001 and includes comparisons with previous years to show any trends that are beginning to become evident as more detailed datasets are compiled through this program.

2. METHODS

Participants in the FROG CENSUS were recruited by a number of methods:

- many participants were registered from previous years
- a media release by the Department for Environment and Heritage invited members of the public to register their interest at the EPA
- presentations to school and community groups invited their participation.

All registered participants were sent a FROG CENSUS kit. The kit contained a blank audiocassette, a return-addressed and postage-paid postpak and a datasheet (see appendix 1). The datasheet described the methods to be used to record frog calls on the cassette. Participants were to provide their own recording equipment.

Participants were requested to make a recording of three to five minutes in the evening during 'Frog Week' (10-16 September 2001) at sites of interest to them. Most recordings were made predominantly between dusk and midnight. Participants who were unable to make recordings during Frog Week were still encouraged to be involved; most recordings were made during the month of September. The recordings were analysed by EPA staff who identified the frogs calling and assigned abundance categories for each species detected at each site.

All location, participant and frog data were stored on an ORACLE EDMS database at the EPA. Data were also converted and placed into a Microsoft Access database for report writing and participant information retrieval. All maps were produced using ArcMap; charts were produced using Microsoft Excel.

The distribution of each species recorded during FROG CENSUS was compared with the records published by Barker et al. (1995), Tyler (1977; 1978) and Brooks (1984). All scientific names follow those used by Tyler (1978), with the following exceptions: the Genus *Crinia* replaces Genus *Ranidella* and *Cyclorana platycephala* has replaced *Cyclorana platycephalus*.

Participants were sent the results of their recording(s) with specific information on the life history of each frog calling at the site(s) where they recorded and a general information sheet (see appendix 2) with overall results from the 2001 FROG CENSUS. Some additional recordings were received after the initial mail-out; numbers relating to participation and species abundance have therefore been revised from those presented on the information sheet. Participants were also sent a summary of their results for each year that they had been involved in the program.

3. RESULTS

3.1 Observer and location details

Table 1 details the public participation in the FROG CENSUS for the past eight years. It was discovered that a number of records on the database were incorrect or incomplete. Therefore, every datasheet held on file was re-examined and, where necessary, records were updated. The summary table for participation in the FROG CENSUS reflects the corrected data.

FROG CENSUS 2001 involved 759 groups (155 groups for the first time) recording frogs from 1182 sites throughout South Australia, 1280 separate recordings were made. In total, 2580 records were obtained for frog abundance and distribution throughout the State. This total is the largest number of records for the FROG CENSUS thus far. The poor quality of a small number (16) of these recordings did not permit identification of frogs.

Table 1 Number of groups involved, sites visited and recordings made in the FROG CENSUS

	2001	2000	1999	1998	1997	1996	1995	1994	Total
Groups	759	702	774	672	657	603	608	303	1917*
Sites	1182	994	915	789	813	771	779	452	2857*
Recordings	1280	1081	1017	869	886	852	917	507	7409

* Total is the number of different groups or sites that have been included in the FROG CENSUS to date, not merely a summation of the groups or sites in each year.

Figure 1 shows the distribution of all FROG CENSUS sites. In 2001, the most northerly recording was taken at Pandie Pandie Station in the North East. The most southerly recording was from Germein Reserve at Port MacDonnell in the South East. The easternmost recording was from near the SA-Victoria border in the South East. The westernmost recording was from Scrubby Peak in the Gawler Ranges, Eyre Peninsula.

Forty sites have been recorded during each year that the FROG CENSUS has been running (figure 2). The number of species recorded for each of these sites during the FROG CENSUS is listed in table 2. There have been fluctuations in the number of species recorded at each site between years but, overall, there appears to be little change in the frog abundance at these sites.

Eight years is a relatively short time for a monitoring program to show consistent patterns. Frog mating activity and the success of breeding can change markedly with even slight variation in temperature and rainfall. For example, in wet years there may be more frogs breeding and a greater chance of offspring surviving to adulthood than in dry years. It is, therefore, very important that these sites continue to be monitored to provide ongoing information about the frog fauna in South Australia. With more information collected over a number of years, in different weather conditions, the better able we are to understand the status of frogs in the State.

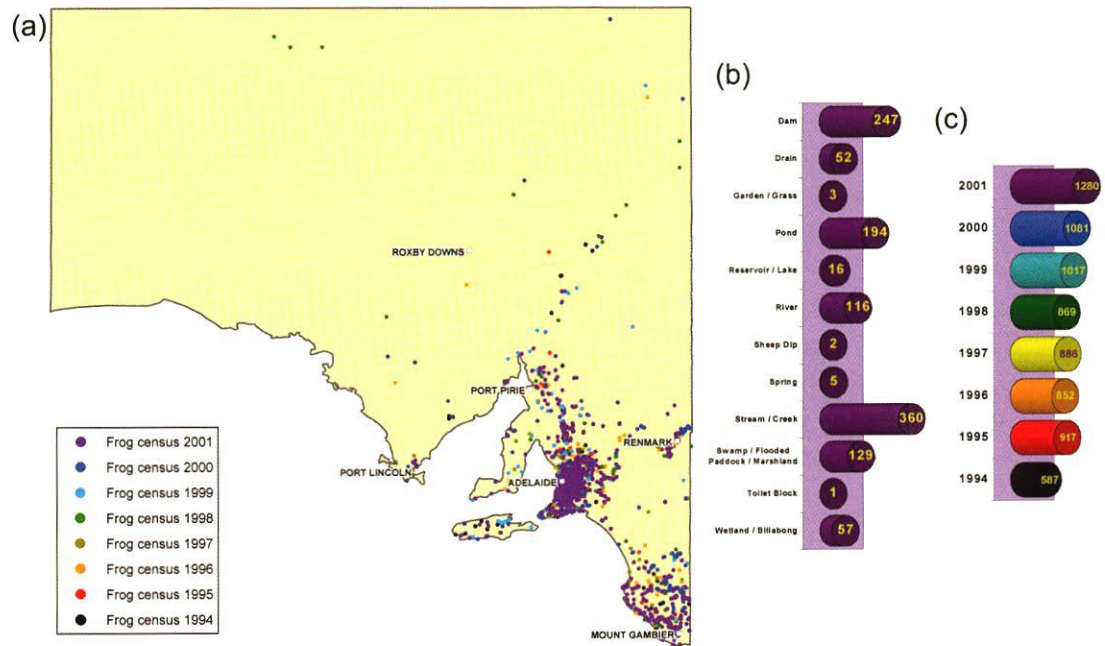


Figure 1 Distribution of recording sites for the FROG CENSUS

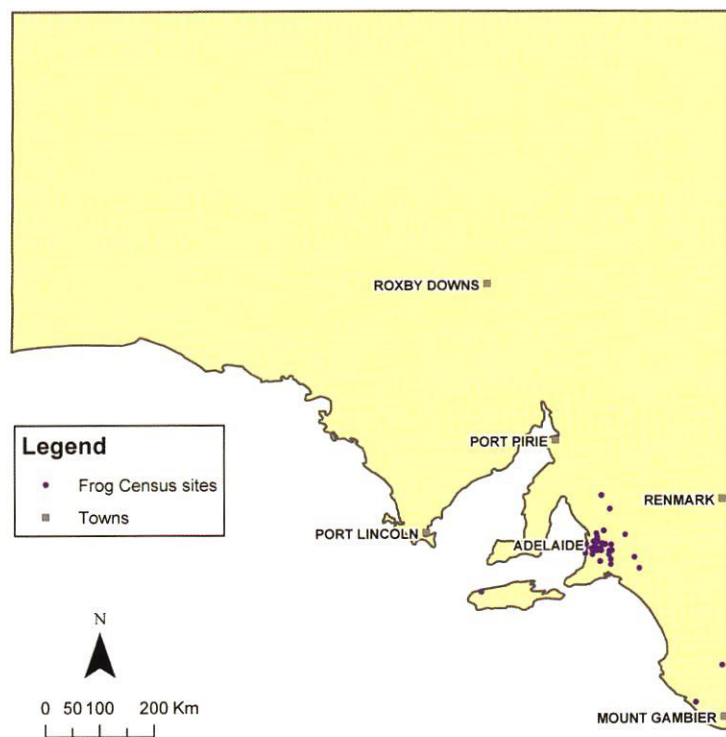


Figure 2 FROG CENSUS recording locations sampled in every census

3.2 Frog species abundance and distribution

Sixteen species of frog were recorded in 2001 (table 3). The most commonly recorded species were the Common Froglet (*Crinia signifera*), Spotted Grass Frog (*Limnodynastes tasmaniensis*), Brown Tree Frog (*Litoria ewingi*) and the Eastern Banjo Frog (*Limnodynastes dumerili*). Other species recorded were: Peron's Tree Frog (*Litoria peroni*), Southern Bell Frog (*Litoria raniformis*), Desert Tree Frog (*Litoria rubella*), Eastern Sign Bearing Froglet (*Crinia parinsignifera*), Streambank Froglet (*Crinia riparia*), Smooth Frog (*Geocrinia laevis*), Long Thumbed Frog (*Limnodynastes fletcheri*), Brown Striped Marsh Frog (*Limnodynastes peroni*), Trilling Frog (*Neobatrachus centralis*), Painted Frog (*Neobatrachus pictus*), Sudell's Frog (*Neobatrachus sudelli*) and Bibron's Toadlet (*Pseudophryne bibroni*).

Some sites were recorded more than once—by the same participant or by numerous participants. On occasion, there were different species or abundances of frogs calling. Table 4 lists the number of recordings that were made of each species and the total number of different locations at which those species were found.

Table 5 shows the number of recordings of each species in each abundance category. As in 2000, most records (46.2%) were of few (2–9) individuals of the same species and 35% of records had many (10–50) frogs. The categories of one frog and lots (>50) were much less frequently recorded (7.1% and 9.1% respectively).

Table 6 shows the number of recordings of each species from each habitat type. Most recordings were from streams (31.6%), dams (20.2%) and ponds (15.3%). Of the major habitats, springs had the lowest number of recordings (0.4%).

Table 2 Species counts for the sites recorded in every FROG CENSUS

Site	2001	2000	1999	1998	1997	1996	1995	1994
Apex Wetland, Sir Donald Bradman Dr, West Beach	3	3	4	4	3	4	3	3
Arbury Park Outdoor School, Bridgewater, pond	2	3	5	3	4	3	2	2
Bald Hills Rd, Mt Barker, creek		3	3	1	2	3	3	1
Bald Hills Rd, Mt Barker, dam		4	4	2	3	2	3	2
Berri Res, Albury Ct, Hope Valley	1	2	2	3	3	4	3	1
Brabham Gr, Aberfoyle Park, stream	1	2	3	1	1	2	1	2
Californian Cres, Glenalta	1	2	2	1	2	1	2	1
Carisbrook Park, Salisbury	3	3	2	4	2	3	4	3
CC Hood Park, Panorama	1	2	2	1	2	2	2	2
Cormorant Dr, Hallett Cove	1	1	1	1	1	1	1	0
Dalton Ave, Aldgate	4	2	2	1	2	1	2	4
DeMole R, Kangaroo Island	1	3	1	2	1	1	1	1
Ferry Crossing, Wellington	3	3	2	1	3	2	3	3
First Ck, Hazelwood Park	2	2	3	1	1	1	2	1
Frank Barker Rd, Humbug Scrub, dam	3	3	1	3	1	2	2	0
Gares Swamp, Naracoorte	4	3	2	4	4	3	4	3
Grant's Gully Rd, Clarendon	0	1	2	1	3	2	1	1
Hamilton Park, Fife St, Vale Park	2	3	2	1	3	1	1	1
Hampstead Hill Rd, Aldgate, dam	3	3	4	3	3	2	3	2
Hawkers Ck Rd, Kapunda	2	2	3	2	2	2	2	1
Heathfield Rd, Heathfield	3	3	3	1	1	3	0	2
Highland Valley, Mt Barker, shearing shed pond	3	1	2	2	2	2	2	2
Ironbank Rd, Ironbank, stream	2	2	2	2	2	2	3	2
Kingfisher Dr, Modbury Heights	1	1	1	1	1	1	1	1
Knotts Hill Rd, Ashton	1	1	2	1	1	1	1	1
Leabrook Dr & Porter Tce, Rostrevor	1	2	2	1	1	1	2	1
Leslie Ck, Mylor, dam	2	2	2	3	2	2	3	1
McIntyre's Quarry Wetland, Millicent	3	4	3	4	2	4	4	1
Minno Ck, Hawthorndene Oval	2	2	1	1	1	2	2	1
Morris Rd, Prospect Hill	3	2	1	1	1	1	3	2
Murray Bridge City Council Wetland Res	3	3	3	4	3	4	4	3
Paech Rd, Wistow	1	2	3	2	2	3	2	1
Pfeiffer Rd, Woodside, stream	2	2	1	2	2	2	2	3
Renown Ave, Crafers	2	2	2	2	3	2	1	1
Roper Rd, Willyaroo, Angas R	2	2	1	2	1	3	2	1
Stoneybrook Dr, Paradise	1	1	2	1	1	2	1	1
Swamp Rd, Lenswood, creek	2	3	2	2	1	2	3	1
Sydney Rd, Nairne	2	1	0	0	1	0	2	1
Walker Flat Rd, Mt Pleasant	2	2	1	2	2	1	2	2
Winkler Park, Saddleworth	2	2	2	2	2	2	2	1

The count is the total number of different species recorded in that year, regardless of which group made the recording.

Table 3 Number of recordings of different species in the FROG CENSUS

Species	Common Name	2001		2000		1999		1998		1997		1996		1995		1994	
		#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
<i>Cyclorana cultripes</i>	Knife Footed Frog	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Cyclorana platycephala</i>	Water Holding Frog	0	0.0	0	0.0	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0
<i>Litoria caerulea</i>	Green Tree Frog	0	0.0	0	0.0	0	0.0	1	0.1	0	0.0	1	0.1	0	0.0	0	0.0
<i>Litoria ewingi</i>	Brown Tree Frog	393	30.7	286	26.5	281	27.6	290	33.4	268	30.2	203	23.8	214	23.4	92	18.1
<i>Litoria peroni</i>	Peron's Tree Frog	12	0.9	29	2.7	11	1.1	17	2.0	3	0.3	22	2.6	19	2.1	1	0.2
<i>Litoria raniformis</i>	Southern Bell Frog	6	0.5	42	3.9	8	0.8	17	2.0	3	0.3	16	1.9	23	2.4	1	0.2
* <i>Litoria rothi</i>	Roth's Tree Frog	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2
<i>Litoria rubella</i>	Desert Tree Frog	2	0.2	0	0.0	1	0.1	2	0.2	0	0.0	0	0.0	0	0.0	0	0.0
<i>Crinia deserticola</i>	Desert Froglet	0	0.0	1	0.1	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Crinia parinsignifera</i>	Eastern Sign Bearing Froglet	20	1.6	32	3.0	16	1.6	24	2.8	14	1.6	30	3.5	21	2.3	3	0.6
<i>Crinia riparia</i>	Streambank Froglet	1	0.1	0	0.0	2	0.2	2	0.2	0	0.0	1	0.1	0	0.0	3	0.6
<i>Crinia signifera</i>	Common Froglet	1088	85.0	813	75.2	820	80.6	695	80.0	753	85.0	699	82.0	734	80.1	368	72.6
<i>Geocrinia laevis</i>	Smooth Frog	3	0.2	1	0.1	2	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Limnodynastes dumerili</i>	Eastern Banjo Frog	378	29.5	384	35.5	287	28.2	241	27.7	128	14.4	243	28.5	356	38.9	99	19.5
<i>Limnodynastes fletcheri</i>	Long Thumbed Frog	1	0.1	4	0.4	6	0.6	4	0.5	1	0.1	0	0.0	0	0.0	2	0.4
<i>Limnodynastes peroni</i>	Brown Striped Marsh Frog	68	5.3	60	5.6	15	1.5	21	2.4	20	2.3	8	0.9	19	2.1	6	1.2
<i>Limnodynastes spenceri</i>	Spencer's Frog	0	0.0	0	0.0	0	0.0	2	0.2	0	0.0	0	0.0	0	0.0	0	0.0
<i>Limnodynastes tasmaniensis</i>	Spotted Grass Frog	493	38.5	406	37.6	357	35.1	269	31.0	278	31.4	309	36.3	378	41.3	185	36.5
<i>Neobatrachus centralis</i>	Trilling Frog	1	0.1	0	0.0	1	0.1	4	0.5	0	0.0	0	0.0	0	0.0	0	0.0
<i>Neobatrachus pictus</i>	Painted Frog	24	1.9	12	1.1	2	0.2	9	1.0	12	1.4	7	0.8	5	0.5	5	1.0
<i>Neobatrachus sudelli</i>	Sudell's Frog	20	1.6	8	0.7	1	0.1	8	0.9	1	0.1	0	0.0	1	0.1	0	0.0
<i>Neobatrachus sutor</i>	Shoemaker Frog	0	0.0	0	0.0	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0
<i>Pseudophryne bibroni</i>	Bibron's Toadlet	2	0.2	1	0.1	3	0.3	10	1.2	6	0.7	88	10.3	68	7.4	21	4.1
<i>Pseudophryne semimarmorata</i>	Southern Toadlet	0	0.0	0	0.0	0	0.0	0	0.0	1	0.1	4	0.5	0	0.0	0	0.0
No frogs		52	4.1	87	8.0	93	9.1	56	6.4	60	6.8	36	4.2	22	2.4	45	8.9
Poor quality recording		16	1.3	17	1.6	0	0.0	0	0.0	1	0.1	0	0.0	1	0.1	1	0.2

* Introduced individuals from Northern Australia.

Table 4 Number of recordings and different sites where each species was recorded in the 2001 FROG CENSUS

Species *	Recordings**		Sites**	
	#	%	#	%
<i>Litoria ewingi</i>	393	30.7	382	32.4
<i>Litoria peroni</i>	12	0.9	11	0.9
<i>Litoria raniformis</i>	6	0.5	6	0.5
<i>Litoria rubella</i>	2	0.2	2	0.2
<i>Crinia parinsignifera</i>	20	1.6	14	1.2
<i>Crinia riparia</i>	1	0.1	1	0.1
<i>Crinia signifera</i>	1088	85.0	1012	85.6
<i>Geocrinia laevis</i>	3	0.2	3	0.3
<i>Limnodynastes dumerili</i>	378	29.5	356	30.1
<i>Limnodynastes fletcheri</i>	1	0.1	1	0.1
<i>Limnodynastes peroni</i>	68	5.3	67	5.7
<i>Limnodynastes tasmaniensis</i>	493	38.5	468	39.6
<i>Neobatrachus centralis</i>	1	0.1	1	0.1
<i>Neobatrachus pictus</i>	24	1.9	24	2.0
<i>Neobatrachus sudelli</i>	20	1.6	20	1.7
<i>Pseudophryne bibroni</i>	2	0.2	2	0.2
No frogs	52	4.1	51	4.3
Poor quality recording	16	1.3	16	1.4

* See table 3 for common names. ** A total of 1280 recordings was made at 1182 different sites.

Table 5 Number of recordings for different abundance categories per species during 2001

Species*	One**	Few (2-9)	Many (10-50)	Lots (> 50)	Total
<i>Litoria ewingi</i>	49	260	69	15	393
<i>Litoria peroni</i>	4	7	1	0	12
<i>Litoria raniformis</i>	1	4	1	0	6
<i>Litoria rubella</i>	0	0	2	0	2
<i>Crinia parinsignifera</i>	1	8	11	0	20
<i>Crinia riparia</i>	0	1	0	0	1
<i>Crinia signifera</i>	20	381	546	141	1088
<i>Geocrinia laevis</i>	0	2	1	0	3
<i>Limnodynastes dumerili</i>	56	200	88	34	378
<i>Limnodynastes fletcheri</i>	0	0	1	0	1
<i>Limnodynastes peroni</i>	2	23	21	22	68
<i>Limnodynastes tasmaniensis</i>	48	277	147	21	493
<i>Neobatrachus centralis</i>	0	1	0	0	1
<i>Neobatrachus pictus</i>	0	20	4	0	24
<i>Neobatrachus sudelli</i>	1	7	11	1	20
<i>Pseudophryne bibroni</i>	1	0	1	0	2

* See table 3 for common names. ** There were 51 sites that had no frogs calling.

Table 6 Number of recordings per species in each habitat in the 2001 FROG CENSUS

Species*	Dam	Drain	Garden/ Grass	Pond	Reservoir/ Lake	River	Sheep Dip	Spring	Stream/ Creek	Swamp/ Flooded Paddock/ Marshland	Toilet Block	Wetland/ Billabong
<i>Litoria ewingi</i>	113	21	0	57	8	23	0	1	78	66	0	15
<i>Litoria peroni</i>	1	0	0	1	0	3	0	0	0	2	0	4
<i>Litoria raniformis</i>	0	0	0	0	1	1	0	0	0	2	0	2
<i>Litoria rubella</i>	0	0	0	0	0	0	0	0	1	0	1	0
<i>Crinia parinsignifera</i>	0	0	0	1	0	2	0	0	2	2	0	13
<i>Crinia riparia</i>	0	0	0	0	0	0	0	0	1	0	0	0
<i>Crinia signifera</i>	226	41	1	132	15	103	0	5	333	118	0	37
<i>Geocrinia laevis</i>	0	0	0	0	0	0	0	0	0	3	0	0
<i>Limnodynastes dumerili</i>	98	15	1	42	3	52	0	1	68	46	0	30
<i>Limnodynastes fletcheri</i>	0	0	0	0	0	0	0	0	0	1	0	0
<i>Limnodynastes peroni</i>	2	8	0	5	7	0	0	0	0	39	0	6
<i>Limnodynastes tasmaniensis</i>	115	14	0	91	3	31	1	2	124	56	0	31
<i>Neobatrachus centralis</i>	0	0	0	0	0	0	0	0	1	0	0	0
<i>Neobatrachus pictus</i>	9	0	0	1	1	0	0	0	7	6	0	0
<i>Neobatrachus sudelli</i>	2	3	0	0	8	0	0	0	1	5	0	1
<i>Pseudophryne bibroni</i>	0	0	0	0	0	0	0	0	2	0	0	0
No frogs	9	1	1	15	0	6	1	0	12	4	0	3
Poor quality recording	3	1	0	1	0	3	0	0	4	3	0	1
Total number of recordings	259	55	3	196	17	131	2	5	404	138	1	69

* See table 3 for common names.

3.3 Geographical variation

Tyler (1977) split the State into a number of geographical regions based on known species distribution at that time (figure 3). The number of sites visited and species recorded in each region during the FROG CENSUS are shown in tables 7 and 8 respectively. Although more sites were recorded in 2001, the geographic range of recordings was similar to 2000 (Walker and Goonan 2001). Most recordings were again made in the Central Districts, Mount Lofty Ranges and Adelaide Plains, more than have previously been included. The number of recordings from the Yorke Peninsula decreased from the number taken in 2000. The River Murray had the largest number of recordings that have ever been made in the census – these were taken along most of its length in South Australia. The Eyre Peninsula and Flinders Ranges also had more recordings than in any other year, with most of the Flinders Ranges sites being located in the Southern Flinders Ranges. Kangaroo Island had a slight increase in the number of recordings from 2000 and the South East had a similar number of recordings to previous years (Walker and Goonan 2001).

The Murray Valley and the South East had the greatest frog diversity; nine species. The North East District and the Yorke Peninsula both had only one species recorded. No frogs were recorded at the single site visited in the North West District and no recordings were made on the Nullarbor Plain.

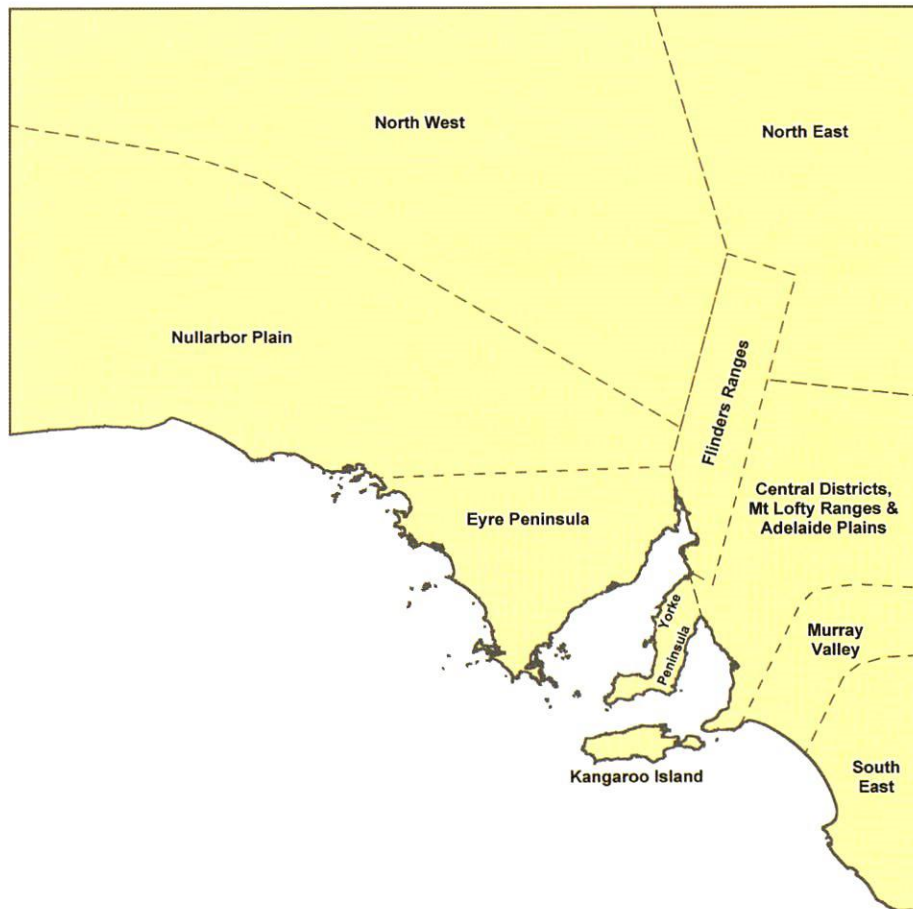


Figure 3 Geographic frog regions of South Australia

Table 7 Number of sites visited in each geographical region during the FROG CENSUS

Region	2001	2000	1999	1998	1997	1996	1995	1994
Central Districts, Mt Lofty Ranges & Adelaide Plains	715	567	617	516	535	463	513	304
Eyre Peninsula	18	10	5	6	8	4	3	3
Flinders Ranges	30	13	23	15	14	18	17	10
Kangaroo Island	17	14	26	10	13	7	2	10
Murray Valley	220	202	162	150	147	175	184	97
North East	2	3	2	8	0	1	0	1
North West	1	1	0	4	0	0	0	0
Nullarbor Plain	0	0	0	1	0	1	0	0
South East	172	175	70	71	88	89	54	25
Yorke Peninsula	7	9	10	7	8	13	5	2

Table 8 Number of species recorded in each geographical region during the FROG CENSUS

Region	2001	2000	1999	1998	1997	1996	1995	1994
Central Districts, Mt Lofty Ranges & Adelaide Plains	8	6	6	6	7	6	7	7
Eyre Peninsula	5	5	1	2	3	2	2	2
Flinders Ranges	5	3	7	5	3	7	4	3
Kangaroo Island	5	5	4	4	5	5	3	5
Murray Valley	9	9	8	8	9	8	9	9
North East	1	2	1	6	0	1	0	1
North West	0	0	0	5	0	0	0	0
Nullarbor Plain	0	0	0	1	0	1	0	0
South East	9	10	7	8	8	9	9	6
Yorke Peninsula	1	3	3	1	4	2	1	1

The species recorded in each region during the 2001 FROG CENSUS are as follows (species names in **bold** are from recordings taken outside the previously published range for that species):

Central Districts, Mount Lofty Ranges & Adelaide Plains (715 sites, eight species)

Brown Tree Frog, Common Froglet, Eastern Banjo Frog, **Brown Striped Marsh Frog**, Spotted Grass Frog, Painted Frog, Sudell's Frog and Bibron's Toadlet.

Eyre Peninsula (18 sites, five species)

Common Froglet, Spotted Grass Frog, Trilling Frog, Painted Frog and **Bibron's Toadlet**.

Flinders Ranges (30 sites, five species)

Streambank Froglet, Common Froglet, Eastern Banjo Frog, Spotted Grass Frog and Painted Frog.

Kangaroo Island (17 sites, five species)

Brown Tree Frog, Common Froglet, Eastern Banjo Frog, Spotted Grass Frog and Painted Frog.

Murray Valley (220 sites, nine species)

Brown Tree Frog, Peron's Tree Frog, Southern Bell Frog, Eastern Sign Bearing Froglet, Common Froglet, Eastern Banjo Frog, Long Thumbed Frog, Spotted Grass Frog and Painted Frog.

North East District (two sites, one species)

Desert Tree Frog.

North West District (one site, no frogs)

No species were recorded.

Nullarbor Plain

No recordings were made in this region.

South East (172 sites, nine species)

Brown Tree Frog, Southern Bell Frog, Common Froglet, Smooth Frog, Eastern Banjo Frog, Brown Striped Marsh Frog, Spotted Grass Frog, Painted Frog and Sudell's Frog.

Yorke Peninsula (seven sites, one species)

Spotted Grass Frog.

3.4 Species diversity

Table 9 shows species diversity categories for sites recorded in the FROG CENSUS. In 2001, the highest number of species recorded at any site was six, at two sites near Mannum in the Murray Valley – Lake Carlet, and Sec. 52, Hd Younghusband. Sites with five species were found in the Central Districts, Mt Lofty Ranges & Adelaide Plains, the Murray Valley and the South East. Although there appears to be an increase in species diversity in 2001 (due to a slightly greater proportion of sites with two to four species), there is also an increase in the proportion of sites with only one species and a drop in the number of sites with five species. There is, therefore, a slight reduction in overall species diversity, when compared to 2000.

However, the species diversity at sites over the course of the FROG CENSUS has been relatively stable, with most sites having one, two or three species and sites with four or more species being less frequently found (figure 4). Figure 5 shows the location of sites grouped by species diversity for the 2001 FROG CENSUS.

Table 9 Number of sites with different numbers of species present in the FROG CENSUS

Diversity*	2001		2000		1999		1998		1997		1996		1995		1994	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Unknown	16	1.4	16	1.6	0	0.0	0	0.0	1	0.1	0	0.0	1	0.1	1	0.2
0	46	3.9	82	8.2	84	9.2	54	6.8	55	6.8	32	4.1	19	2.4	43	9.5
1	371	31.4	280	28.2	299	32.7	280	35.5	316	38.9	278	36.0	229	29.3	201	44.6
2	395	33.5	319	32.1	296	32.3	241	30.5	293	36.0	236	30.6	281	36.1	121	26.6
3	224	18.9	185	18.6	174	19.0	134	17.0	111	13.7	154	19.9	178	22.9	61	13.5
4	115	9.7	85	8.6	49	5.4	62	7.9	35	4.3	63	8.2	54	6.9	21	4.7
5	13	1.1	25	2.5	11	1.2	16	2.0	2	0.2	6	0.8	15	1.9	4	0.9
6	2	0.2	2	0.2	2	0.2	1	0.1	0	0.0	3	0.4	2	0.3	0	0.0
7	0	0.0	0	0.0	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0

* Includes all species recorded at a site, regardless of which group made the recording.

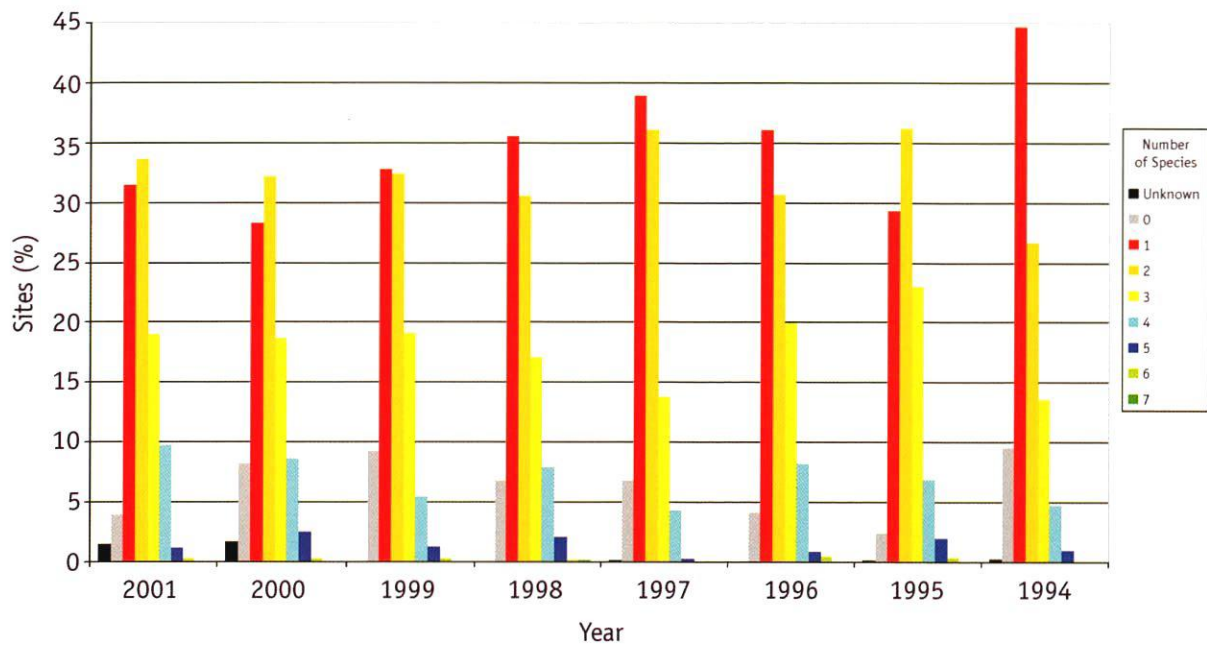


Figure 4 Species diversity in the FROG CENSUS

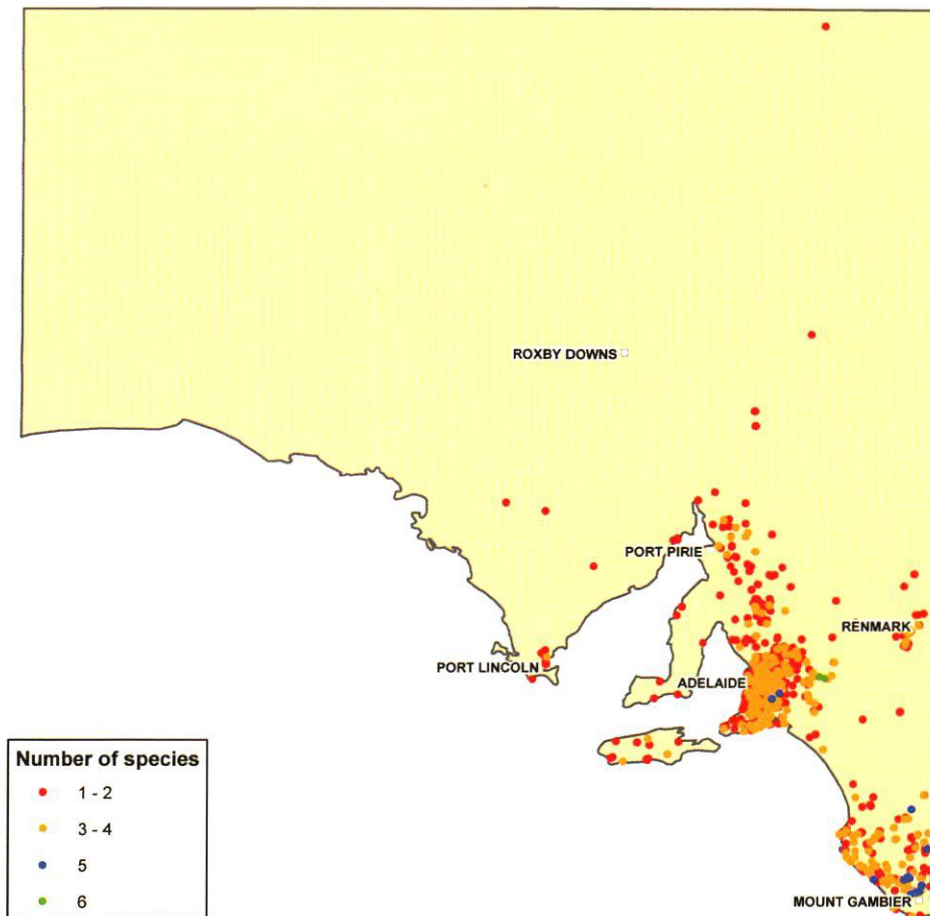


Figure 5 Species diversity in the 2001 FROG CENSUS

3.5 Specific frog distribution and abundance

Figures 6–23 show the sites where each species was recorded in the 2001 FROG CENSUS. Details on the geographical distribution of recordings from 1994–2001 (a), habitat distribution (b), abundance (c) and number of recordings in the FROG CENSUS (d) are presented below.

3.5.1 FAMILY HYLIDAE

In South Australia, there are two genera that make up the family Hylidae — *Cyclorana* and *Litoria*:

- *Cyclorana* species are burrowing frogs that are commonly called water holding frogs because of the large amounts of water they store. They do not possess toe discs but have a metatarsal tubercle, a hardened ridge on the undersurface of the foot, which acts like a spade to assist in digging. In most species, there is very little, if any, webbing between the toes.
- *Litoria* species are predominantly tree frogs that have flattened discs on the tips of their fingers and toes that secrete sticky mucus to aid in climbing. The undersurface of the disc has an indentation around the circumference. Most *Litoria* species have long legs and large amounts of webbing between the toes, while the fingers may have small amounts of webbing.

All of the South Australian hylids lay clumps of eggs in the water.

No recordings of any *Cyclorana* species were made during the 2001 FROG CENSUS.

3.5.1.1 Brown Tree Frog (*Litoria ewingi*)

The Brown Tree Frog is the only tree frog commonly found in Adelaide and the Mount Lofty Ranges; it is sometimes seen climbing on windows in search of food. It is a slender, medium-sized frog (22–46 mm) with prominent toe and finger discs, a broad head and rounded snout. There is a narrow, black or brown stripe from the snout to the shoulder and a pale stripe beneath the eye. The backs of the thighs are yellow or orange with occasionally some small, black spots. In the South East the brown colouration may be partly or completely replaced with green.



(Photograph: Steve Walker)

The advertisement call is a loud and distinctive, high pitched ‘weep-eeep-eeep’ of ten to 20 notes.

The Brown Tree Frog was present on 393 recordings (30.7%) in 2001. This species was the third most commonly recorded species during the census. Recordings were taken primarily in dams (28.8%) and streams (19.8%). Most recordings (66.2%) were of few (2–9) frogs.

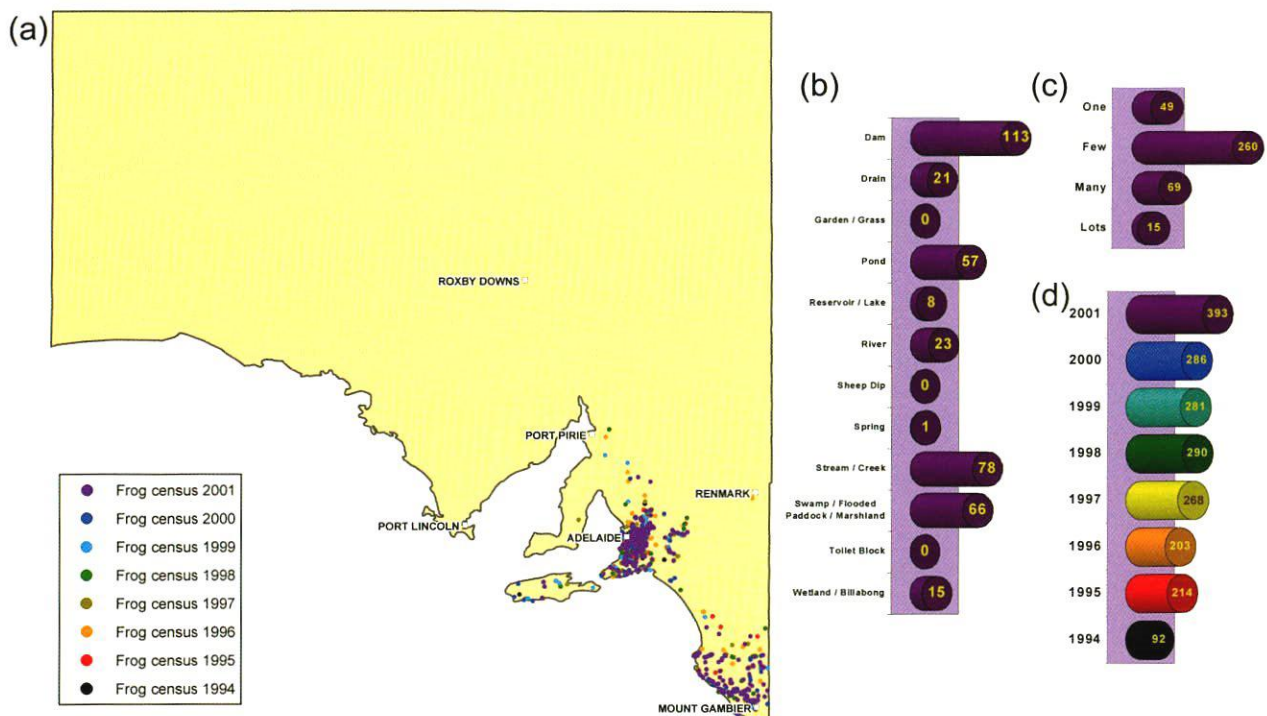


Figure 6 FROG CENSUS locations with the Brown Tree Frog

3.5.1.2 Peron's Tree Frog (*Litoria peroni*)

In South Australia, Peron's Tree Frog has been reported along the River Murray and swamps in the South East. It is grey or brown and has a number of small, pale emerald spots. A thin black line marks the skin fold above its ear and the backs of the thighs are heavily marked with black on yellow or orange. Peron's Tree Frog has distinctively large toe and finger discs and ranges in size from 44–65 mm.

Its call is a long series of 29–50 explosive notes, often described as a 'maniacal cackle'.



(Photograph: Steve Walker)

The number of recordings with Peron's Tree Frogs decreased from 29 in 2000 (Walker and Goonan 2001) to 12 (0.9%) in 2001. The most obvious explanation for this decrease is the result of recent dry conditions. Most of the recordings (58.3%) were of few (2–9) frogs calling and were made within their known distribution along the length of the River Murray. Peron's Tree Frog is usually only found along the main river and backwaters in the River Murray, but this year it was also recorded from a dam at Mt Barker. Recently, a number of pet stores have been selling tadpoles of this species, so it is possible that the record in Mt Barker is the result of a frog being released. However, this species also occurs in parts of New South Wales and Queensland, where fruit and vegetables are produced. It is very common for these and other tree frogs to be transported interstate in shipments of these products.

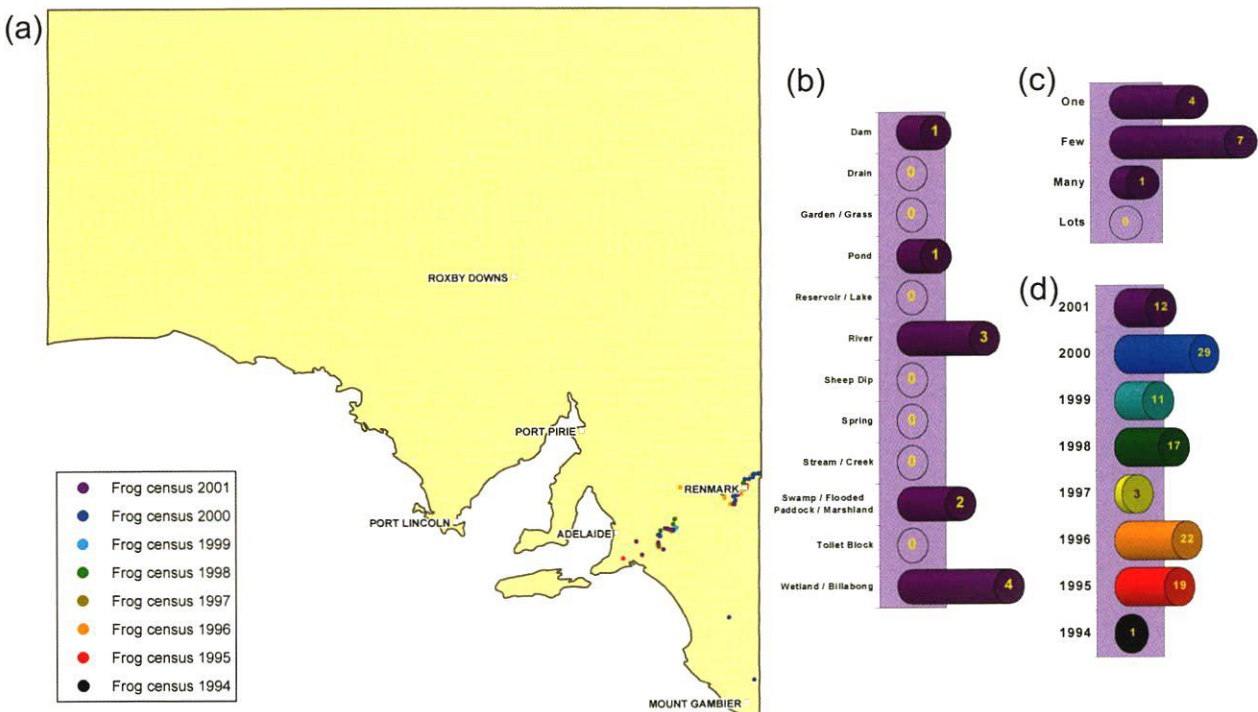


Figure 7 FROG CENSUS locations with Peron's Tree Frog

3.5.1.3 Southern Bell Frog (*Litoria raniformis*)

The Southern Bell Frog is a large frog (55–104 mm) found throughout the swamps of the Murray Valley and the South East. It is characterised by a loud, barking call and distinctive, colourful skin patterns. This frog has a pale green mid-dorsal stripe with large, black spots on its back. The belly is coarsely granular and the thighs are turquoise. Fingers are not webbed, but the toes are almost fully webbed.



(Photograph: Steve Walker)

Its call is a loud, modulated growl, followed by a series of short grunts.

Following the dry conditions experienced between FROG CENSUS 2000 and 2001, the number of recordings with the Southern Bell Frog decreased to six (0.5%). All recordings were taken in typically wet habitats: rivers, swamps, lakes and wetlands. The abundance of frogs at most sites was few (2–9). A separate study looking to document the distribution and conservation status of this species in the State commenced in the Murray Valley in September 2000 and continued in the South East during 2000 and 2001. The Southern Bell Frog was not encountered at any of the locations visited in and around Kingston SE, Robe and Beachport. The records for the survey in 2001, including all species encountered, have been included in the FROG CENSUS.

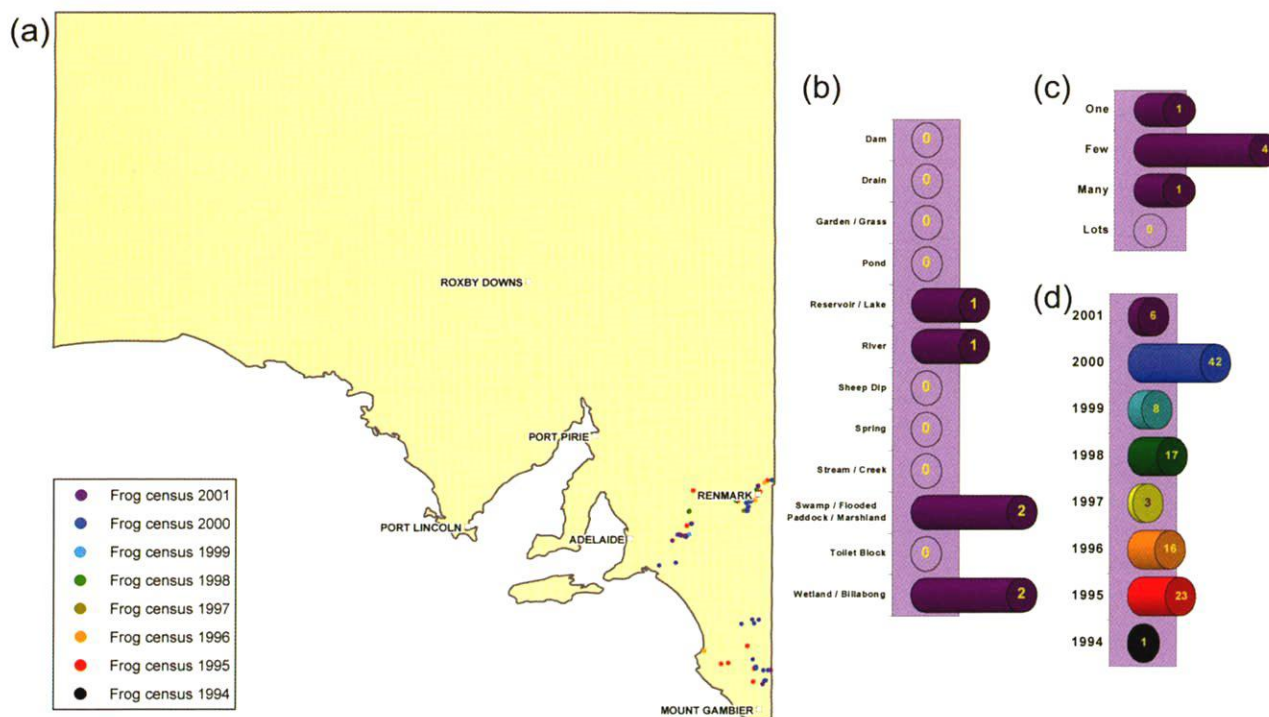


Figure 8 FROG CENSUS locations with the Southern Bell Frog

3.5.1.4 Desert Tree Frog (*Litoria rubella*)

Also known as the Red Tree Frog, this species has a wide geographic distribution occupying most of the State's far north east. The frog is pale grey to red-brown with some small black flecks. A dark band extends along the side of the head and body. Underneath, the skin is white, except for the throat of breeding males, which is a very dark grey. The limbs are short and robust and the fingers and toes have large discs. The fingers have slight webbing, while the toes are half webbed. Size ranges 28–43 mm.



(Photograph: Steve Walker)

The mating call of this species is a loud screeching, high-pitched, distinctly pulsed note – much like the screech of a seagull.

Although the Desert Tree Frog has a range that covers much of Northern Australia, very few recordings were taken in these regions and it was recorded from only two locations (0.2% of recordings). They were a stream at Pandie Pandie Station and a toilet block at Arkaroola Village, both in the North East. Many (10–50) frogs were present at both locations.

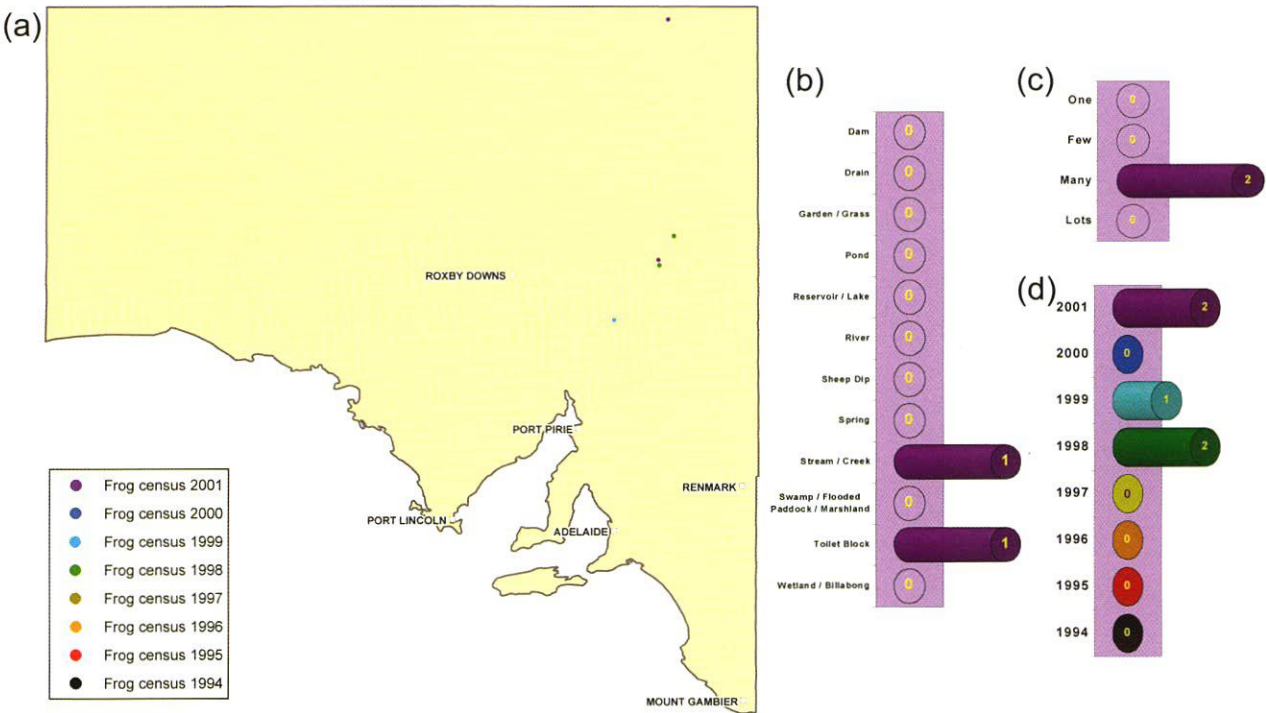


Figure 9 FROG CENSUS locations with the Desert Tree Frog

3.5.2 FAMILY LEPTODACTYLIDAE

The frogs in the family Leptodactylidae (also known as Myobatrachidae) are usually terrestrial but occupy a wide range of habitats ranging from wet areas around streams and swamps to desert regions that have very little water. There are very few physical characteristics to help distinguish all the species and, indeed, genera from this family. The vast majority of frogs in South Australia are leptodactylids, of which there are six genera ranging in size from about 1.6 cm (*Crinia riparia*) to 8.3 cm (*Limnodynastes dumerili*).

There are also many and varied reproductive strategies used, even within a genus, which highlights the diversity within this family. Some lay eggs in clumps attached to submerged vegetation, others produce a floating foam nest or long chains of eggs, and others have direct or semi-direct development within the egg capsule laid on land.

3.5.2.1 Eastern Sign Bearing Froglet (*Crinia parinsignifera*)

The Eastern Sign Bearing Froglet is distributed along the River Murray north of Walker's Flat. It is small with highly variable colour patterns. The grey or brown skin on the back may be smooth or have ridges or other raised areas. The belly is rough.

The mating call is a long harsh, slowly repeated 'squelch'. The call is like the noise made when a wet finger is drawn over an inflated balloon.



(Photograph: Mike Mahony – Frogwatch resource materials)

The Eastern Sign Bearing Froglet was on 20 recordings (1.6%) in 2001, a drop from 32 in the 2000 FROG CENSUS. Most recordings (57.9%) were of many (10–50) frogs that were calling from wetlands (65%), the River Murray (10%), streams (10%), swamps (10%) and a pond (5%) in the Murray Valley.

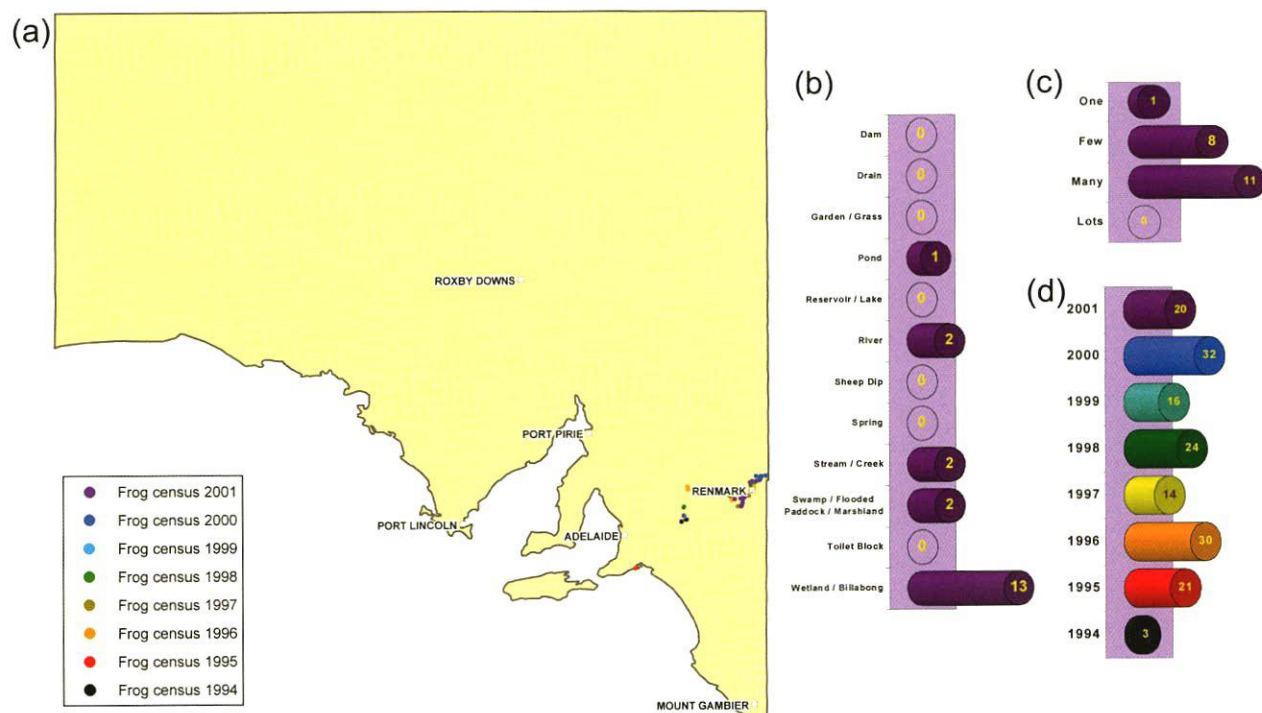


Figure 10 FROG CENSUS locations with the Eastern Sign Bearing Froglet

3.5.2.2 Streambank Froglet (*Crinia riparia*)

As in other *Crinia* species the Streambank Froglet, which ranges from 16–25 mm, displays highly variable skin colour and patterns. It also lacks the tympanum (disc-like external ear). The Streambank Froglet is South Australia's only endemic frog, with a distribution restricted to the Flinders and Gammon Ranges.

The advertisement call is a soft 'kra-a-a-a-a-ack' that is repeated slowly and sounds like a squeaking door.



(Photograph: Mike Mahony – Frogwatch resource materials)

The Streambank Froglet was recorded from a single creek at Brachina Gorge in the Flinders Ranges in 2001. Few (2–9) froglets were recorded. Although only recorded once, there were very few sites visited in the Flinders Ranges in 2001 and this species is believed to be very abundant (M. Hutchinson pers. comm.).

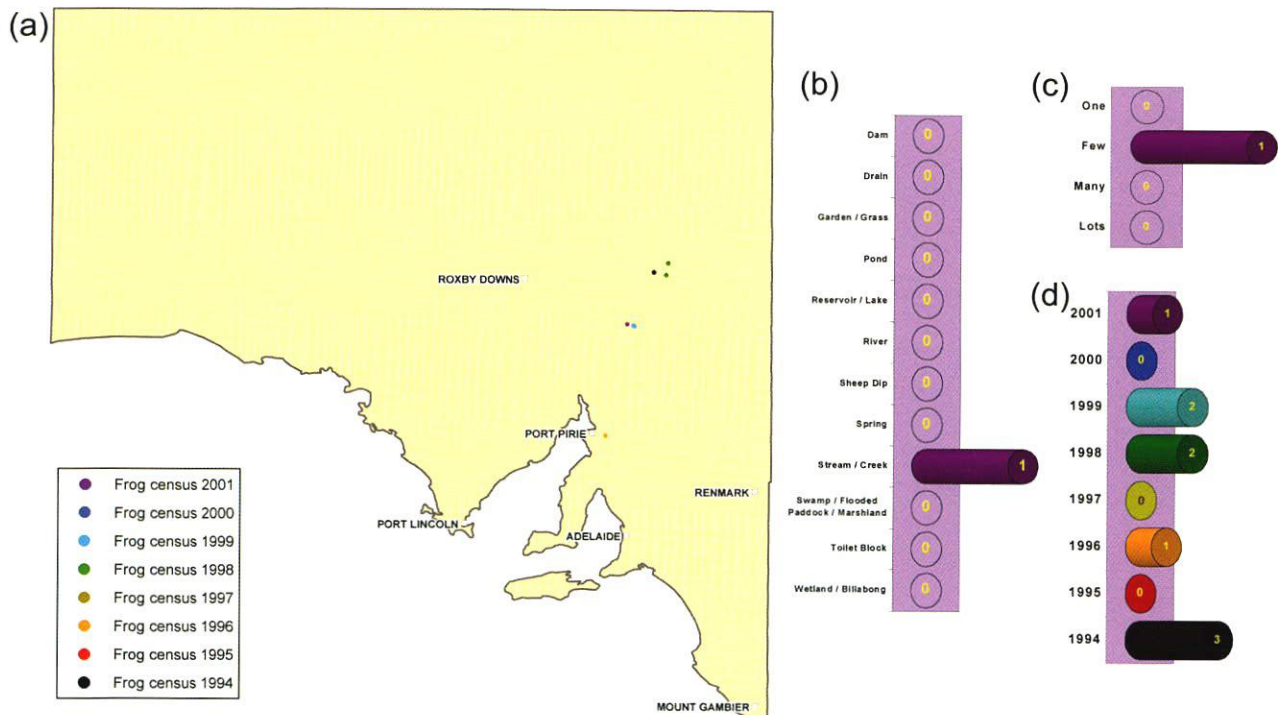


Figure 11 FROG CENSUS locations with the Streambank Froglet

3.5.2.3 Common Froglet (*Crinia signifera*)

The Common Froglet is the most frequently found frog in the Mount Lofty Ranges and the South East of South Australia. It also occurs on southern Eyre Peninsula, Yorke Peninsula and Kangaroo Island. This species has a highly variable skin colour and texture that may be plain, striped or spotted, smooth, warty or ridged. The belly is usually white with black markings.

The call of this species is a series of 'crick...crick...crick', repeated at varying intervals.



(Photograph: Steve Walker)

As in previous years, the Common Froglet was the most commonly recorded species in the FROG CENSUS, being taped on 85% of recordings. Common Froglets were recorded in every major habitat type (none was recorded in toilet blocks or disused sheep dips), although most were calling from streams and dams. Most sites had many (10–50) frogs (50.2%) or few (2–9) frogs (35%) calling. Once again, the Common Froglet was recorded calling from all parts of its known distribution, with the exception of the Yorke Peninsula, and does not appear to be experiencing any population declines.

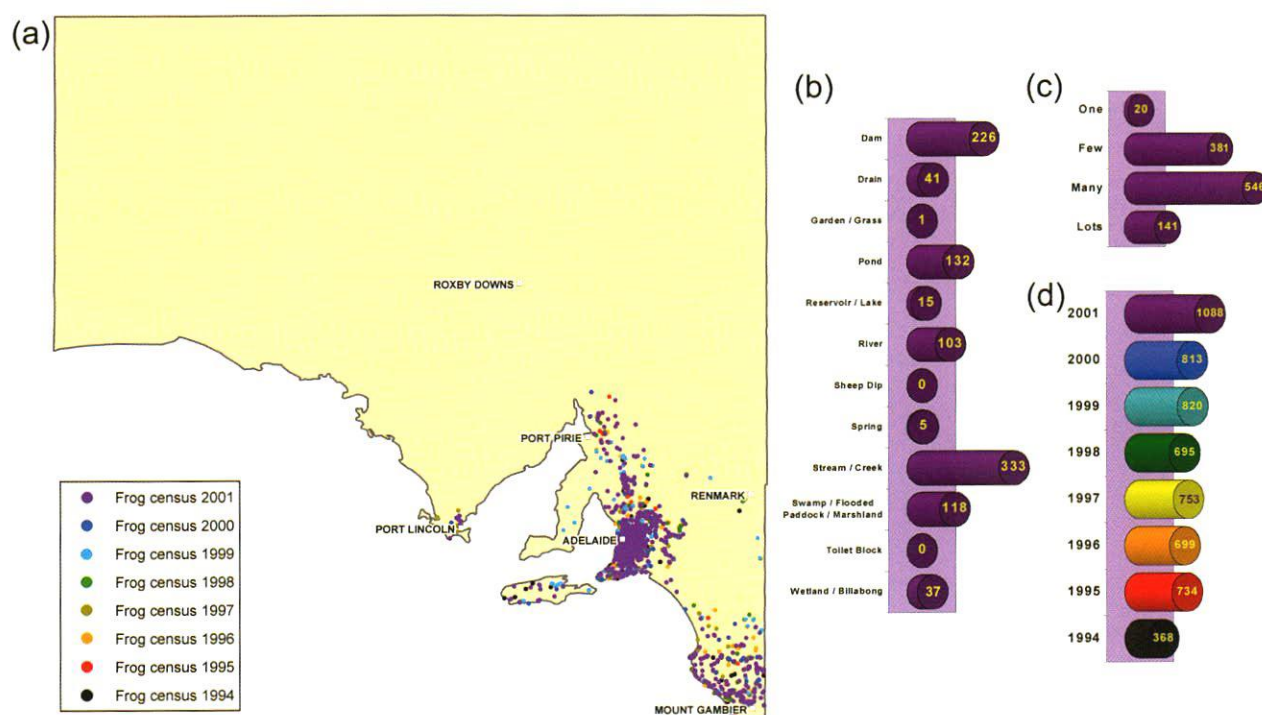


Figure 12 FROG CENSUS locations with the Common Froglet

3.5.2.4 Smooth Frog (*Geocrinia laevis*)

The Smooth Frog can be found in leaf litter in Eucalypt and pine forests that experience temporary flooding, in the lower South East of the State. It is a medium sized frog (22–35 mm) with short limbs and smooth skin. Pale pink patches are present underneath the legs and in the groin. The belly is mottled or densely covered with grey or dark brown flecks.



(Photograph: Steve Walker)

The Smooth Frog does not breed in water; instead, it lays large, unpigmented eggs in loose, elongated masses attached to moist vegetation. Following flooding, tadpoles hatch in the water and complete development in about six months.

The mating call is very similar to that of the Common Froglet and consists of one or more pulses, with the first often being longer than the rest—‘cra-a-a-a-a-ack...cra-a-a-ck...cra-a-ck’.

The Smooth Frog was recorded at three sites (0.2% of recordings), the highest number of recordings in the census to date. As suggested by its breeding requirements, it was only recorded in areas experiencing seasonal inundation. This species normally breeds before the spring rains and therefore only a low number of recordings is expected during September. Recordings were of few (2–9) or many (10–50) frogs.

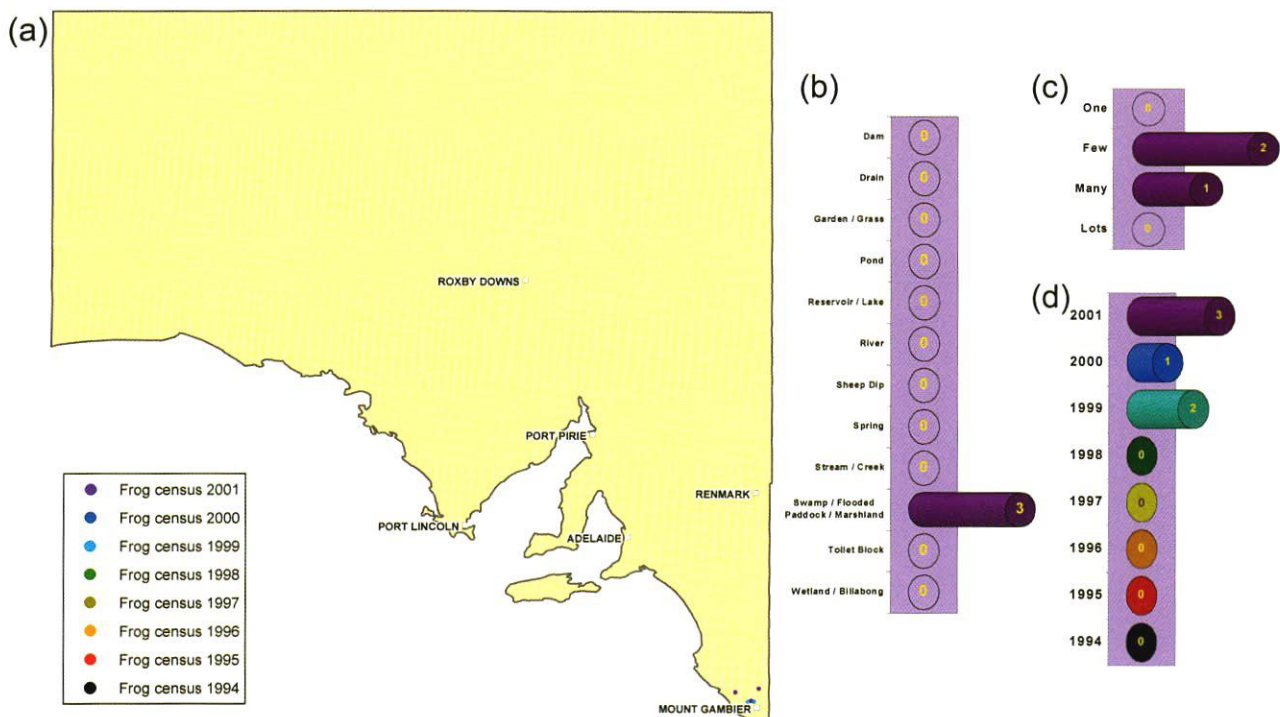


Figure 13 FROG CENSUS locations with the Smooth Frog

3.5.2.5 Eastern Banjo Frog (*Limnodynastes dumerili*)

The Eastern Banjo Frog is a common inhabitant of wetlands and rivers throughout the wetter parts of the State. During dry periods it lives in a burrow and is often dug up by gardeners, who may mistake it for a Cane Toad. It is a medium to large frog with a broad, rounded head and short, thick limbs. Large glands are present on the tibia and at the edge of the mouth. The body is rough and warty, varying from a pale grey to dark brown or black. The sides are commonly marked with bronze, purple or black.



(Photograph: Steve Walker)

Eggs are laid in a large foam nest attached to floating or emergent vegetation. The mating call is a loud, explosive 'bonk'.

The large number of Eastern Banjo Frog recordings (378, 29.5%) made in the 2001 FROG CENSUS is a very slight drop from the 2000 FROG CENSUS (384 recordings). Most recordings were of few (2–9) frogs (52.9%) or many (10–50) frogs (23.3%) and were made throughout its known distribution, with the exception of the Eyre Peninsula, where it was recorded for the first time in 2000. Like the Common Froglet, Eastern Banjo Frogs were found in all major habitats, with most recordings being taken at dams (25.9%). Other recordings were in areas with abundant water, not surprising considering that the tadpoles grow quite large and may take over a year to develop (Barker et al. 1995).

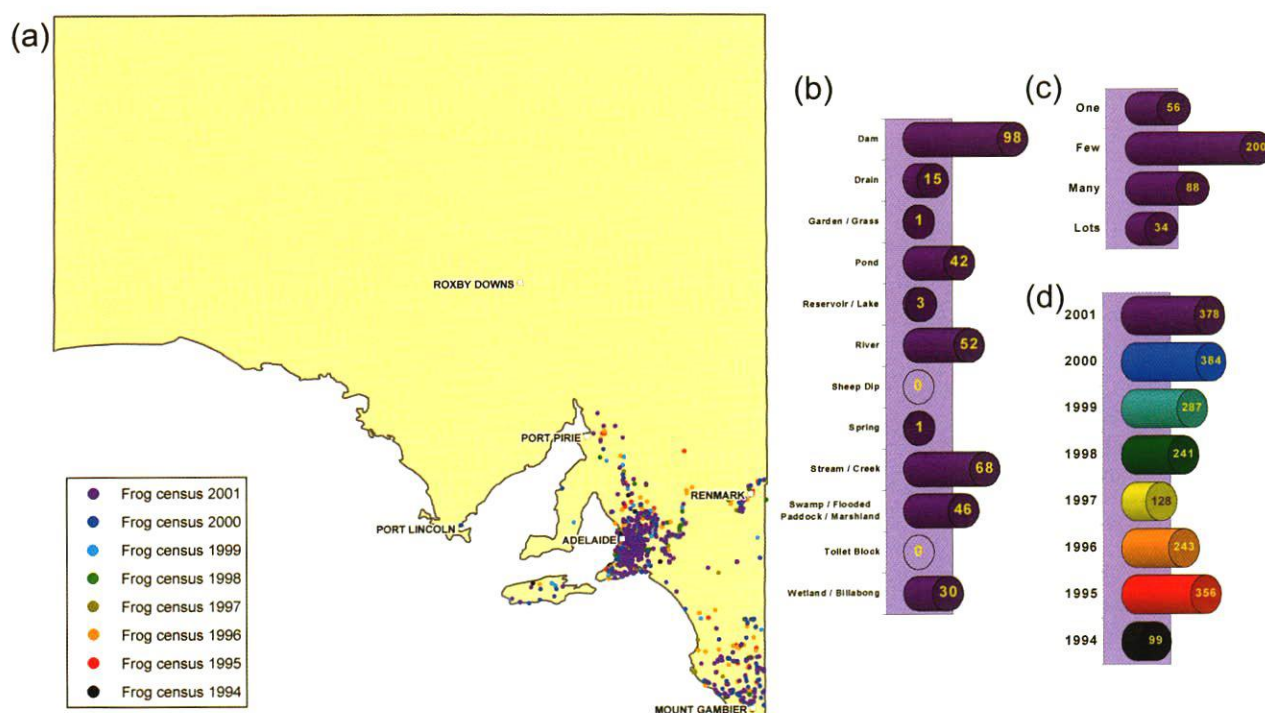


Figure 14 FROG CENSUS locations with the Eastern Banjo Frog

3.5.2.6 Long Thumbed Frog (*Limnodynastes fletcheri*)

In South Australia, the Long Thumbed Frog is restricted to the Murray Valley. It is a medium-sized frog characterised by rose-coloured patches above the eyes, irregular patches on the dorsal (top) surface, and a first finger (thumb) that is longer than the second. It is very similar in appearance to the Spotted Grass Frog (*Limnodynastes tasmaniensis*).



(Photograph: Steve Walker)

Breeding follows rains, with males calling from deep within clumps of floating debris. The mating call is like the sound of a distant barking dog ‘whuck.....whuck’. Eggs are laid in a foam nest.

As in 1997, only one recording was made of the Long Thumbed Frog in 2001, from a swamp at Point Sturt, near the mouth of the River Murray. The recording was of many (10–50) frogs. Barker et al. (1995) report that the breeding season for this species varies with the amount of rainfall. Therefore, it is not surprising that there have been very few recordings after the dry conditions experienced in 2001.

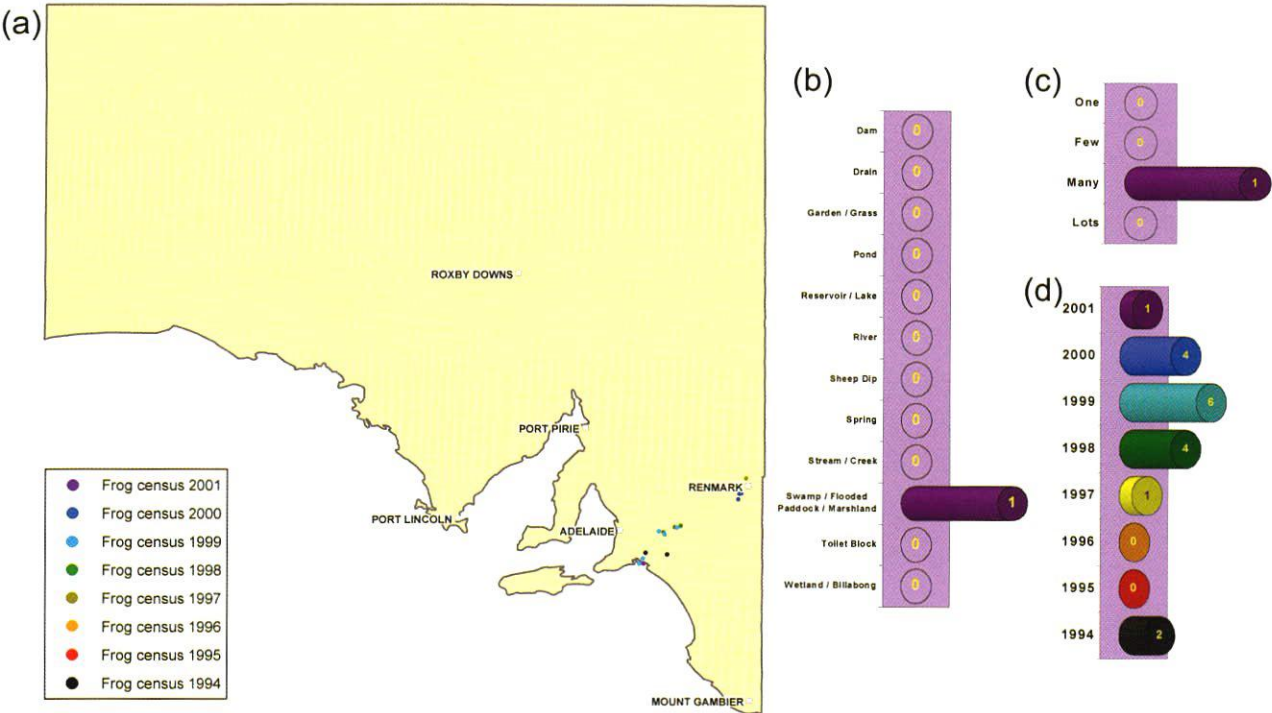


Figure 15 FROG CENSUS locations with the Long Thumbed Frog

3.5.2.7 Brown Striped Marsh Frog (*Limnodynastes peroni*)

The Brown Striped Marsh Frog is a medium-sized frog whose dorsal surface is marked with brown, longitudinal stripes. These stripes break up laterally to form a series of spots or blotches. The iris of the eye is golden at the top and dark brown at the bottom. A long spine on the tip of the male's first finger is used to improve grip during mating.

The mating call is a loud 'tok' or 'pok', much like the sound of a tennis ball being hit, or of corn popping.



(Photograph: Steve Walker)

Perhaps because of the Southern Bell Frog survey, (refer p.18), the 68 recordings of this species (5.3%) are the highest for the FROG CENSUS to date. The frog was abundant at most locations where it was recorded, with just two sites having only one frog calling. The majority of recordings (57.4%) were taken in swamps. An unusual recording was made of this species introduced into a pond in the Bicentennial Conservatory in the Adelaide Botanic Gardens.

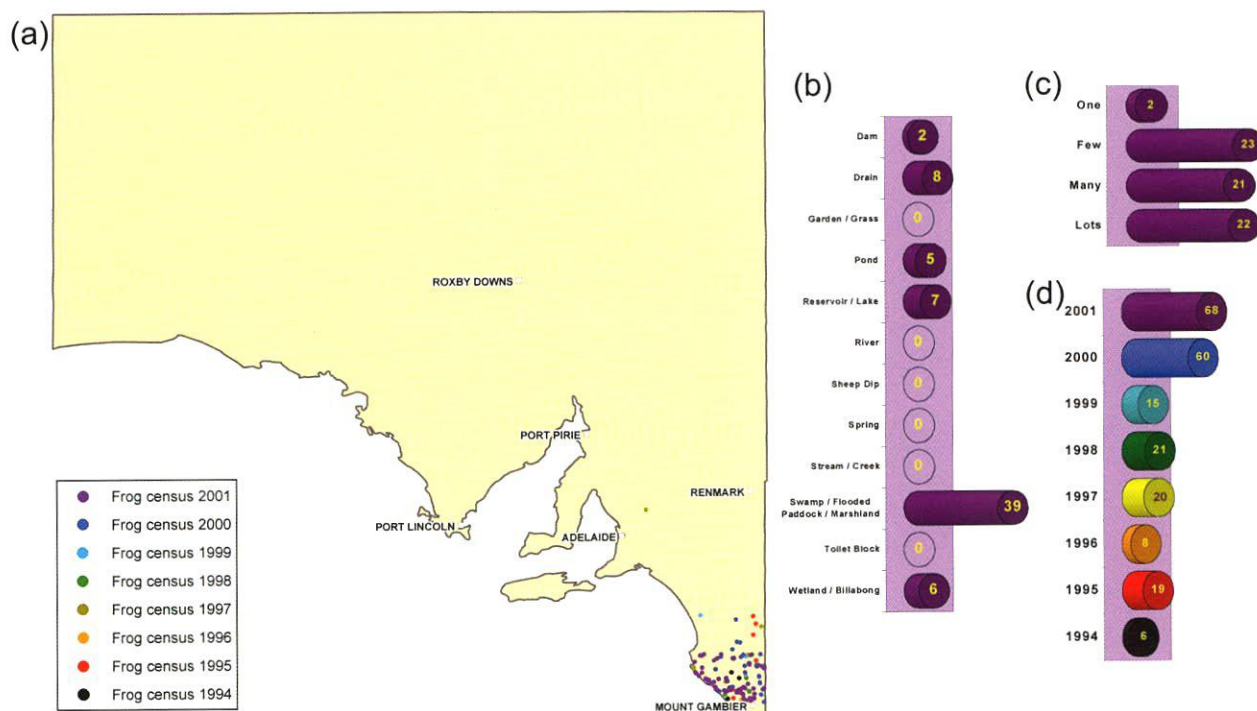


Figure 16 FROG CENSUS locations with the Brown Striped Marsh Frog

3.5.2.8 Spotted Grass Frog (*Limnodynastes tasmaniensis*)

The Spotted Grass Frog is the most common frog in Australia. It has olive-green or brown spots on a pale grey or brown back. The belly is smooth and white. Many specimens have a mid-dorsal stripe that may range from white or yellow through to rusty red. Adult males have a dark yellow or green throat. Females have large flanges (flaps of skin) on the first two fingers that are used to create a foam nest in which the eggs are deposited.



(Photograph: Steve Walker)

There are three different 'call races' present in South Australia: Southern—a single 'click' (South East), Northern—a rapid 'uk-uk-uk-uk' (Murray River and North East) and Western—two or three rapid 'clicks' (Mount Lofty and Flinders Ranges).

The 2001 FROG CENSUS recorded more Spotted Grass Frogs than any previous census, 493 recordings (38.5%). Once again, this species was the second most commonly recorded, continuing the pattern that has occurred since the program commenced in 1994. Recordings were made throughout its known range with the exception of the North East, where only a small number of sites were visited. It occurred in all habitats, except grassy areas in gardens and toilet blocks. Most recordings were made in dams (23.3%), streams (25.2%) and ponds (18.5%). Recordings were usually of few (2–9) frogs (56.2%).

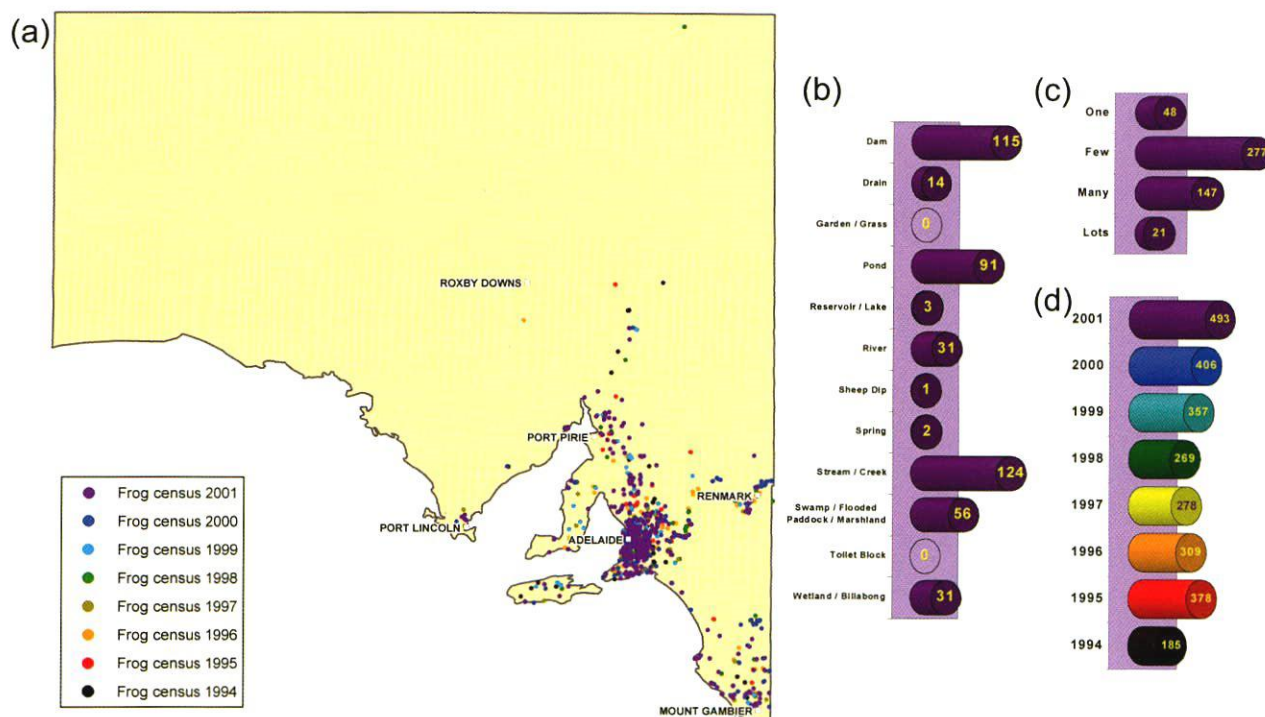


Figure 17 FROG CENSUS locations with the Spotted Grass Frog

3.5.2.9 Trilling Frog (*Neobatrachus centralis*)

The Trilling Frog is characterised by a high and broad head. Its colour is mostly sandy-grey to brown with irregular dark and light markings. The frog may also have a stripe running down its back. The eyes are large and the tympanum (ear) is not visible. The limbs are short, the toes are cylindrical and extensively webbed while the fingers have no webbing.

The call is a prolonged, loud and high-pitched trill.



(Photograph: Mike Tyler)

Although the Trilling Frog is one of the most widespread species in South Australia, it was only recorded from a single site in the Gawler Ranges. The recording was of few (2-9) frogs calling. Once again, this recording is outside the published distribution, but SA Museum records show the species to occur in the region.

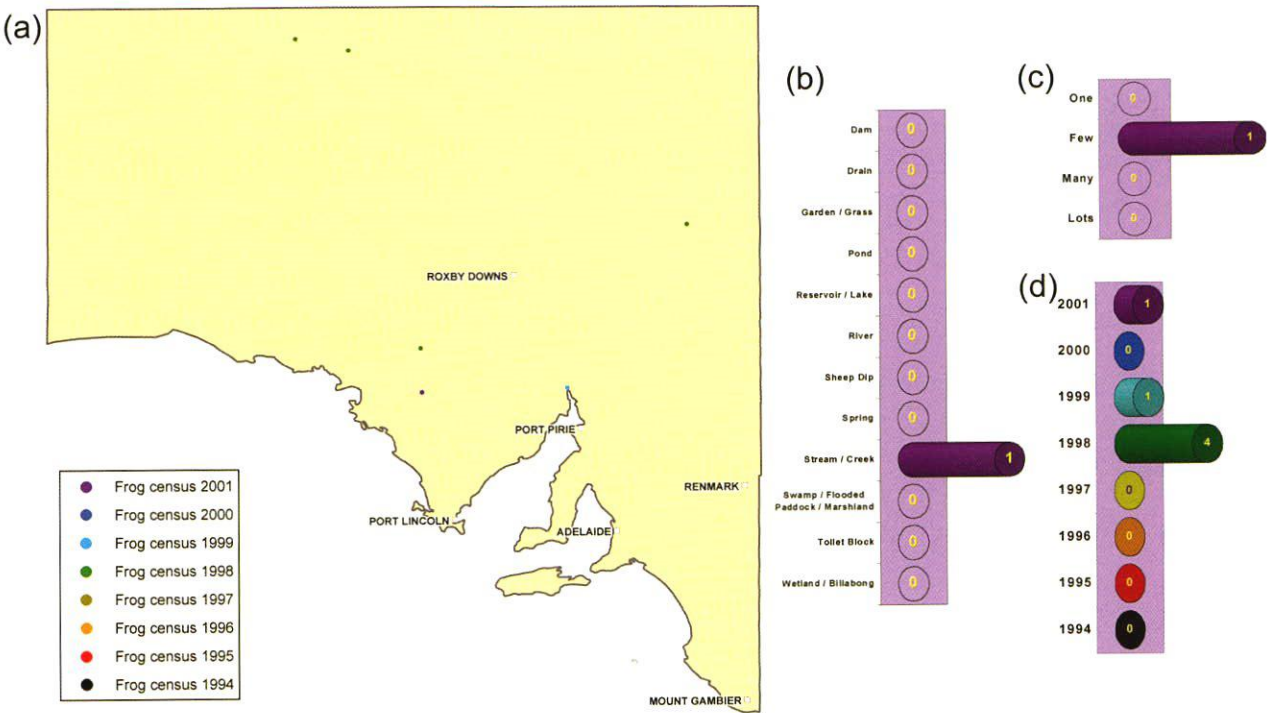


Figure 18 FROG CENSUS locations with the Trilling Frog

3.5.2.10 Painted Frog (*Neobatrachus pictus*)

Living in woodland, mallee, open or disturbed areas of South Australia, the Painted Frog has no obvious habitat preferences. The species is of moderate size (46–58 mm), with a stocky build and short limbs. It is generally a deep olive colour with darker markings on the head and body. The eyes are prominent and have a vertical pupil. The tympanum (ear) is not visible. The fingers are cylindrical and lack webbing, but the toes are extensively webbed. The skin is smooth, except during the mating season when the male will develop tiny black thorns.



(Photograph: Steve Walker)

The mating call is a long, rapidly pulsed, musical trill.

The Painted Frog was recorded calling from 24 sites (1.9%) in 2001, many more than have ever been recorded in the FROG CENSUS. The most likely explanation for the increase in recordings is because of the recent dry conditions. This species has a breeding season dependent on sporadic rain events. As the rains in the southern parts of the state did not occur until around the time of the FROG CENSUS, they were much more active than they have been in recent years. It was recorded throughout its range, except on the Yorke Peninsula. Most recordings (83.3%) were of few (2–9) frogs calling from dams (37.5%), streams (29.2%) and swamps (25%).

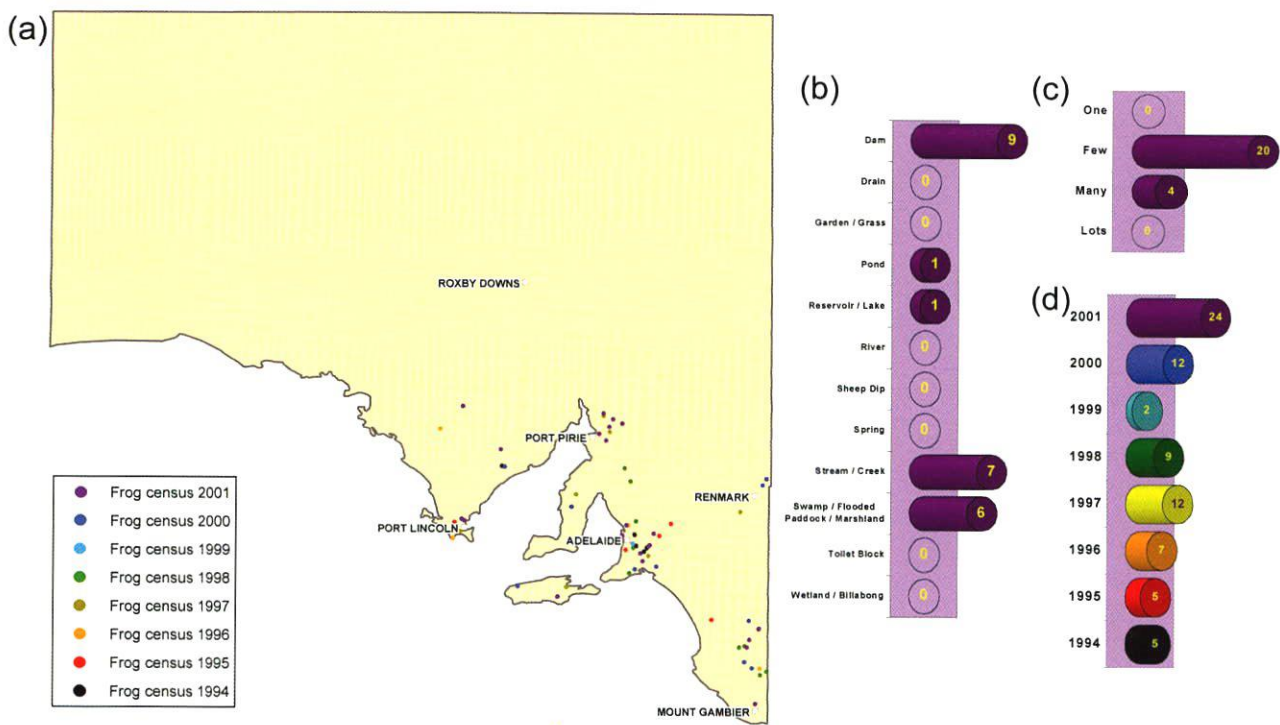


Figure 19 FROG CENSUS locations with the Painted Frog

3.5.2.11 Sudell's Frog (*Neobatrachus sudelli*)

Sudell's Frog is a small (38–49 mm) frog found in open grassland and wooded areas that can be distinguished by the distinctive patterns on its back. The marks are mostly olive or pale green on a dark brown or tan background. A stripe along its back may also be present. There is also a membrane of skin between the knee and the side of the body, which helps distinguish it from the Painted Frog.



(Photograph: Steve Walker)

The male call is a short, musical trill and is typically made while floating in the water. Spawn is deposited in elongated strands that become tangled in submerged vegetation. The tadpole is grey with a metallic sheen.

Twenty recordings (1.6%) were made of this species from a variety of habitats in the South East. Most (55%) were of many (10–50) frogs. As with the Painted Frog, it appears that the wetter conditions at the time of the FROG CENSUS correspond to the higher number of recordings of this species. In fact, the number of recordings made in 2001 is greater than the sum of all previous years.

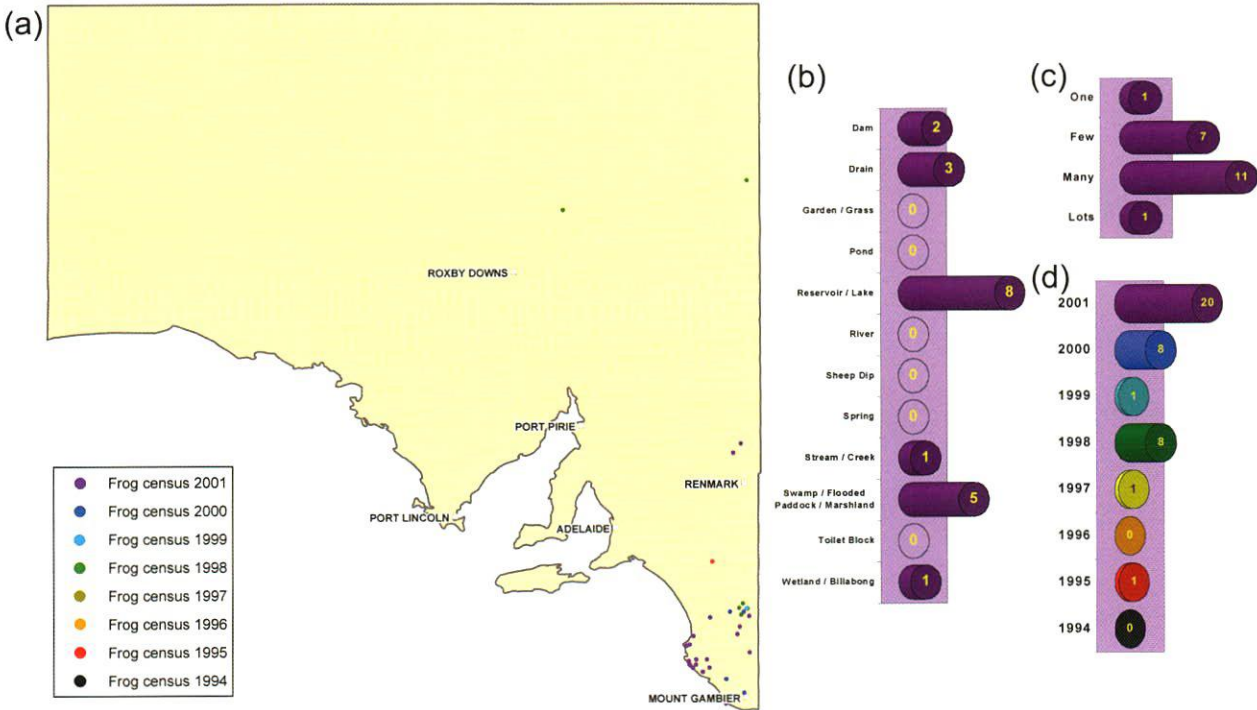


Figure 20 FROG CENSUS locations with Sudell's Frog

3.5.2.12 Bibron’s Toadlet (*Pseudophryne bibroni*)

Bibron’s Toadlet can be found singularly or in low numbers under rocks or logs and breed in well-vegetated areas beside creeks in the wetter parts of the State. The back is brown to almost black above with a scattering of darker flecks and reddish spots. It may have a pale vertical mark on the tip of its snout and a yellow area around the region of the cloaca. The belly is marbled with black and white.



(Photograph: Steve Walker)

The call is a short, grating, upwardly inflected ‘ark’ or ‘squelch’.

Bibron’s Toadlet was only present at two sites (0.2%). One of these was near Port Lincoln, on the Eyre Peninsula – a region where this frog was not known to occur. Bibron’s Toadlet lays eggs in a shallow burrow or in leaf litter on land, with males generally calling before the rains, usually between February and August. It is, therefore, not surprising that it was not recorded in large numbers. Despite the fact that this species is unlikely to be recorded during the FROG CENSUS and there is limited information available from this and other surveys, both locally and nationally, it is believed that population numbers around the country are undergoing decline. Increased urbanisation and habitat clearance may be major causes of decline.

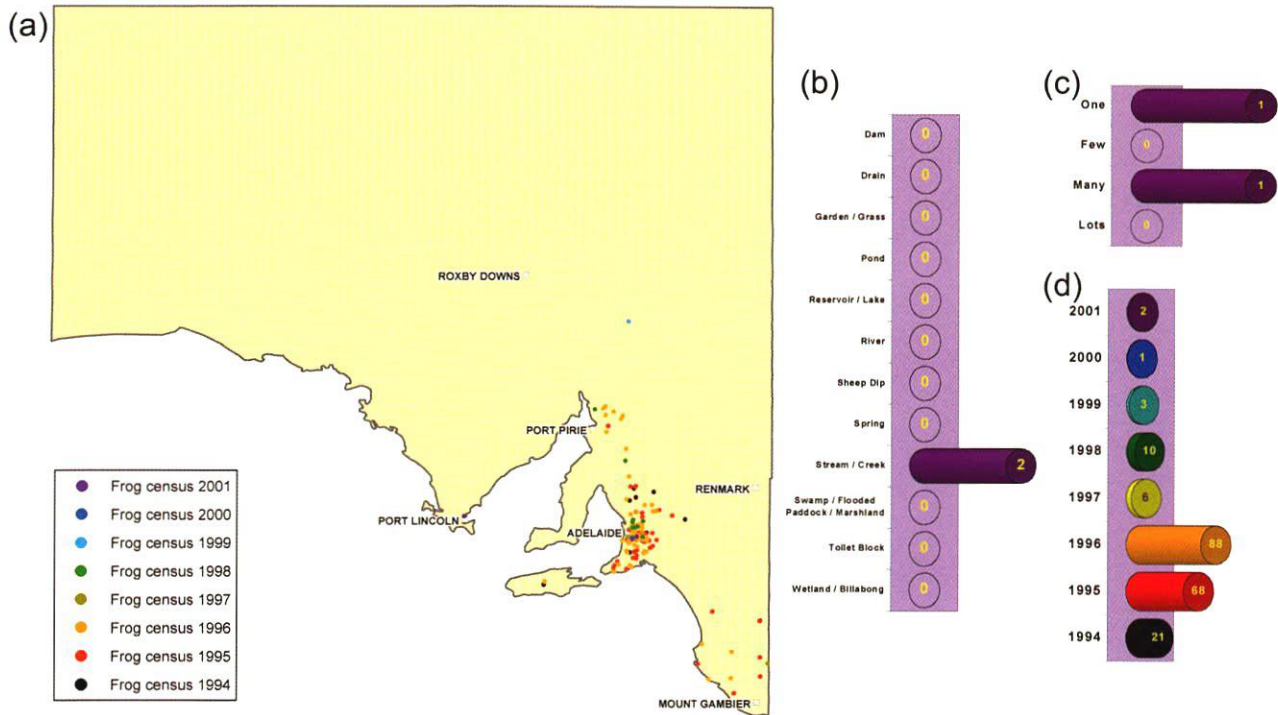


Figure 21 FROG CENSUS locations with Bibron’s Toadlet

3.5.3 NO FROGS RECORDED

In 2001, there were 52 recordings made that had no frogs (4.1%). This is a drop from the much higher numbers encountered in 1999 and 2000. Frogs may have been present but not calling when the recordings were made. In some cases, recordings had crickets or other insects calling, so it is possible that the participants had mistaken them for frogs. Sites with no frogs were scattered throughout the State, but many nearby sites had large numbers of frogs calling. Most records were from ponds (28.8%) and streams (23.1%). Perhaps local habitat issues are responsible for the lack of frog activity, at some of these sites.

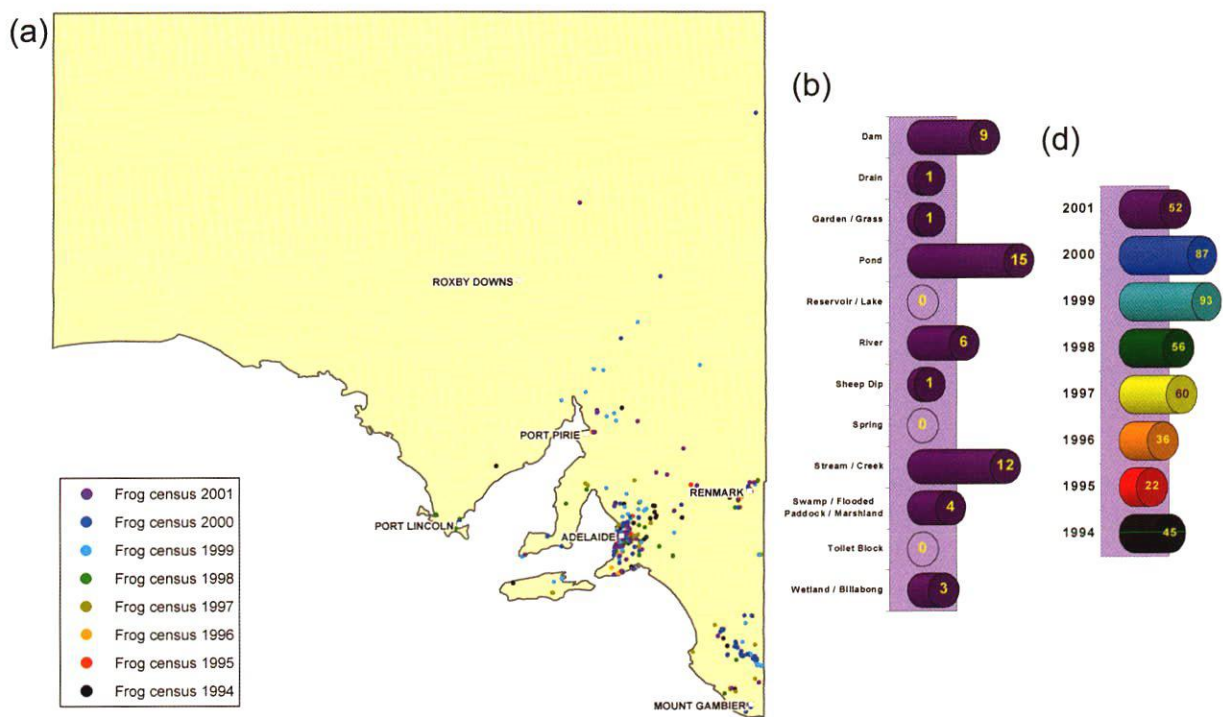


Figure 22 FROG CENSUS locations where no frogs were recorded

3.5.4 POOR QUALITY RECORDINGS

Sixteen recordings (1.3%) were of such poor quality that they did not allow an accurate estimate of frogs calling at the site. Some of these sites were reported by the participants to have frogs, but this could not be verified from the recordings returned.

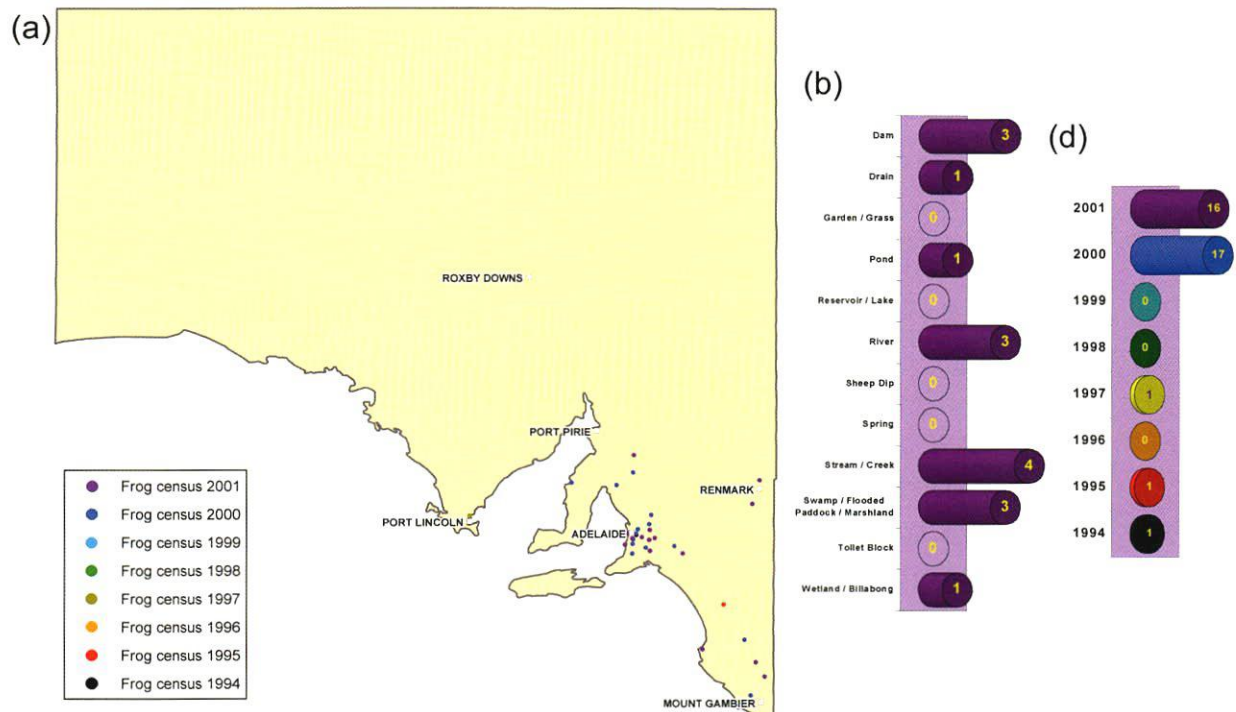


Figure 23 FROG CENSUS locations with poor quality recordings

4. DISCUSSION

The FROG CENSUS is the only large-scale program that records frogs throughout the State. It is being used to observe broad patterns and trends of species richness and, in conjunction with other EPA projects, is providing the framework to detect and monitor environmental impacts and changes over time.

The FROG CENSUS is a program in which the entire public of South Australia can become involved. It does not require any special knowledge or skills and enables the whole community to participate actively to enhance our knowledge of the condition of both the aquatic and terrestrial environments in South Australia. Participants in the program cover a wide age range—in many cases, the FROG CENSUS has become an activity in which the whole family engages and to which they look forward each year. The local knowledge of participants is a valuable resource that the EPA takes great pleasure in fostering. Comments suggest that it is helping to inform the wider community about catchment conditions and general environmental issues.

4.1 Talks, presentations and displays

Over the course of the last few years, FROG CENSUS has been promoted extensively through the media, but a large number of other public activities have also been successfully held. As well as displays for the Royal Adelaide Show (1998–1999) and World Environment Day (2000–2002), FROG CENSUS has also held displays at the Adelaide Zoo for National Frog Week (1999–2001) and a number of field and open days throughout the State. In addition, the author has given many talks to school and community groups during 2001 and 2002, including:

South Australian Science Teachers Association Conference
Elizabeth South Sea Scouts
CSIRO Double Helix Club
Craigburn Primary School
NP&WS (Berri) 'Wildshow'
Adelaide Zoo Teachers Forum
Over 60s Education Association
Onkaparinga Waterwatch Network
Port Adelaide Environment Forum
Environment Educators Landcare Forum
Barossa Valley & Districts Garden Club
Myponga Riparians Group
South Coast Orchid Club
Christian Boys College
Adelaide Gem & Mineral Club
Reynella South Primary School
Friends of Onkaparinga Park
North Ingle Primary School
Sheidow Park Primary School
Fourth Creek Catchment Group
Pagan Forum.

Over 1000 people not directly involved in the FROG CENSUS have been made aware of the program and environmental issues through these talks, displays and presentations. Countless more are aware because of reading or hearing about frogs and the program through media exposure.

APPENDIX 1: FROG CENSUS 2001 DATASHEET

10–16 September

Hints and Instructions

- **Please use a separate datasheet for each site** (neat hand-written is okay). (Sites less than 100m apart will be classed as one site, unless they are obviously separate waterbodies.) For your own safety, please make sure that you have permission to enter private property.
- The best time to make recordings is about 1–3 hours after dusk. Take a torch so that you can see where you are going and be careful. Turn the torch off when you are settled at the site (the frogs will probably go quiet when the light is on and you are moving around). If you talk or walk around, the frogs will probably stop calling, so it is best if you sit or stand still and remain quiet during the recording.
- At the start of the recording, state your name, the date, start time and location. Record any frogs calling for **at least 3 minutes**, but **no longer than 5 minutes**. ***It is very important to tell us if you didn't hear frogs calling.***
- Please check your recording to be sure that the frogs you heard calling at the site can be heard on tape. If you have any problems, such as the tape not working, please contact us for assistance, ph 8204 2099.
- On the label of the tape, write your name and location. Please rewind the tape after the recording.
- Please fill in **all** sections of the datasheet, **except** the end section (**office use only**).
- Above all else, **HAVE FUN!**

Observer Name:		
Postal Address:		
Postcode:		
Telephone:	Home	Work/Mobile
Do you want to be involved next year? <input type="checkbox"/> Yes <input type="checkbox"/> No		

OLD SITE	<i>(Please write the location name we used when we posted last year's results, and use a different datasheet for each site. If you are involved in Waterwatch, please put your Sitecode in addition to the FROG CENSUS location name)</i>
Site Name:	

NEW SITE	<i>(Only needed if this is a new site. If you are involved in Waterwatch, please put your Sitecode as well)</i>	
Site Name:		
Grid Reference OR GPS Reading OR Street Directory Reference		
Edition/Year:		Page Number:
Grid Reference:	E	N
Map Zone (52,53 or 54):		
<i>(We do not have every street directory and they change each year, so please give us lots of information to help us find it on a map—eg nearby street names, suburbs/towns, parks/reserves etc.)</i>		
HABITAT <i>(please select one habitat type that best reflects the major habitat at the site)</i>		
<input type="checkbox"/> Dam	<input type="checkbox"/> Drain	<input type="checkbox"/> Pond
<input type="checkbox"/> Reservoir or Lake	<input type="checkbox"/> Swamp or Flooded Paddock or Marshland	<input type="checkbox"/> Wetland or Billabong
<input type="checkbox"/> River	<input type="checkbox"/> Stream	<input type="checkbox"/> Spring

Date of Recording (eg 14/09/2001)
Starting Time (eg 20:30)

WATER QUALITY <i>If you can see the water, please indicate the condition of the site. Please select all categories that apply.</i> Water Appearance: <input type="checkbox"/> Clear <input type="checkbox"/> Polluted <input type="checkbox"/> Foamy <input type="checkbox"/> Oily <input type="checkbox"/> Muddy Comments or Observations:

FROGS HEARD CALLING Please indicate your estimate of the frogs you heard calling. (It is very important to tell us if you heard no frogs) How many types of frog did you hear calling? What was the total number of frogs you heard calling?

COMMENTS or OBSERVATIONS <i>Please tell us about any interesting things that happened during the census, or general comments and suggestions.</i>

Now we need you to return your datasheet and tape (please rewind the tape first) in the POSTpak (postage has been pre-paid) to: FROG CENSUS Environment Protection Agency REPLY PAID 2607 ADELAIDE SA 5001	Please send the tape back straight away or we may not be able to include it in this year's census. We need tapes returned by the beginning of December (please let us know if you cannot make this time). Thank you for being involved; we hope you had fun. We will identify your frog calls and let you know the results of your recordings.
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Office use only: Please don't fill in below here

	Species 1	Species 2	Species 3	Species 4	Species 5	Species 6	Species 7
Species Name							
One							
Few (2-9)							
Many (10-50)							
Lots (>50)							

ENVIRONMENT PROTECTION AUTHORITY
www.epa.sa.gov.au/frogcensus

APPENDIX 2: FROG CENSUS 2001 PARTICIPANT FEEDBACK



Volunteers

A big thank you to the dedicated frog volunteers (758 groups & individuals in the 2001 census). This is the eighth year that the FROG CENSUS has been running and we still have 35 volunteer groups who have been with us since the start. They have recorded consistently from 32 different locations. Long-term records are very important because they enable us to compare the frog species present at a site over a long period of time; it will allow us to see trends that may be masked by weather patterns or other events. With volunteers recording at the same sites each year, the data is that much more useful. There have been 200 volunteer groups and 216 sites in at least six of the eight censuses! That is a great level of participation and here at the Environment Protection Agency we really appreciate the effort. One of the great benefits of the FROG CENSUS is that volunteers can collect data from all over the state; scientists would never have the time or money to collect this amount of information.

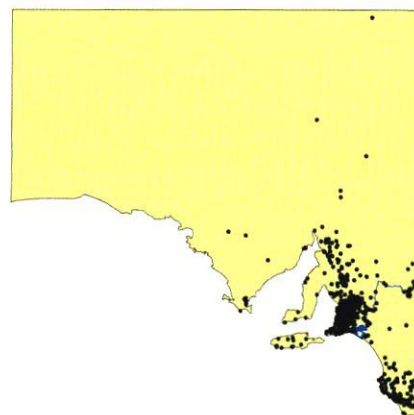
Testing. Testing. 1,2,3

Twelve hundred and sixty recordings were made from 1181 sites in the 2001 FROG CENSUS, the most we have ever had!

Sixteen species were recorded and, once again, the Common Froglet was the most abundant: 1087 recordings from 1011 different sites. Considering that 1260 recordings were made in the census, this species was on over 86% of all the tapes I listened to this year! The next most common species were the Spotted Grass Frog (492 recordings at 468 sites), Brown Tree Frog (392 recordings at 382 sites) and the Eastern Banjo Frog (377 recordings at 356 sites).

This is very similar to previous years, however there were significant increases in the number of sites where the Painted Frog (23 recordings) and Sudell's Frog (19 recordings) were recorded. This is probably due to the drier conditions experienced during the year. Following the rains in early September, many of these burrowing frogs emerged to breed – just at the right time of the year for them to appear in the FROG CENSUS.

The photograph on the right was taken in June 2001 of a young Sudell's Frog attempting to eat a large worm near Beachport in the South East. Amazing to watch!



Slippery little sucker!

Peron's Tree Frog has done it again! This species was believed to only occur in the Murray Valley in South Australia but, in the 2000 census, it was recorded in some Red Gum swamps in the South East. Now the 2001 census has recorded them calling from a dam in Mt Barker. As this species is starting to become popular as a pet and tadpoles can sometimes be bought from pet shops, it is possible that someone in the area released the frogs at Mt Barker. It is important to point out that you should only release frogs that are commonly found nearby. As a general rule-of-thumb, only let frogs go within 50km of their place of origin. If you do buy tadpoles to release on your property, try to make sure that they are local species and have been bred nearby.

High speed frogs!

There was an unusual recording from the Botanic Gardens Bicentennial Conservatory that played back at double speed, so I had to modify it on computer to hear it correctly. As yet, I have not been able to identify it with 100% accuracy, so I am contacting frog experts around the country to confirm its identity.

Site insights

Some of you will notice that sites you have visited have been given different names. This has been done in an attempt to standardise the format of site names, so that they are easier to locate on the database and also so that nearby sites can easily be distinguished. In the past, there have been a number of sites on the database that appeared to be located at the same spot, or different sites that were entered as one. For example, a number of sites monitored along Leabrook Drive on Fourth Creek at Rostrevor were all called *Fourth Ck, Leabrook Dr, Rostrevor*. The different sites have now been given different names corresponding to the nearest street corner. ie *Leabrook Dr & Forest Ave, Rostrevor* or *Leabrook Dr & Lynly Cres, Rostrevor*. Some sites on a single property or road have had the habitat type added to the name, this helps distinguish between dams, creeks, rivers etc. For example, *Marshall Rd, Lenswood, dam* and *Marshall Rd, Lenswood, creek*.

The format now used for site names is *Property or Major waterbody name (if needed), Road, Suburb, Habitat*.

As a result of changing the names, I may have introduced some errors, so please contact me if you think I have named the site incorrectly, or for any other changes that need to be made in the database. If you change your name or postal address, please let me know (or highlight it on the next datasheet). It really speeds up the data entry process if I don't have to search for the volunteer or site name that has been used in the past, so please remember these new names for this year. Hopefully, they won't get changed again.

Fabulous frog facts

South Australia's smallest frog is the Desert Froglet, which only grows to 2cm.

South Australia's biggest frog is the Green Tree Frog, in the wild it usually grows to about 11cm. They have also been known to live over 30 years in captivity!

The fastest developing frog in South Australia is the Desert Spadefoot Toad. It can grow from egg to frog in just 16 days!

South Australia's big breeders are the Eastern Banjo Frogs. They can produce about 4000 eggs in a single foam nest. However, this is much less than the Cane Toad, which can lay over 35,000 eggs!

Bibron's Toadlet, the Southern Toadlet, the Western Toadlet and the Smooth Frog are all terrestrial breeders. That is, they lay eggs in moist leaf litter on land. The tadpoles develop inside the eggs until rains come and flood the nest, causing the eggs to break open. The tadpoles then swim out and complete their development in the water. Metamorphosis can take around 7 months.

The Southern Bell Frog is a large green and brown frog that is found in areas of permanent water, such as the floodplain of the River Murray and swamps in the South East. The tadpole may reach 10cm in length and take over a year to develop. It was once abundant in the Mt Lofty Ranges, but has not been reported there since the late 1980s and it is believed to have declined substantially all over Australia. This frog is cannibalistic; a major food source is other little frogs!



Going on holiday?

So far, 23 of the 28 species of frogs known in the State have been recorded in the FROG CENSUS. Of these 28, 17 are known to occur in the arid and semi-arid zones (in fact, 14 are only found in these regions). In other words, half of the frog species in South Australia are found in the desert regions, where there is the smallest number of people living and recording for the census. Most of these species are burrowing frogs that spend much of their lives underground, only emerging after infrequent and relatively unpredictable rains. Usually these frogs are inactive during the September Frog Week period.

If you ever visit these arid zones, from the southern Flinders Ranges and beyond, at any time of the year, I would be delighted to receive any frog recordings or photographs you happen to take. As 2002 is the Year of the Outback, it would be great to get an increase in participation there this year. The information is most useful if you can give us an accurate indication of where the frogs were seen or heard, and when you encountered them. If you need audiocassettes or datasheets for your trip, I would be most happy to provide them to you.

The five species we have not yet had in the census and which you might see while in the arid areas are:

Small Headed Toadlet



Western Toadlet



Broad Palmed Frog



Desert Spadefoot Toad



Main's Frog



Frog files

The FROG CENSUS database has been shared amongst many students, groups and government agencies that need to know what frogs occur in any particular region (eg. for State of the Environment reporting or study projects). This information could be important for new development sites, particularly if a frog present at the site is of conservation significance. If official records of the frog populations exist, measures may be able to be taken to protect the frog. Many Catchment Water Management Boards have also accessed the database for evaluation of their management strategies. If you want information from the database, we are happy to provide it to you as well. The personal details of volunteers are removed to ensure privacy.

Frog Census 2002

I hope that you can be involved in the next FROG CENSUS. It will run from September 9–15. Put it in your diary, let's make it the biggest and best ever!

Beyond the pond

I have been asked how people can get involved in the Waterwatch program. Waterwatch is a national community water monitoring program that encourages all Australians to become involved and be active in the protection and management of their waterways and catchments. The Waterwatch network is made up of individuals, school and community groups who undertake a variety of biological, physical and chemical tests to build up a picture of the health of the waterways. If you want to get involved, contact your regional network coordinator or the State Project Officer. I have included a pamphlet about the program that has these details.

Talking frogs

If your school or community group would like me to come and talk about the FROG CENSUS and frogs in your area, I would be happy to oblige. Just contact me during office hours to organise a time – please give me plenty of notice to ensure I can organise display equipment and fit you into my busy schedule.



Showing frogs and talking to a school group at the Appila Field Day in Frog Week, September 2001.



An in-depth interview with Fatso, the Green Tree Frog!

Surfing frogs

For further contact details, more information about the FROG CENSUS or the frogs found in South Australia please visit our web page. You can find a copy of last year's report, pictures, calls and descriptions of the frogs, or even a key to identifying the frogs in your area.

If you do not have Internet access at home or work, most public libraries now have computers you can use to log on to the web.

www.epa.sa.gov.au/frogcensus

REFERENCES

- Alexandra, J., Haffenden, S. & White, T. 1996, *Listening to the land: A directory of community environmental monitoring groups in Australia*, Australian Conservation Foundation, Maryborough.
- Barker, J., Grigg, G. C., & Tyler, M. J. 1995, *A field guide to Australian frogs*, Surrey Beatty & Sons, Chipping Norton.
- Bayly, C., Hunwick, J., Hutchinson, M. & Mahony, M. 1990, *FROGWATCH resource materials*, South Australian FROGWATCH Committee, Adelaide.
- Bird, P. & Tyler, M. J. 1990, 'First South Australian record of the fossorial Leptodactylid frog Genus *Uperoleia* Gray', *Trans. R. Soc. S.Aust.*, vol 114, pp. 223-224.
- Brooks, A. J. 1984, *Atlas of frogs of South Australia*, Department of Zoology, University of Melbourne.
- Environment Protection Authority 2002, *Frog Census*, Environment Protection Authority, Adelaide, viewed 9 August 2002, <<http://www.epa.sa.gov.au/frogcensus/>>
- Gynther, I. 1995 'Treasure hunting', *Wildlife Australia*, Autumn, p. 28.
- Hunwick, J. 1991, *FROGWATCH field guide: A field guide to the frogs of South Australia*, School of Education, Flinders University, Adelaide.
- Johnston, G. R. 1990, '*Cyclorana maini* and *Notaden* sp.: Additions to the frog fauna of South Australia', *Trans. R. Soc. S. Aust.*, vol. 114, pp. 229.
- Mostyn, B. J. 1984, *Personal benefits and satisfaction derived from participation in urban wildlife projects*, Nature Conservancy Council, Social and Community Planning Research.
- Tyler, M. J. 1977, *Frogs of South Australia*, 2nd edn, South Australian Museum, Adelaide.
- Tyler, M. J. 1978, *Amphibians of South Australia*, Government Printer, South Australia.
- Tyler, M. J. 1994, *Australian frogs: A natural history*, Reed Books, NSW.
- Walker, S. J. & Goonan, P. M. 2001, *FROG CENSUS 2000: A report on community monitoring of water quality and habitat condition in South Australia using frogs as indicators*, Environment Protection Agency, South Australian Department for Environment and Heritage, Adelaide.