

FROG CENSUS 1998



Environment Protection Agency
Government of South Australia



FROG CENSUS 1998

June 1999

Cover Photographs

TOP: Water-holding Frog (*Cyclorana platycephala*)

MIDDLE: Trilling Frog (*Neobatrachus centralis*)

BOTTOM: Spencer's Frog (*Limnodynastes spenceri*)

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FROG CENSUS

1998

A Report on Community Monitoring
of Water Quality and Habitat Condition in
South Australia using Frogs as Indicators

By

SJ Walker, BM Hill and PM Goonan

SUMMARY

1. The FROG CENSUS is a community survey of frogs throughout South Australia, initiated and coordinated by the Environment Protection Agency (EPA).
2. The aims of the FROG CENSUS are to:
 - increase public awareness of the health of South Australian streams and rivers, particularly the River Torrens, Sturt River and River Murray
 - encourage public involvement in monitoring the water quality of our rivers, streams and wetlands
 - assess the current and long-term health of the State's rivers, streams and wetlands
 - assess the impact of EPA policies on water quality in this State.
3. 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.

Frogs recorded

4. The distribution of recordings in 1998 was similar to previous years, with sites concentrated around the Adelaide metropolitan area and the South East. However, the range of recordings extended from as far north as Pandie Pandie Station in the extreme North East, south to Port Macdonnell near Mount Gambier area, east to a site east of Paringa, and west as far as Agnes Creek near the border between South Australia and the Northern Territory.
5. The 1998 FROG CENSUS recorded the greatest diversity of species so far with 19 of the 28 frog species found in South Australia being taped. The highest number of species recorded from any location was seven from the River Murray downstream of Purnong Landing.
6. The Common Froglet (*Crinia signifera*) was the most commonly recorded species, representing 41.4% of the total number of frogs recorded. The next most common species were the Brown Tree-frog (*Litoria ewingii*) with 17.4%, Spotted Grass-frog (*Limnodynastes tasmaniensis*) with 16.1%, and Eastern Banjo-frog (*Limnodynastes dumerili*) with 14.4%. This is similar to previous years.
7. Species which were recorded at low frequencies included: the Water Holding Frog (*Cyclorana platycephala*), Green Tree Frog (*Litoria caerulea*), Peron's Tree Frog (*Litoria peroni*), Southern Bell Frog (*Litoria raniformis*), Red Tree Frog (*Litoria rubella*), Eastern Sign Bearing Froglet (*Crinia parinsignifera*), Streambank Froglet (*Crinia riparia*), Long Thumbed Frog (*Limnodynastes fletcheri*), Brown Striped Marsh Frog (*Limnodynastes peroni*), Spencer's Frog (*Limnodynastes spenceri*), Trilling Frog (*Neobatrachus centralis*), Painted Frog (*Neobatrachus pictus*), Sudell's Frog (*Neobatrachus sudelli*), Shoemaker Frog (*Neobatrachus sutor*), and Bibron's Toadlet (*Pseudophryne bibronii*).
8. The only species not recorded in 1998 which had previously been recorded in the FROG CENSUS was the Southern Toadlet (*Pseudophryne semimarmorata*).

Observer participation

9. The FROG CENSUS has grown considerably since its inception in 1994, with a total of 669 participants taking part in 1998. They recorded frogs from 790 locations.

ACKNOWLEDGMENTS

We would like to thank all participants, both old and new, for their enthusiasm and eagerness to get out and record the frogs calling from their waterways, regardless of weather conditions for the FROG CENSUS. Without them there would be no FROG CENSUS. We thank them for helping to make 1998 our most successful year.

The media were again very positive in their promotion of the FROG CENSUS, through various channels on television and radio, and in newspapers. Without their help many new participants would not have been aware of the programme.

Thanks to those people who kindly gave us permission to use the pictures shown on the web-page and in the discussion section of this document. Finally, thanks to David Gooding for assisting with the production of the maps and the web page.

CONTENTS

1. INTRODUCTION	1
2. METHODS.....	3
3. RESULTS.....	4
3.1 Observer and location details	4
3.2 Frog species abundance and distribution	4
3.3 Specific frog distribution and abundance	10
3.4 Species diversity	34
3.5 Distribution of frogs in catchments of the Mount Lofty Region	35
3.6 Participant survey	38
4. DISCUSSION.....	43
4.1 Frogs of South Australia	43
4.2 Frogs as indicators	46
4.3 Community education and involvement	47
4.4 Future directions	48
5. REFERENCES.....	50

LIST OF TABLES

Table 1. Number of observers and sites involved in the FROG CENSUS in 1994–1998.....	4
Table 2. Species counts for all sites recorded at in all FROG CENSUS years.....	7
Table 3. Frog species recorded by the FROG CENSUS in 1994–1998.	8
Table 4. Number of frogs recorded in each habitat in the 1998 FROG CENSUS	9
Table 5. Number of locations where different abundance values were recorded for each species of frog during 1998.	9
Table 6. Number of locations with different numbers of species present. Some sites were recorded multiple times.....	34
Table 7. Recordings made in the Mt Lofty Ranges during the 1998 FROG CENSUS.	36
Table 8. Age group and sex of participants in the FROG CENSUS, from mail out surveys. Total includes responses where sex was not specified.	38
Table 9. Responses from participant survey questions on whether their involvement in the FROG CENSUS had increased their awareness of their local environment. Total includes responses where number of years involved was not given.....	39

Table 10. Responses from participant survey questions about whether their involvement in the FROG CENSUS improved their knowledge of frogs and associated topics. Total includes responses where number of years involved is not given.....	40
Table 11. Topics that FROG CENSUS participants are interested in learning more about.....	42
Table 12. Regional variation of species diversity in the 1998 FROG CENSUS.....	47

LIST OF FIGURES

Figure 1 Geographic range of recording sites for the 1998 FROG CENSUS. Region names follow Tyler 1977.	6
Figure 2 FROG CENSUS recording location of the Water Holding Frog, <i>Cyclorana platycephala</i> . Published distribution range of this species is shown in the shaded area.	11
Figure 3 FROG CENSUS recording location of the Green Tree Frog, <i>Litoria caerulea</i> . Published distribution range of this species is shown in the shaded area.	12
Figure 4 FROG CENSUS recording locations of the Brown Tree Frog, <i>Litoria ewingii</i> . Published distribution range of this species is shown in the shaded area.	13
Figure 5 FROG CENSUS recording locations of Peron’s Tree Frog, <i>Litoria peroni</i> . Published distribution range of this species is shown in the shaded area.	14
Figure 6 FROG CENSUS recording locations of the Southern Bell Frog, <i>Litoria raniformis</i> . Published distribution range of this species is shown in the shaded area.	15
Figure 7 FROG CENSUS recording locations of the Red Tree Frog, <i>Litoria rubella</i> . Published distribution range of this species is shown in the shaded area.	16
Figure 8 FROG CENSUS recording locations of the Eastern Sign Bearing Froglet, <i>Crinia parinsignifera</i> . Published distribution range of this species is shown in the shaded area.	20
Figure 9 FROG CENSUS recording locations of the Streambank Froglet, <i>Crinia riparia</i> . Published distribution range of this species is shown in the shaded area.	21
Figure 10 FROG CENSUS recording locations of the Common Froglet, <i>Crinia signifera</i> . Published distribution range of this species is shown in the shaded area.	22
Figure 11 FROG CENSUS recording locations of the Eastern Banjo Frog, <i>Limnodynastes dumerili</i> . Published distribution range of this species is shown in the shaded area.....	23
Figure 12 FROG CENSUS recording locations of the Long Thumbed Frog, <i>Limnodynastes fletcheri</i> . Published distribution range of this species is shown in the shaded area.....	24

Figure 13 FROG CENSUS recording locations of the Brown Striped Marsh Frog, <i>Limnodynastes peroni</i> . Published distribution range of this species is shown in the shaded area.	25
Figure 14 FROG CENSUS recording locations of Spencer’s Frog, <i>Limnodynastes spenceri</i> . Published distribution range of this species is shown in the shaded area.	26
Figure 15 FROG CENSUS recording locations of the Spotted Grass Frog, <i>Limnodynastes tasmaniensis</i> . Published distribution range of this species is shown in the shaded area.	27
Figure 16 FROG CENSUS recording locations of the Trilling Frog, <i>Neobatrachus centralis</i> . Published distribution range of this species is shown in the shaded area.	28
Figure 17 FROG CENSUS recording locations of the Painted Frog, <i>Neobatrachus pictus</i> . Published distribution range of this species is shown in the shaded area.	29
Figure 18 FROG CENSUS recording locations of Sudell’s Frog, <i>Neobatrachus sudelli</i> . Published distribution range of this species is shown in the shaded area.	30
Figure 19 FROG CENSUS recording location of the Shoemaker Frog, <i>Neobatrachus sutor</i> . Published distribution range of this species is shown in the shaded area.	31
Figure 20 FROG CENSUS recording locations of Bibron’s Toadlet, <i>Pseudophryne bibronii</i> . Published distribution range of this species is shown in the shaded area.	32
Figure 21 FROG CENSUS recording locations where no frogs were recorded.	33
Figure 22 Frog species counts for catchments within the Mt Lofty Ranges.	37

1. INTRODUCTION

FROG CENSUS is a survey of frogs throughout South Australia initiated and coordinated by the Environment Protection Agency (EPA), and undertaken by people of the general community. The survey was developed as an extension of the State FROGWATCH programme (Bayly et al 1990, Hunwick 1991) which has been carried out by schools since 1991. FROG CENSUS provides a 'snapshot' of the distribution and abundance of frogs in the waterways of South Australia.

The EPA FROG CENSUS aims to:

- *increase public awareness* of the health of the State's waterways
- *encourage public involvement* in monitoring the health of the environment
- *assess the current and long-term health* of the State's waterways
- *determine the distribution* of frogs in South Australia.

Frogs are the highest form of life to lay a naked egg in water (Tyler 1994). This makes them sensitive biological indicators because any aquatic pollutant which comes into 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, for frogs to successfully complete their life-cycle they require a habitat free of environmental pollutants, and changes to the presence and abundance of frog populations may mirror those occurring to other organisms in the environment. Consequently, the census provides a simple assessment of the health of aquatic environments through the assumption that healthy catchments provide appropriate conditions for a diverse and abundant range of frog populations and, conversely, that unhealthy habitats have correspondingly reduced frog populations in terms of both diversity and abundance.

Every species of frog has a distinctive mating call and this allows frogs vocalising at a location to be accurately identified, another reason frogs are a useful biological monitor. This is particularly applicable in a community-based programme, embracing the valuable resource of public involvement, where participants do not require any previous experience in collecting samples or propensity for identifying frogs in the field.

In South Australia many of our rivers, creeks and wetlands have been degraded by different sorts of human-induced activities which 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 (eg spraying and removal of aquatic plants, excessive grazing); invasion by exotic species; and inappropriate floodplain and catchment development. These impacts have reduced the habitat available for aquatic and riparian fauna and flora, and increased erosion, and nutrient and salt inputs into waterbodies.

Catchment management, Landcare and Waterwatch groups have been very active in recent years tackling many of these issues relating to aquatic and riparian management, largely through revegetation and public education programmes. The FROG CENSUS provides a monitoring tool which can help assess the success of efforts being made to improve the condition of freshwater habitats in this State.

The FROG CENSUS also exposes the community to local environmental conditions. Participation in urban wildlife projects has been shown 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 et al 1996). Involving the community in monitoring 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 can lead to the discovery of new species records for specific areas (Gynther 1995).

The diversity of the frog fauna of South Australia is relatively low compared with the rest of Australia, with only 28 out of a total of 210 species described in Australia having been recorded in this State (Johnston 1990). The Streambank Froglet (*Crinia riparia*) from the Flinders Ranges is the only endemic species (Tyler 1994). 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.

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, Heritage and Aboriginal Affairs invited members of the public to register their interest at the EPA.
- All schools in the State were sent a promotional brochure through the Department of Education, Training and Employment.
- Promotional brochures were distributed at the Royal Show.
- In an effort to expand the geographic sampling range, station owners in the northern arid regions of the State were contacted by mail to inform them of the FROG CENSUS and encourage their registration.

All registered participants were sent a FROG CENSUS kit. The kit contained a blank audio cassette tape (30 or 60 minutes length), a return-addressed and postage-paid post-pak and a data sheet (Appendix 1). The data sheet described the aims of the FROG CENSUS and the methods to be used to record frog calls on the audio cassette. Participants were to provide their own recording equipment.

Most recordings were made during 'Frog Week' (7–13 September), predominantly between dusk and midnight. Locations were chosen by the participant. 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, observer and frog data were stored on an Oracle EDMS database at the EPA. Data were also converted and placed in to a Microsoft Access database for report writing and participant information retrieval. All maps were produced using MapInfo.

Participants were sent the results of their recording with specific information on the life history of each frog calling at the site where they recorded, and a general information sheet with overall results from the 1998 FROG CENSUS. This year participants were also sent a participant survey (Appendix 2) to be returned to the EPA. The aim of the survey was to evaluate the role of the FROG CENSUS in education and increasing awareness of frogs and local catchment health for participants.

Participant survey data were stored and collated in an Access database.

The distribution of each species recorded during FROG CENSUS was compared with the records published by Tyler (1977, 1978) and Brooks (1984). All scientific names follow those used by Tyler (1997).

3. RESULTS

3.1 Observer and location details

FROG CENSUS 1998 had 669 participants recording frogs from 790 sites throughout South Australia. Records totalling 1666 were obtained for frog abundance and distribution throughout the State. This is the largest number of records for the FROG CENSUS thus far.

Table 1 details the public participation in the FROG CENSUS for the past five years. This year the number of participants increased slightly. Although less sites were recorded this year the geographic range of recordings throughout the State widened (Figure 1). FROG CENSUS 1998 had the best coverage of the State in the five years that the programme has been running. Many new participants were from the north of the State, the Eyre Peninsula and the South East.

A total of 47 sites have been recorded every year the FROG CENSUS has been running. The number of species recorded for each of these sites during the census is listed in Table 2. It is pleasing to note that these sites cover a relatively wide area of the FROG CENSUS and includes sites in the Murray Valley, Mid-North, coastal regions, and much of the Mt Lofty Ranges. 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. Five years is a relatively low number of samples for a long term monitoring project. It is important that these sites continue to be monitored in the future for FROG CENSUS to provide information of the health of the frog fauna of South Australia over time.

Table 1. Number of observers and sites involved in the FROG CENSUS in 1994–1998.

	1998	1997	1996	1995	1994	Total
Observers	669	652	591	610	285	1804
Locations	790	812	786	787	456	1994

3.2 Frog species abundance and distribution

A total of 19 species were recorded in 1998 (Table 3). This is the highest number of species ever recorded in the FROG CENSUS, an increase of six species from 1997. Five previously unrecorded species were included in 1998: Red Tree Frog, Shoemaker Frog, Spencer's Frog, Trilling Frog and Water Holding Frog, all from the north of the State. The Southern Toadlet was the only species previously recorded by the FROG CENSUS that was not recorded this year.

Figure 1 shows the distribution of all FROG CENSUS sites used in 1998. The geographic range of recordings has widened considerably from 1997. In 1997 the northern most recording was from Hawker in the southern Flinders Ranges (Goonan et al 1998), in 1998 there were 15 records from 12 sites further north than Hawker. The most northerly recording was taken at Pandie Pandie Station near the Diamantina River in the extreme north-east of the State. The most southerly recording was, as in 1997, at Port Macdonnell in the South East. The eastern most recording was from the Murray Valley near Paringa. The western most site was at Agnes Creek, north of Marla near the Northern Territory border.

Many recordings were again made in the Mount Lofty Ranges and Fleurieu Peninsula. On the Eyre Peninsula recordings were made at the northern and

southern ends. Yorke Peninsula had recordings taken from the northern end, as in 1997, and from new sites in the south. The River Murray recordings were taken from along its length in South Australia, with an increase in recordings from the northern end. Kangaroo Island and the South East had a similar number of recordings to 1997.

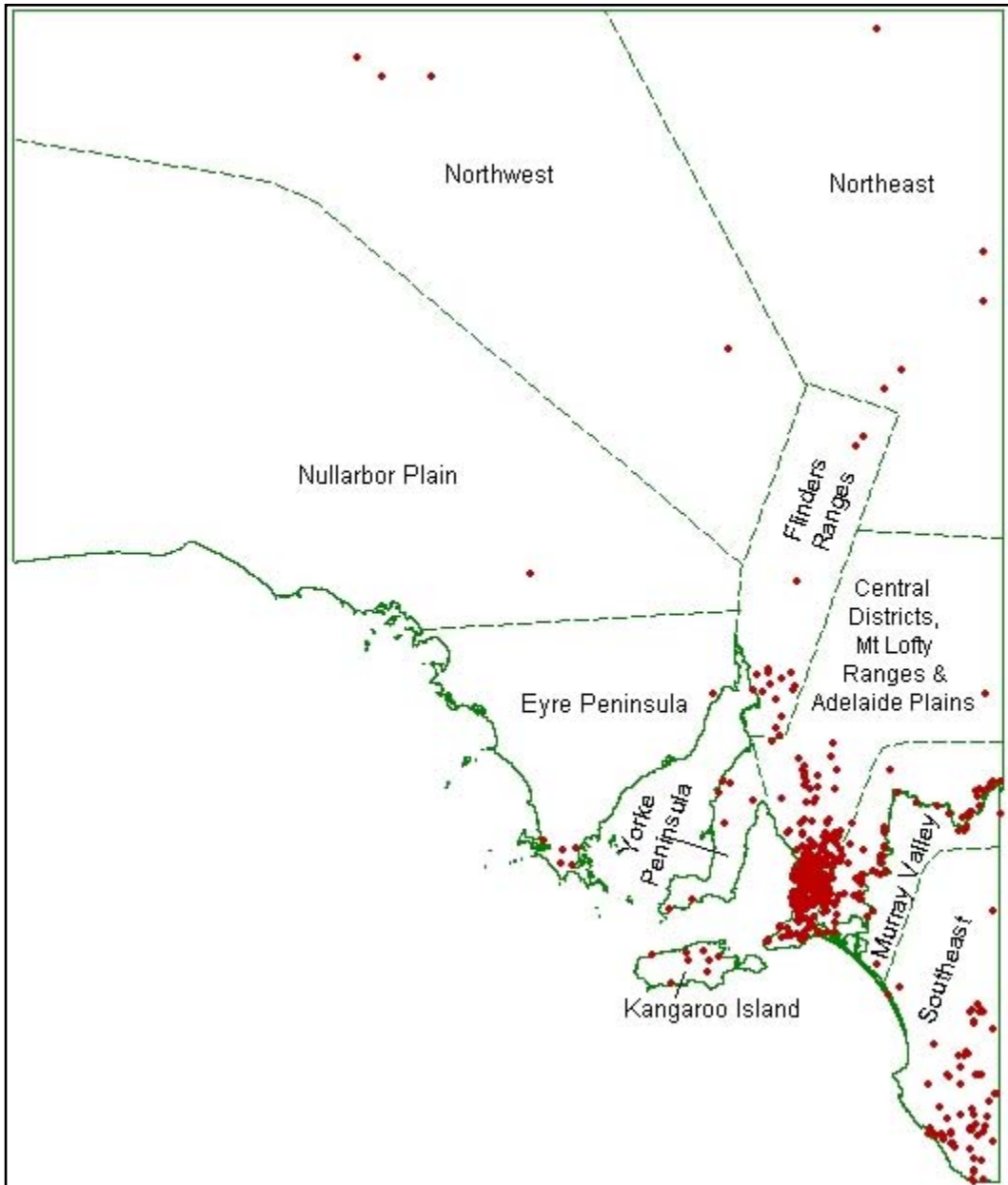


Figure 1. Geographic range of recording sites for the 1998 FROG CENSUS. Region names follow Tyler 1977.

Table 2. Species counts for all sites recorded at in all FROG CENSUS years.

Site name	Number of species				
	1994	1995	1996	1997	1998
Allan St, Vista	5	2	1	1	1
Angas River, Strathalbyn, adj bridge	1	2	1	1	2
Apex wetland on Burbridge Rd, West Beach	3	3	3	3	4
Arbury Park Outdoor School, Bridgewater	2	2	3	4	3
Bald Hills Rd, Mt Barker, creek	1	3	3	2	1
Bald Hills Rd, Mt Barker, dam	2	3	2	3	2
Bradey Rd, Windsor Gardens	2	3	1	1	3
Burra Creek, Thames St, Burra	2	1	1	1	1
Californian Cres, Glenalta	1	2	1	2	1
Dalton Ave, Aldgate	4	2	1	2	2
DeMole River, Kangaroo Island	1	1	1	1	2
Dry Creek, Modbury North	1	3	1	1	1
Ferry Crossing, Wellington	2	3	2	3	1
Fife St, Vale Park	1	1	1	3	1
First Creek, Hazelwood Park	1	2	1	1	1
Francis St, Port Adelaide	1	3	2	1	2
Goolwa Rd, Strathalbyn	2	3	3	3	1
Gorge Rd, Cudlee Creek	1	2	2	2	2
Grants Gully Rd, Clarendon	1	2	3	3	1
Hampstead Hill Rd, Aldgate, dam	2	3	2	3	3
Hawkers Creek Rd, Kapunda	1	2	2	2	2
Ironbank Rd, Ironbank	2	3	2	2	2
Kangarilla general store	1	2	1	1	2
Kingfisher Dr, Modbury Heights	1	1	1	1	1
Knotts Hill Rd, Ashton	1	1	1	1	1
Long Gully Rd, Mannum	3	4	3	2	3
Marshall Rd, Lenswood	3	2	2	2	2
Milne Rd, Ridgehaven	3	3	4	2	3
Morris Rd, Prospect Hill	2	3	1	1	1
North Bremer River Rd, Strathalbyn	2	2	1	1	2
Paech Rd, Wistow	1	2	3	2	2
Parawa Dam on trib of Yankalilla R, south site	3	2	1	2	2
Ray Orr Dr, Mt Barker	5	3	4	3	3
Renown Ave	1	1	2	3	2
Sabaruma Rd, Wongulla	4	5	3	2	4
Salter Springs Rd, Rhynie	1	3	1	1	1
Sandison Rd, Hallet Cove	1	1	1	1	1
Selma Ave, Hahndorf	2	2	4	3	3
Shannon Tce, Maitland	1	1	2	1	1
Smart and Hancock Rds, Tea Tree Gully	2	2	1	1	1
Springs Rd, Mt Barker Springs, site 1	2	3	4	3	4
Stoneybrook Dve, Paradise	1	1	2	1	1
Tugwell Rd, Encounter Bay	1	3	1	1	1
Waite Arboretum, Urrbrae	2	2	3	2	2
Waite Rd, Aldgate Dam 1	3	3	3	3	3
Walker Flat Rd, Mt Pleasant	2	2	1	2	2
Wall Irrigation Area, River Murray	3	3	2	3	3

Table 3. Frog species recorded by the FROG CENSUS in 1994–1998.

Species	Common name	1998		1997		1996		1995		1994	
		No. of records	% of total	No. of records	% of total	No. of records	% of total	No. of records	% of total	No. of records	% of total
<i>Cyclorana platycephala</i>	Water Holding Frog	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0
<i>Litoria caerulea</i>	Green Tree Frog	1	0.1	1	0.1	0	0.0	0	0.0	0	0.0
<i>L. ewingii</i>	Brown Tree Frog	289	17.3	263	17.2	192	11.7	198	11.4	84	10.5
<i>L. peroni</i>	Peron's Tree Frog	17	1	3	0.2	29	1.8	18	1.0	2	0.3
<i>L. raniformis</i>	Southern Bell Frog	17	1	3	0.2	15	1.0	19	1.1	1	0.1
<i>L. rubella</i>	Red Tree Frog	2	0.1	0	0.0	0	0.0	0	0.0	0	0.0
<i>Crinia parinsignifera</i>	Eastern Sign Bearing Froglet	24	1.4	14	1.0	30	1.8	20	1.1	3	0.4
<i>C. riparia</i>	Streambank Froglet	2	0.1	0	0.0	0	0.0	0	0.0	3	0.4
<i>C. signifera</i>	Common Froglet	690	41.4	743	48.9	679	41.3	690	40.0	347	43.4
<i>Limnodynastes dumerili</i>	Eastern Banjo Frog	239	14.4	124	8.1	230	14.0	330	19.0	91	11.4
<i>L. fletcheri</i>	Long Thumbed Frog	4	0.2	1	0.1	0	0.0	0	0.0	1	0.1
<i>L.s peroni</i>	Brown Striped Marsh Frog	21	1.3	20	1.3	2	0.1	18	1.0	6	0.8
<i>L. spenceri</i>	Spencer's Frog	2	0.1	0	0.0	0	0.0	0	0.0	0	0.0
<i>L. tasmaniensis</i>	Spotted Grass Frog	268	16.1	275	18.0	306	18.6	357	20.5	176	22.0
<i>Neobatrachus centralis</i>	Trilling Frog	4	0.2	0	0.0	0	0.0	0	0.0	0	0.0
<i>N. pictus</i>	Painted Frog	9	0.6	12	1.0	5	0.3	3	0.2	5	0.6
<i>N.s sudelli</i>	Sudell's Frog	8	0.5	1	0.1	0	0.0	1	0.1	0	0.0
<i>N. sutor</i>	Shoemaker Frog	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0
<i>Pseudophryne bibronii</i>	Bibron's Toadlet	10	0.6	6	0.4	90	5.3	63	3.6	21	2.6
<i>P. semimarmorata</i>	Southern Toadlet	0	0.0	1	0.1	2	0.1	0	0.0	0	0.0
No frogs		57	3.4	60	3.9	60	3.7	24	1.4	59	7.4

Table 4. Number of frogs recorded in each habitat in the 1998 FROG CENSUS

Species	Dam	Drain	Pond	River	Spring	Stream	Swamp	Wetland
<i>Cyclorana platycephala</i>	0	0	0	0	0	0	1	0
<i>Litoria caerulea</i>	0	0	0	0	0	1	0	0
<i>L. ewingii</i>	109	7	38	29	0	77	20	9
<i>L. peroni</i>	0	0	1	8	0	0	2	6
<i>L. raniformis</i>	0	0	0	2	0	0	3	12
<i>L. rubella</i>	0	1	0	0	0	1	0	0
<i>Crinia parinsignifera</i>	0	0	0	4	0	3	4	13
<i>C. riparia</i>	0	0	0	0	1	1	0	0
<i>C. signifera</i>	157	13	77	93	4	272	44	30
<i>Limnodynastes dumerili</i>	72	9	21	41	0	46	22	28
<i>L. fletcheri</i>	0	0	0	1	0	0	2	1
<i>L. peroni</i>	1	5	2	0	0	0	9	4
<i>L. spenceri</i>	1	0	1	0	0	0	0	0
<i>L. tasmaniensis</i>	68	7	34	31	0	80	19	29
<i>Neobatrachus centralis</i>	0	0	1	0	0	2	1	0
<i>N. pictus</i>	4	0	0	1	0	0	4	0
<i>N. sudelli</i>	2	0	2	0	0	2	2	0
<i>N. sutor</i>	0	0	0	0	0	1	0	0
<i>Pseudophryne bibronii</i>	2	1	1	1	0	4	1	0
No frogs	9	3	4	9	2	23	3	4

Table 5. Number of locations where different abundance values were recorded for each species of frog during 1998.

Species	Low (0–1)	Few (2–9)	Many (10–50)	Lots (>50)
<i>Cyclorana platycephala</i>	0	0	1	0
<i>Litoria caerulea</i>	0	0	1	0
<i>L. ewingii</i>	25	171	88	5
<i>L. peroni</i>	2	6	7	2
<i>L. raniformis</i>	1	7	8	1
<i>L. rubella</i>	0	1	1	0
<i>Crinia parinsignifera</i>	0	1	10	13
<i>C. riparia</i>	0	1	1	0
<i>C. signifera</i>	15	211	331	133
<i>Limnodynastes dumerili</i>	22	109	68	40
<i>L. fletcheri</i>	0	2	2	0
<i>L. peroni</i>	1	7	11	2
<i>L. spenceri</i>	0	0	2	0
<i>L. tasmaniensis</i>	32	141	75	20
<i>Neobatrachus centralis</i>	0	0	3	1
<i>N. pictus</i>	3	6	0	0
<i>N. sudelli</i>	0	4	4	0
<i>N. sutor</i>	0	0	1	0
<i>Pseudophryne bibronii</i>	5	4	1	0

Table 4 shows the number of records of each species from each habitat type. The greatest number of recordings was made at streams (31%) and dams (26%). The lowest number of recordings was made at springs.

Most recordings were of few (2–9) individuals of the same species. Table 5 shows the abundance of each species for each recording location.

3.3 Specific frog distribution and abundance

Figures 2–20, show the known distribution of each frog species within South Australia and the sites where each species was recorded in the 1998 FROG CENSUS. The distributions were adapted from Barker et al (1995) and Hunwick (1991) to fit the most accurate distribution available from current publications. These maps show how much of a species range is sampled during the FROG CENSUS, where species records occur outside the known range (if recorded by the FROG CENSUS) and areas where a species has not been recorded within its known range. Details on the abundance, distribution and habitats for each species recorded by FROG CENSUS 1998 are presented below.

3.3.1 FAMILY HYLIDAE

Water Holding Frog *Cyclorana platycephala* (Figure 2)

This species was recorded for the first time in the 1998 FROG CENSUS. It was recorded from a single site at Cameron's Corner, which is near the border between South Australia, Queensland and New South Wales. It was recorded with an abundance of many (10–50) in a swamp. A photograph of the species from the same location in July 1998 was sent with the datasheet.

Green Tree Frog *Litoria caerulea* (Figure 3)

The Green Tree Frog was recorded for the second time in 1998. It was recorded outside its known distribution at Agnes Creek. The single recording makes up only 0.1% of all recordings, but many (10–50) frogs were calling.

Brown Tree Frog *Litoria ewingii* (Figure 4)

The Brown Tree Frog made up 17% of the recordings for 1998, from 289 sites. Records were from all habitats, with the exception of springs. Recordings covered every abundance category, but most (59%) were of few (2–9) frogs. Almost one third of recordings were of many (10–50) frogs. All recordings were made within the published distribution of this species in South Australia.

Peron's Tree Frog *Litoria peroni* (Figure 5)

The number of Peron's Tree Frogs increased in 1998 to close to those recorded in 1996 and 1995, (17 recordings representing 1%), probably as a result of wetter conditions. Almost half (41%) of the recordings were for many (10–50) frogs, 35% were of few (2–9), with a small number of sites (2) having lots (>50). All recordings were made within the known distribution in the Murray Valley and consequently, recordings were only made in ponds, rivers (47%), swamps (18%) and wetlands (35%).

Southern Bell Frog *Litoria raniformis* (Figure 6)

Following the wet conditions experienced between FROG CENSUS 1997 and 1998 the number of recordings of the Southern Bell Frog jumped from a low of 3 (0.2%) in 1997 to 17 (1%) in 1998, similar to the pattern observed for Peron's Tree Frog. Recordings were made throughout its range in the Murray Valley, and also from a site in the South East, where it was not recorded in 1997.

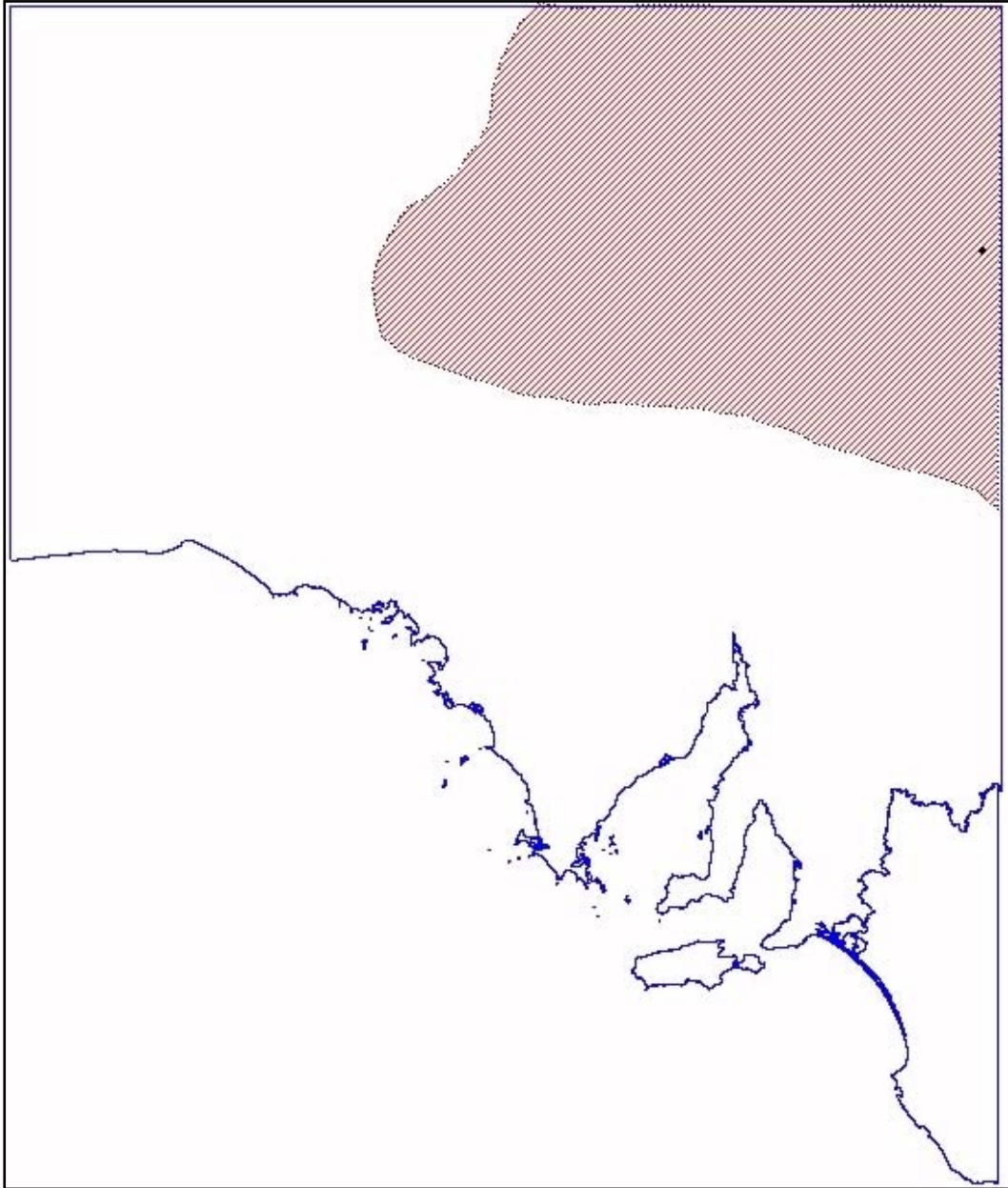


Figure 2. FROG CENSUS recording location of the Water Holding Frog, *Cyclorana platycephala*. Published distribution range of this species is shown in the shaded area.

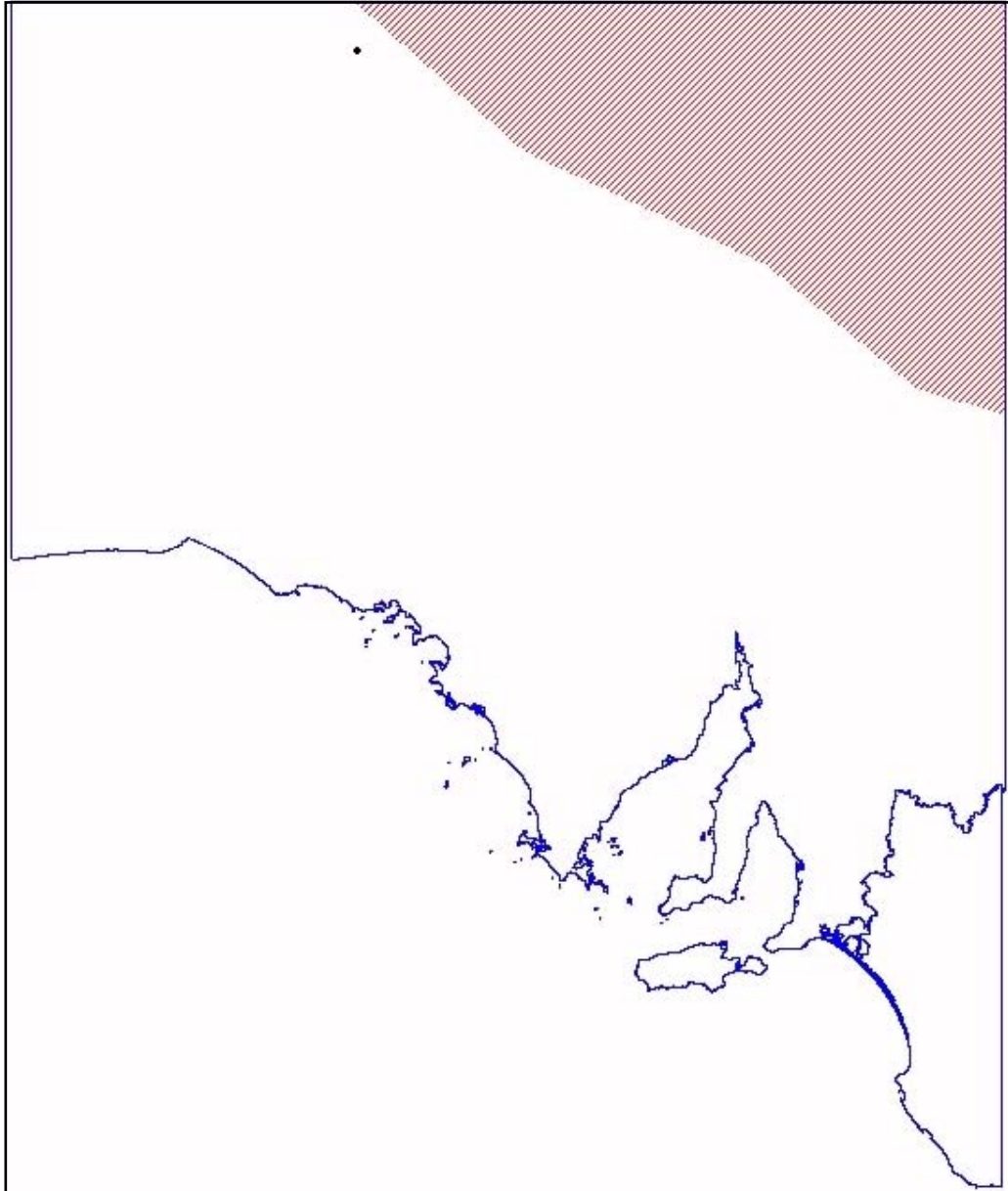


Figure 3. FROG CENSUS recording location of the Green Tree Frog, *Litoria caerulea*. Published distribution range of this species is shown in the shaded area.

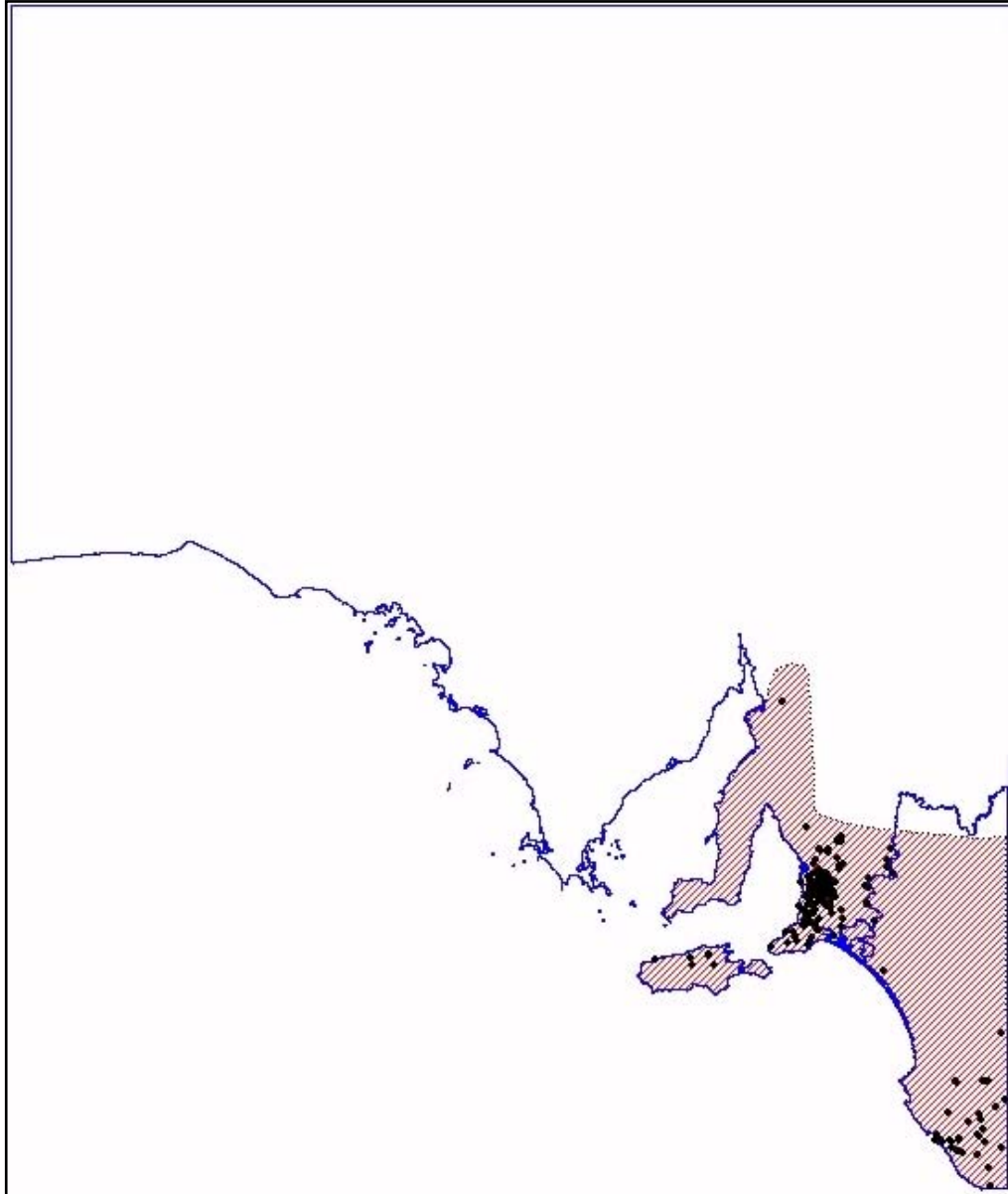


Figure 4. FROG CENSUS recording locations of the Brown Tree Frog, *Litoria ewingii*. Published distribution range of this species is shown in the shaded area.

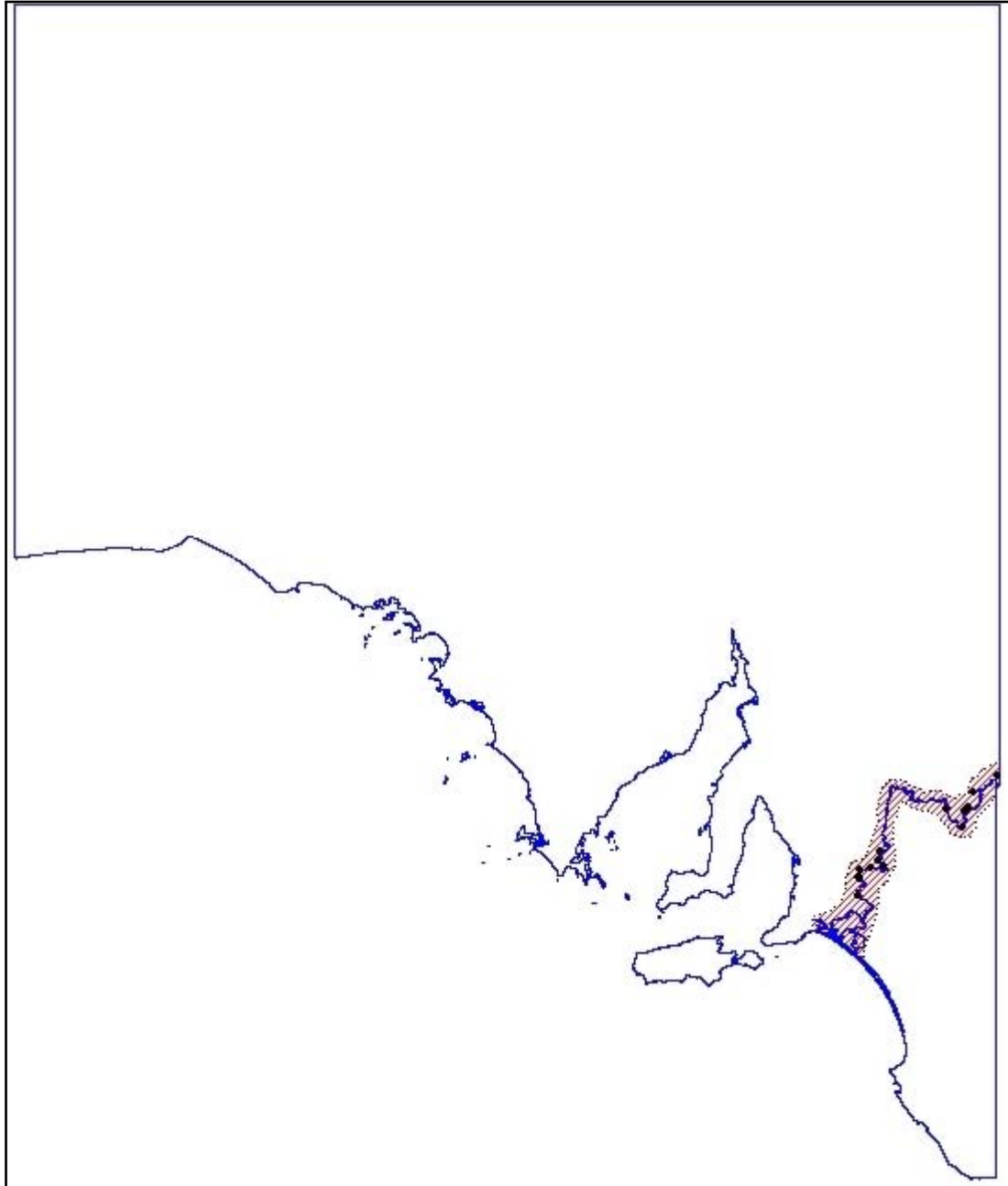


Figure 5. FROG CENSUS recording locations of Peron's Tree Frog, *Litoria peroni*. Published distribution range of this species is shown in the shaded area.

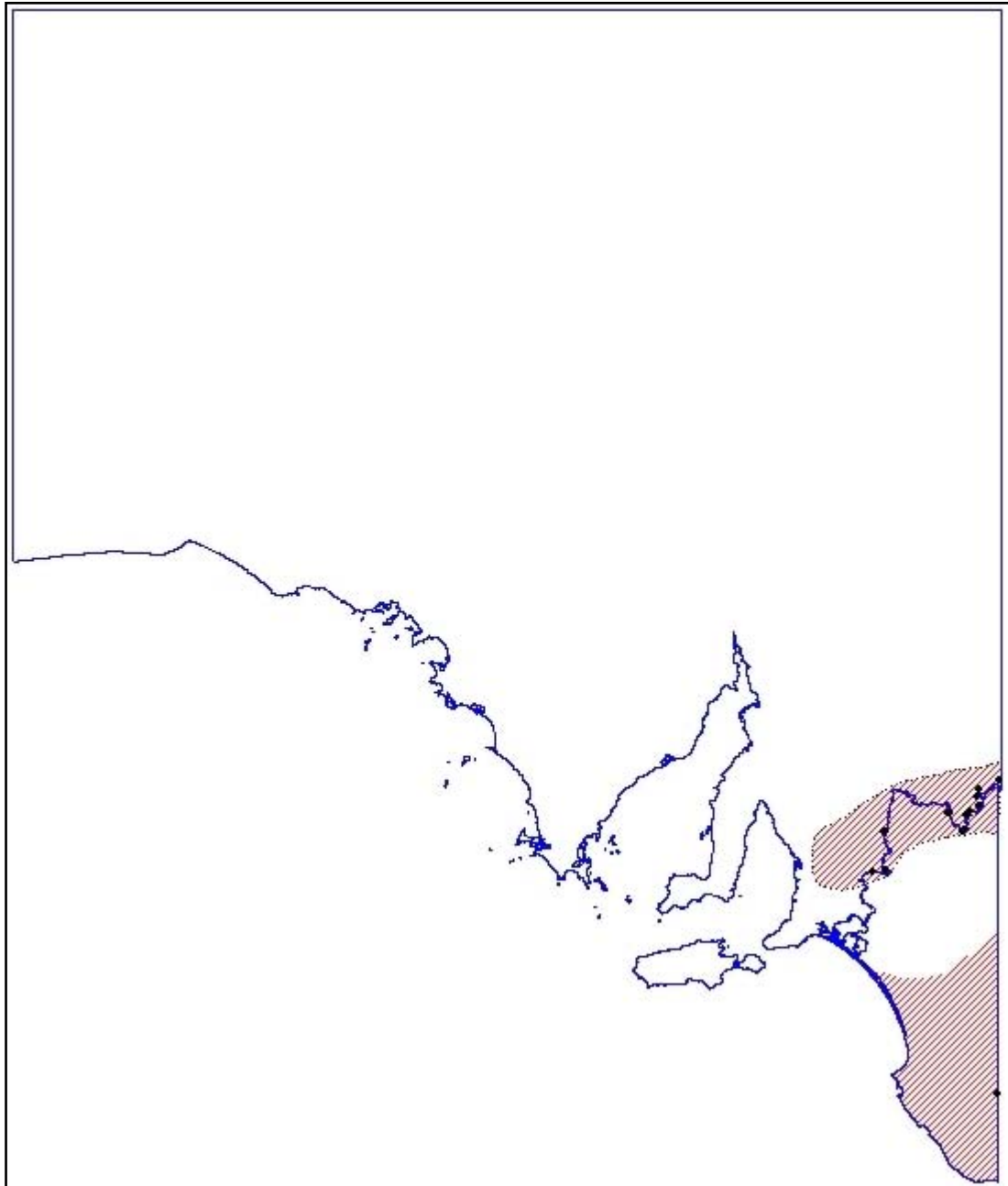


Figure 6. FROG CENSUS recording locations of the Southern Bell Frog, *Litoria raniformis*. Published distribution range of this species is shown in the shaded area.

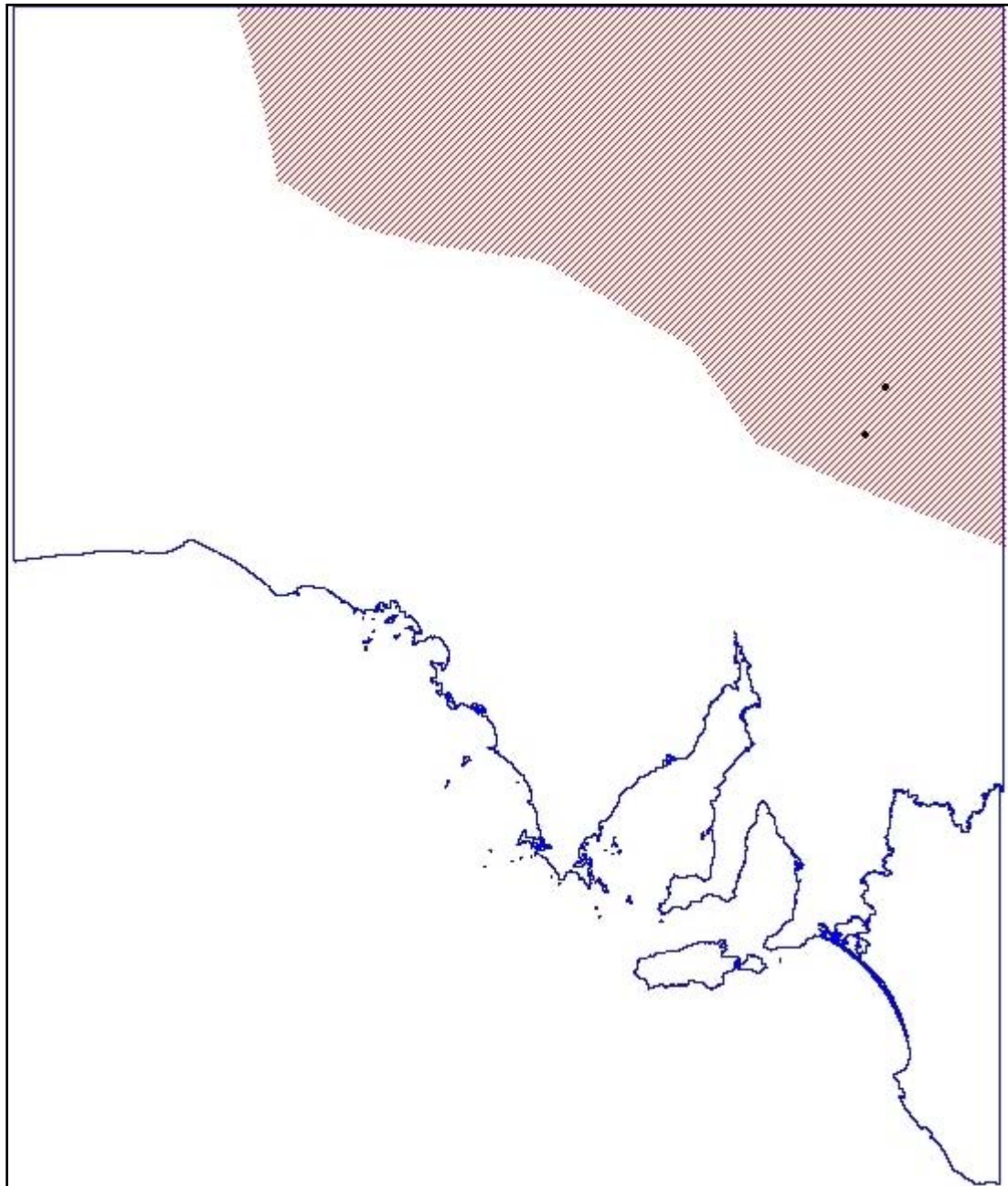


Figure 7. FROG CENSUS recording locations of the Red Tree Frog, *Litoria rubella*. Published distribution range of this species is shown in the shaded area.

The abundance of frogs was from all categories, with most sites having many (10–50; 47%) or few (2–9; 41%) frogs. All recordings were taken in typically wet habitats; rivers (12%), swamps (18%) and wetlands (71%).

Red Tree Frog *Litoria rubella* (Figure 7)

The Red Tree Frog was recorded for the first time in the 1998 FROG CENSUS from two locations within the Flinders Ranges region. Few (2–9) were recorded at a drain and many (10–50) from a stream. Recordings of this species represent only 0.1% of the total. A participant's observation of the Brown Tree Frog, *Litoria ewingii*, from the extreme north-east of the State was probably the Red Tree Frog but this could not be confirmed from the recording.

3.3.2 FAMILY LEPTODACTYLIDAE

Eastern Sign Bearing Froglet *Crinia parinsignifera* (Figure 8)

Although there was an increase in the number of Eastern Sign Bearing Froglet recordings (24 in 1998) this species still only made up a small percentage of the total number of recordings (1%). All records were made within the known distribution of this species, covering the extent of its range along the River Murray, excluding a small area around Morgan where recordings were taken but were mostly of no frogs (Figure 21). Most recordings were of lots (>50; 54%) or many (10–50; 42%) frogs so populations of this species appear large and healthy (Table 5). Most recordings were from wetlands along the River Murray (Table 4).

Streambank Froglet *Crinia riparia* (Figure 9)

The distribution of this species is restricted to streams in the Flinders Ranges. The number of FROG CENSUS sites in the Flinders Ranges has been low in recent years. The Streambank Froglet was recorded by FROG CENSUS 1998 for the first time since 1994. Many (10–50) froglets were recorded at Weetootla Creek in the Gammon Ranges and few (2–9) were recorded at Bollobollana Springs in the Flinders Ranges.

Common Froglet *Crinia signifera* (Figure 10)

The Common Froglet was the most common species recorded in 1998, making up approximately 40% of all calls recorded. There were slightly less Common Froglets recorded this year than in 1997, but as a proportion of total recordings this species has consistently made up just under half of all calls recorded in all years (Table 3). Common Froglets were recorded in every habitat type, although most were from streams (40%) and dams (22%) (Table 4). A participant's observation of this species from the extreme north-east of the State was possibly the Desert Froglet, *Crinia deserticola*, but this could not be confirmed from the tape recording. Hopefully this site will again be sampled in 1999.

Eastern Banjo Frog *Limnodynastes dumerili* (Figure 11)

A similar number of Eastern Banjo Frog recordings were made in 1998 and 1997, but they made up a higher proportion of calls (14%) in 1998, compared to 8% in 1997. Recordings were made throughout its known distribution except for the upper South East and Yorke Peninsula. The majority of recordings were of few (2–9; 45%) and many (10–50; 28%) frogs. Eastern Banjo Frogs were found in all habitats with the exception of springs, with most recordings being taken at dams (30%).

Long Thumbed Frog *Limnodynastes fletcheri* (Figure 12)

In 1997 a single Long Thumbed Frog was collected, but in 1998 four recordings were made of this species in the lower reaches of the River Murray. Recordings were either of a few (2–9; 50%) or many (10–50; 50%) frogs, in the main channel of the

river, or in adjacent swamps and wetlands. All recordings were made within the known range for this species, but none were from the upper Murray in the State.

Brown Striped Marsh Frog *Limnodynastes peroni* (Figure 13)

All recordings of this species were within its known distribution range, in the South East of the State. The number of recordings (21) was similar to last year (20) and once again represented approximately 1% of all recordings. Of the recordings 52% were of many (10–50) frogs, and one-third were of few (2–9). Most recordings were taken in swamps (43%), with approximately 25% of recordings from wetlands and drains.

Spencer's Frog *Limnodynastes spenceri* (Figure 14)

This frog was recorded for the first time in the 1998 FROG CENSUS. It was recorded at two sites in the far north-west of the State. Recordings were taken at a dam and a pond and both showed many (10–50) frogs present.

Spotted Grass Frog *Limnodynastes tasmaniensis* (Figure 15)

Once again this species was recorded from many locations (16%) during the FROG CENSUS, but it is interesting to note that the proportion of recordings has gradually declined from 22% in 1994 to 16% in 1998. The actual number of recordings has decreased from a maximum of 357 in 1995, to 268 in 1998. It is likely that the difference is due to the change in the distribution of recording locations (1994 had the lowest number of Spotted Grass Frogs recorded but with the greatest proportion). Recordings were made throughout much of its range including the extreme north, Flinders Ranges, and west into Eyre Peninsula. It occurred in all habitats except springs. Most recordings were made in streams (30%) and dams (25%). Almost 53% of recordings were of a few (2–9) frogs and about 28% were of many (10–50).

Trilling Frog *Neobatrachus centralis* (Figure 16)

This frog was recorded for the first time in the 1998 FROG CENSUS from four recordings in the north of the State. Three sites were from the far north and the western most of these was just outside its known distribution, at Agnes Creek. A late recording just after rains in January 1999 was from the western side of the Gawler Ranges near Lake Everard, well outside the published distribution of this species. However, M Tyler (pers comm) informed us that he was aware of its presence in the Gawler Ranges from museum records in the area. One recording was of lots (>50) and three were of many (10–50). Habitat types were a pond, two streams, and a swamp

Painted Frog *Neobatrachus pictus* (Figure 17)

In 1997 there were 12 recordings of the Painted Frog making up 1% of the total whereas in 1998 only 9 recordings were made (0.5%). Recordings were mostly made in dams and swamps (about 44% each) but a single recording was made at the Gawler River. Of the recordings 66% were of few (2–9) individuals, and 33% were of one. All recordings were well within the known distribution for this species.

Sudell's Frog *Neobatrachus sudelli* (Figure 18)

This frog was first recorded in the 1995 FROG CENSUS (1 recording) and then again in 1997 (1 recording). In 1998 wet conditions and a wider sampling range resulted in 8 recordings: half of few (2–9) and half of many (10–50) frogs. Recordings were made in dams, ponds, streams and swamps. One of the recordings, at Lake Eyre, was well outside the previously recorded distribution for this species. The recording was

checked to ensure that it was not mistaken for similar species (eg Trilling Frog or Painted Frog).

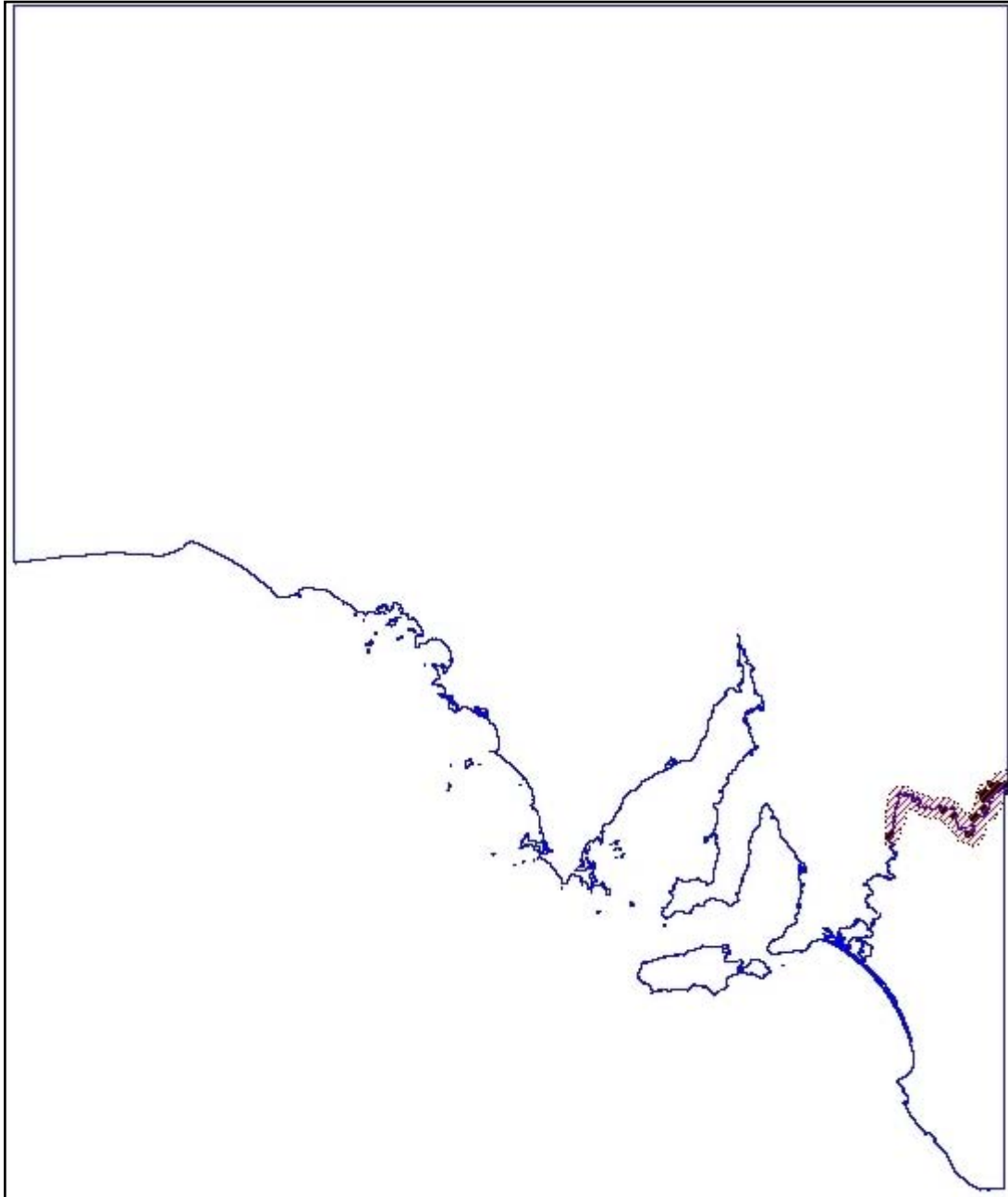


Figure 8. FROG CENSUS recording locations of the Eastern Sign Bearing Froglet, *Crinia parinsignifera*. Published distribution range of this species is shown in the shaded area.

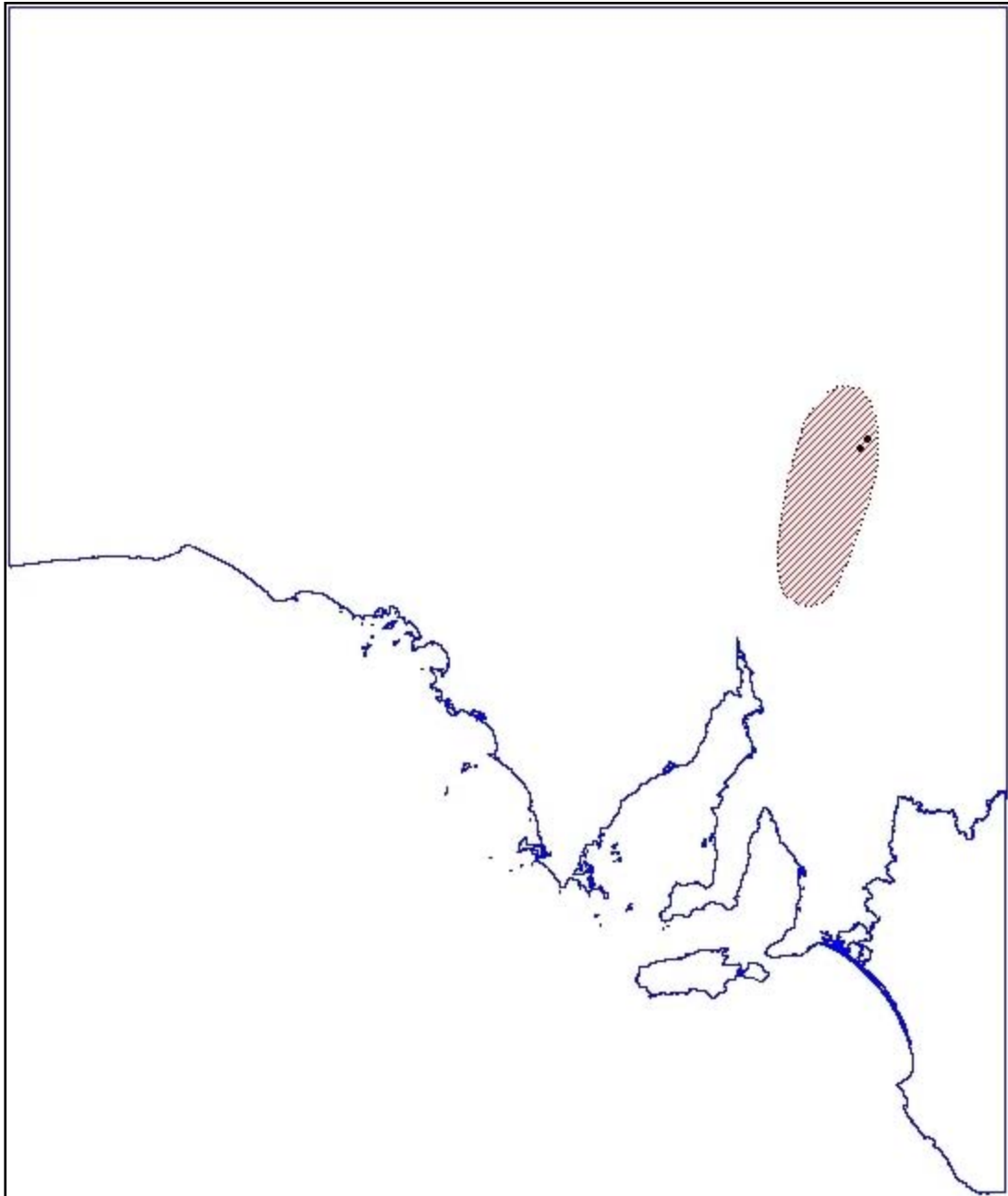


Figure 9. FROG CENSUS recording locations of the Streambank Froglet, *Crinia riparia*. Published distribution range of this species is shown in the shaded area.

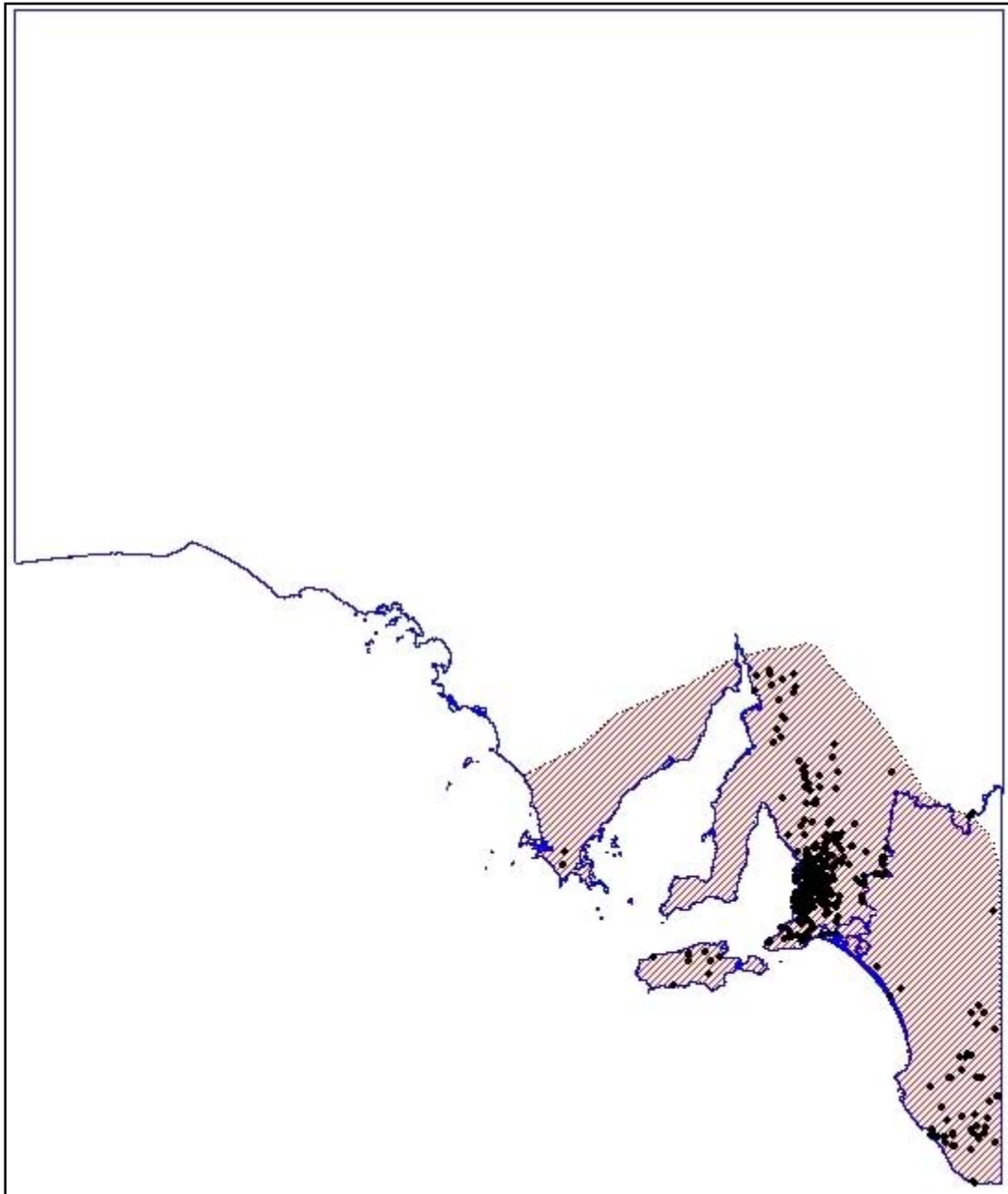


Figure 10. FROG CENSUS recording locations of the Common Froglet, *Crinia signifera*. Published distribution range of this species is shown in the shaded area.

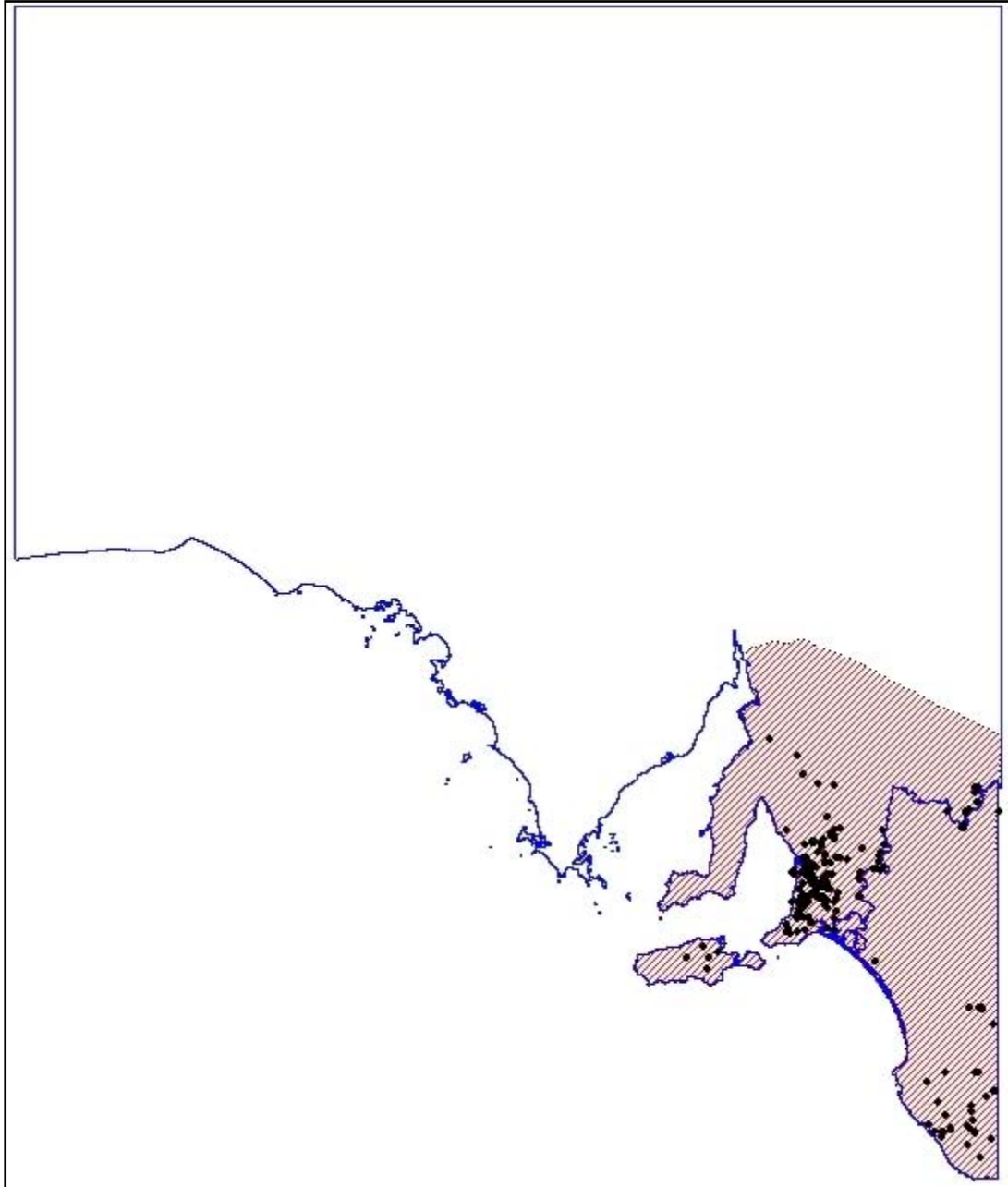


Figure 11. FROG CENSUS recording locations of the Eastern Banjo Frog, *Limnodynastes dumerili*. Published distribution range of this species is shown in the shaded area.

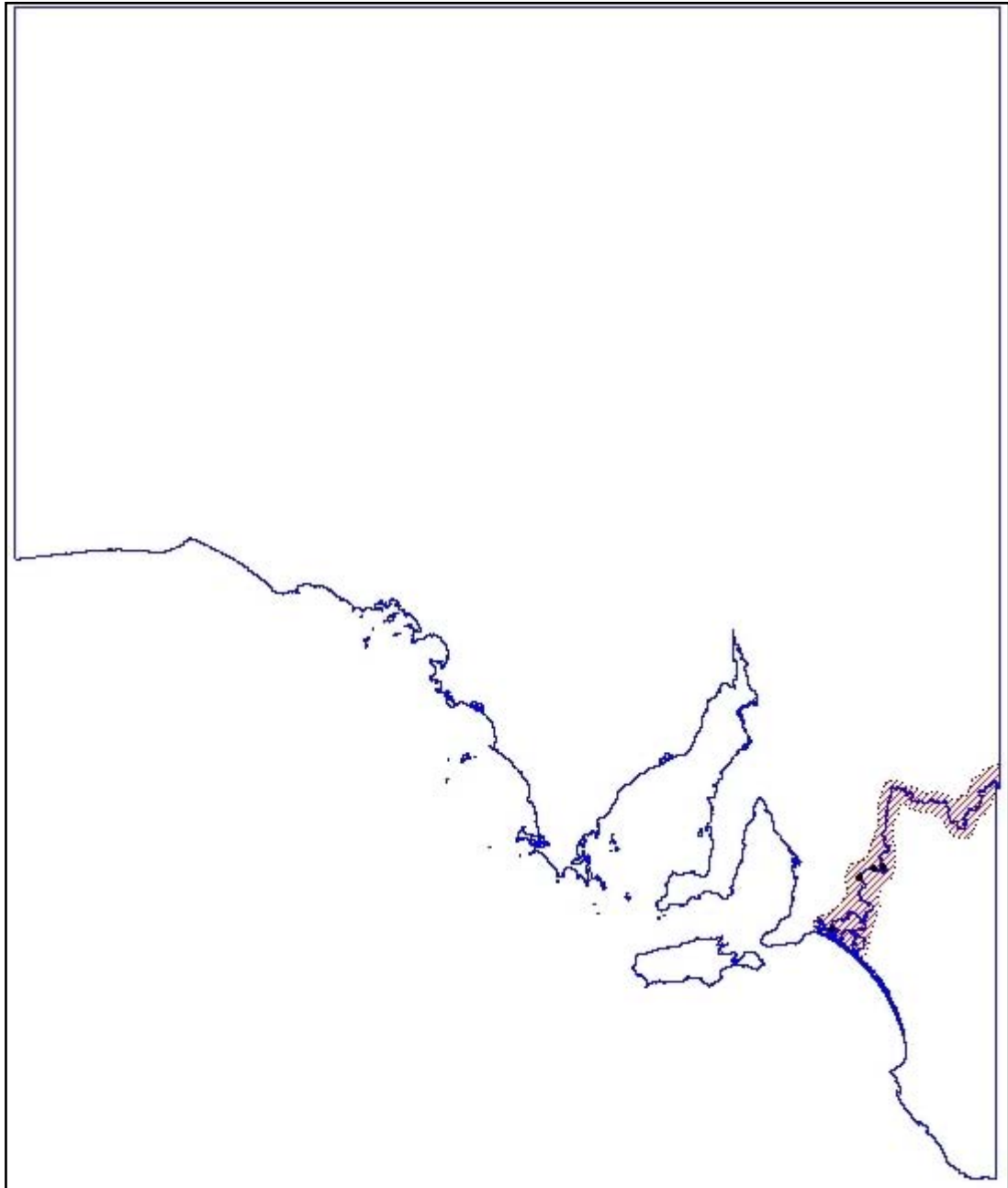


Figure 12. FROG CENSUS recording locations of the Long Thumbed Frog, *Limnodynastes fletcheri*. Published distribution range of this species is shown in the shaded area.

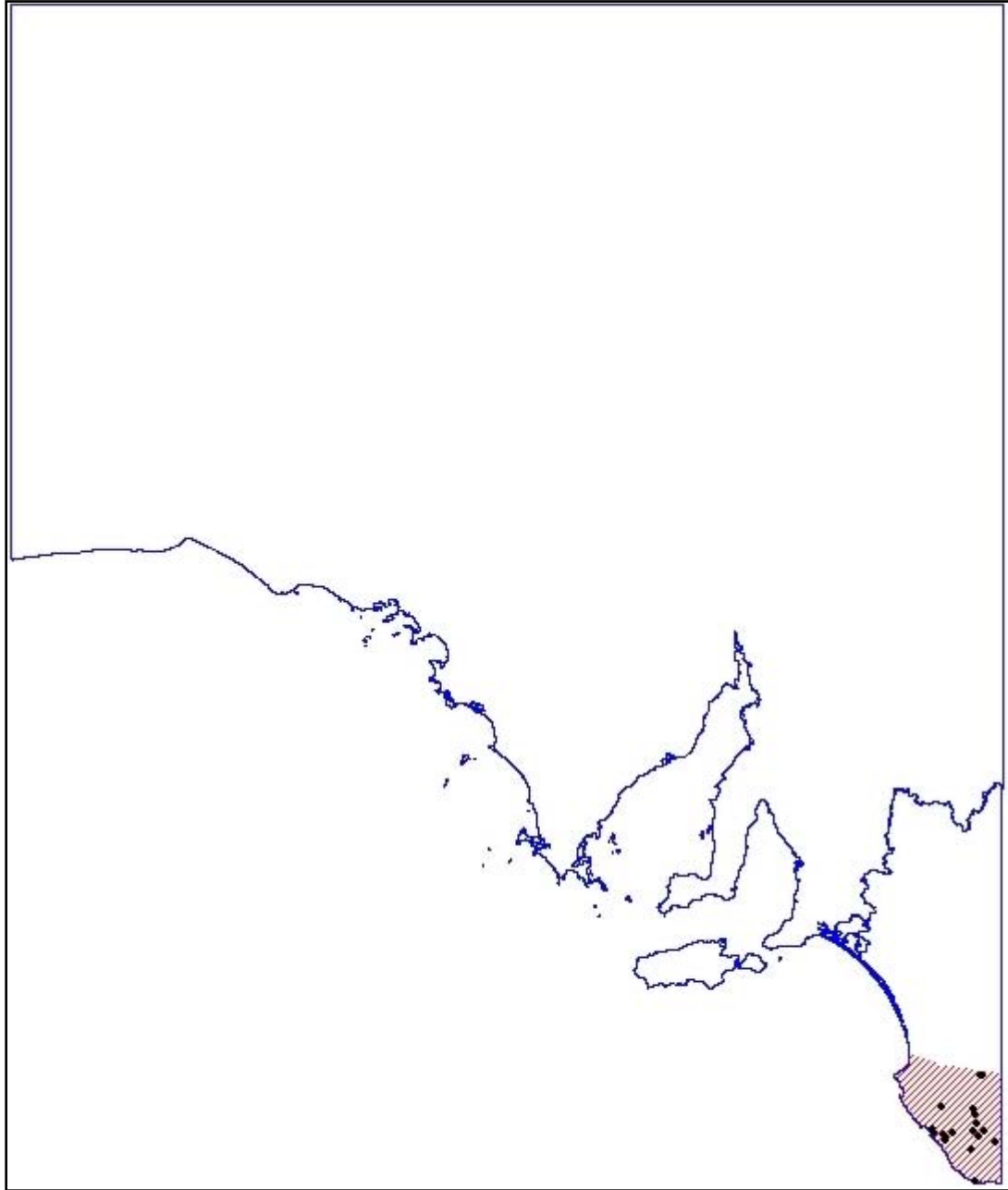


Figure 13. FROG CENSUS recording locations of the Brown Striped Marsh Frog, *Limnodynastes peroni*. Published distribution range of this species is shown in the shaded area.

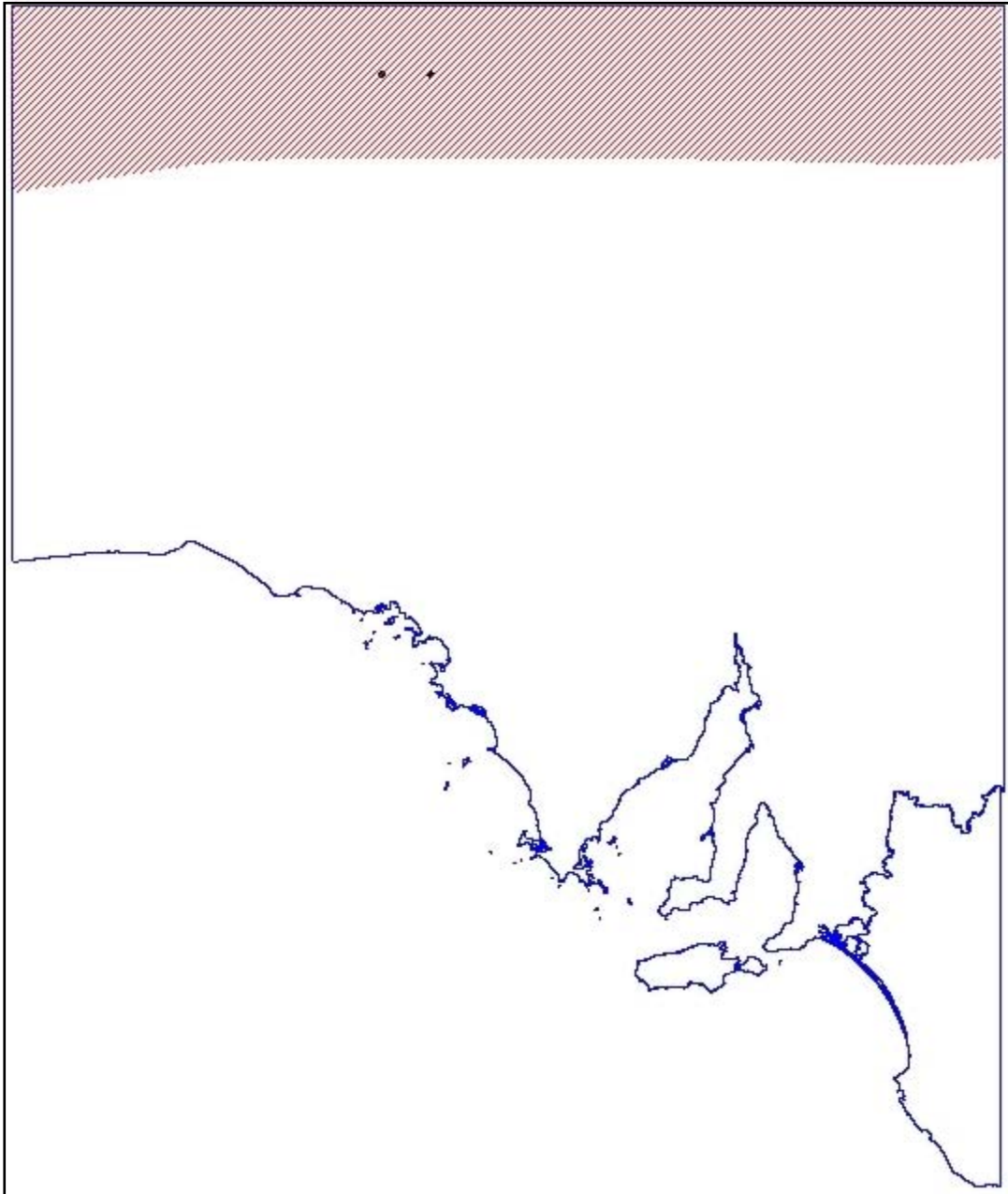


Figure 14. FROG CENSUS recording locations of Spencer's Frog, *Limnodynastes spenceri*. Published distribution range of this species is shown in the shaded area.

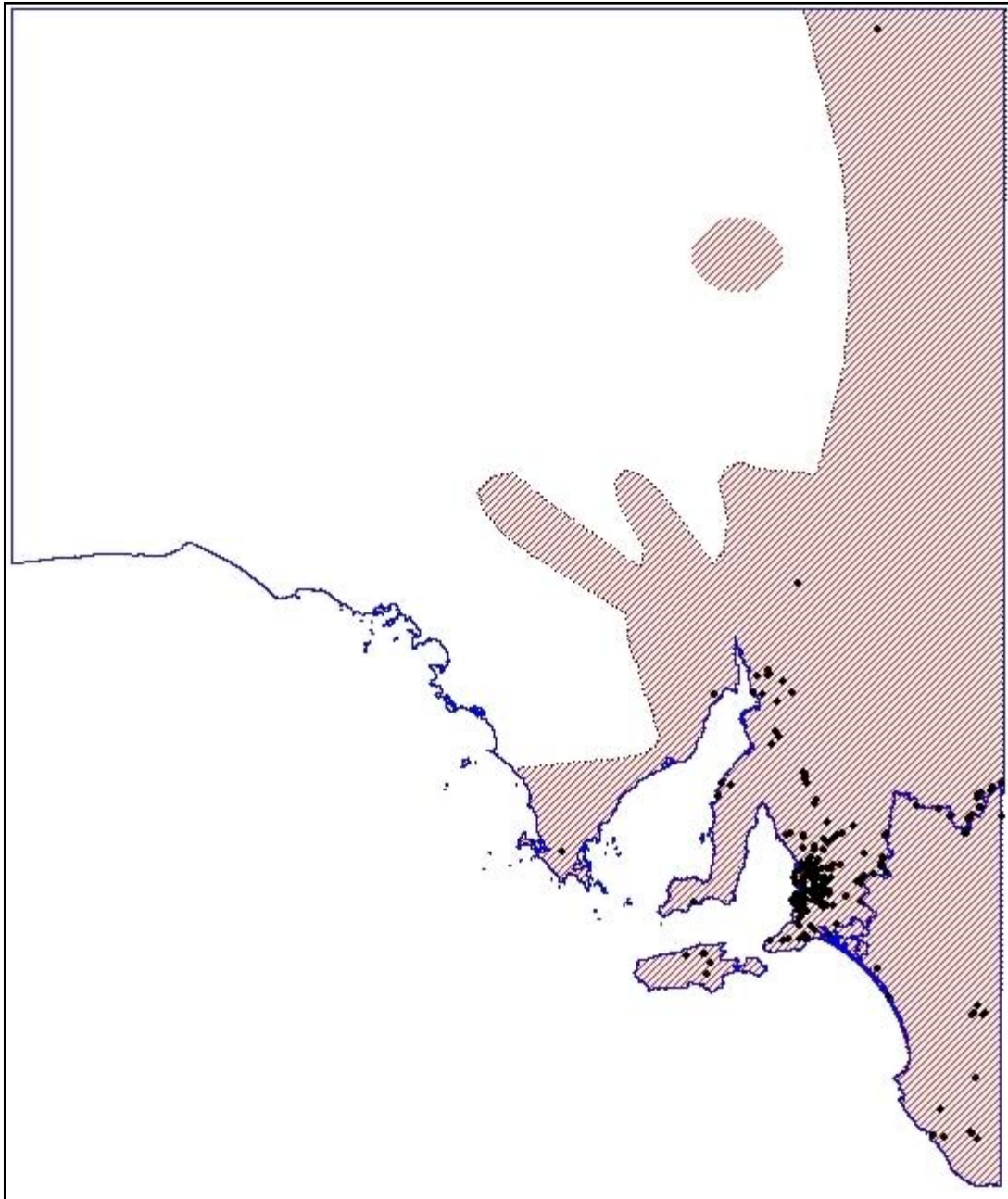


Figure 15. FROG CENSUS recording locations of the Spotted Grass Frog, *Limnodynastes tasmaniensis*. Published distribution range of this species is shown in the shaded area.

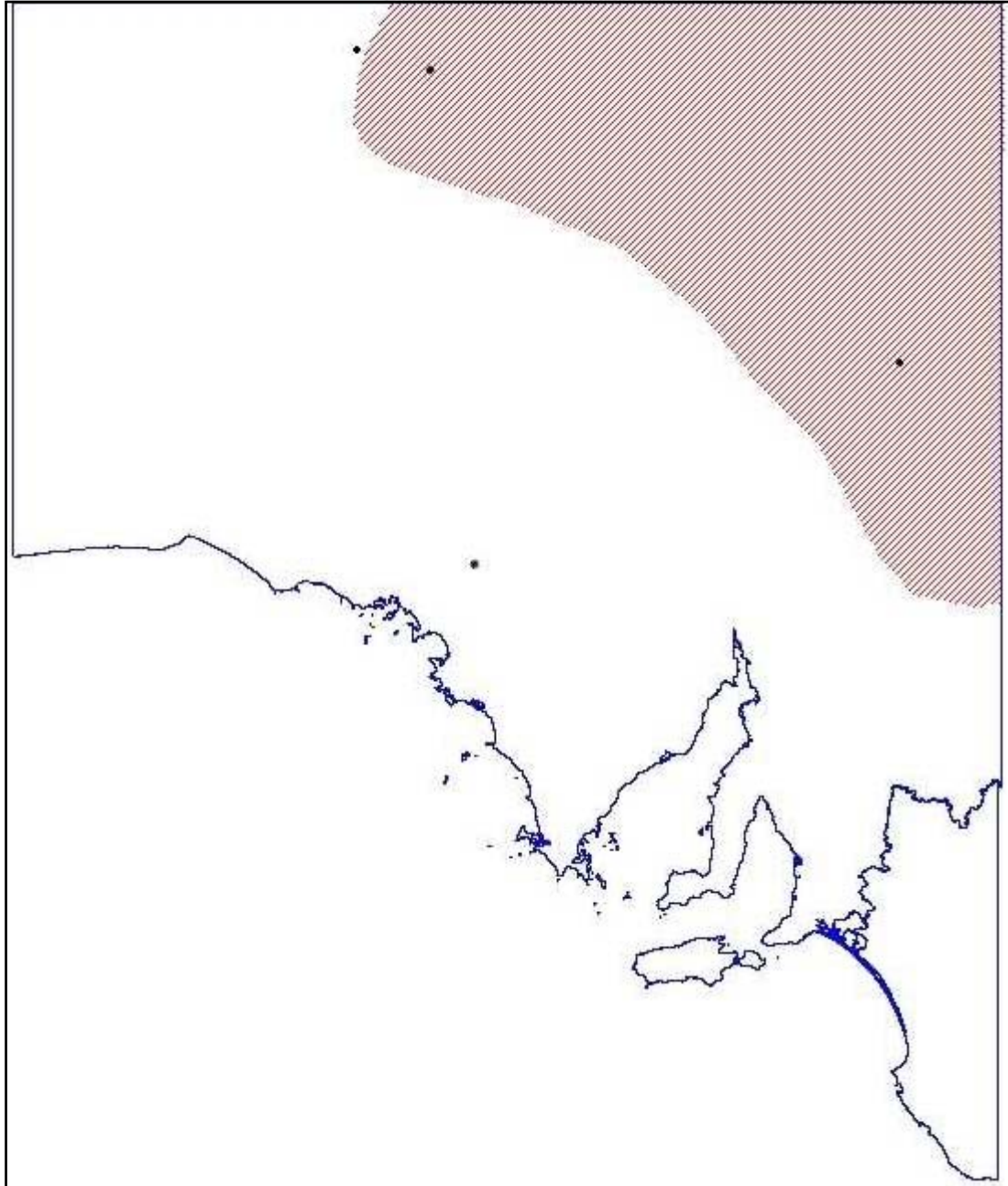


Figure 16. FROG CENSUS recording locations of the Trilling Frog, *Neobatrachus centralis*. Published distribution range of this species is shown in the shaded area.

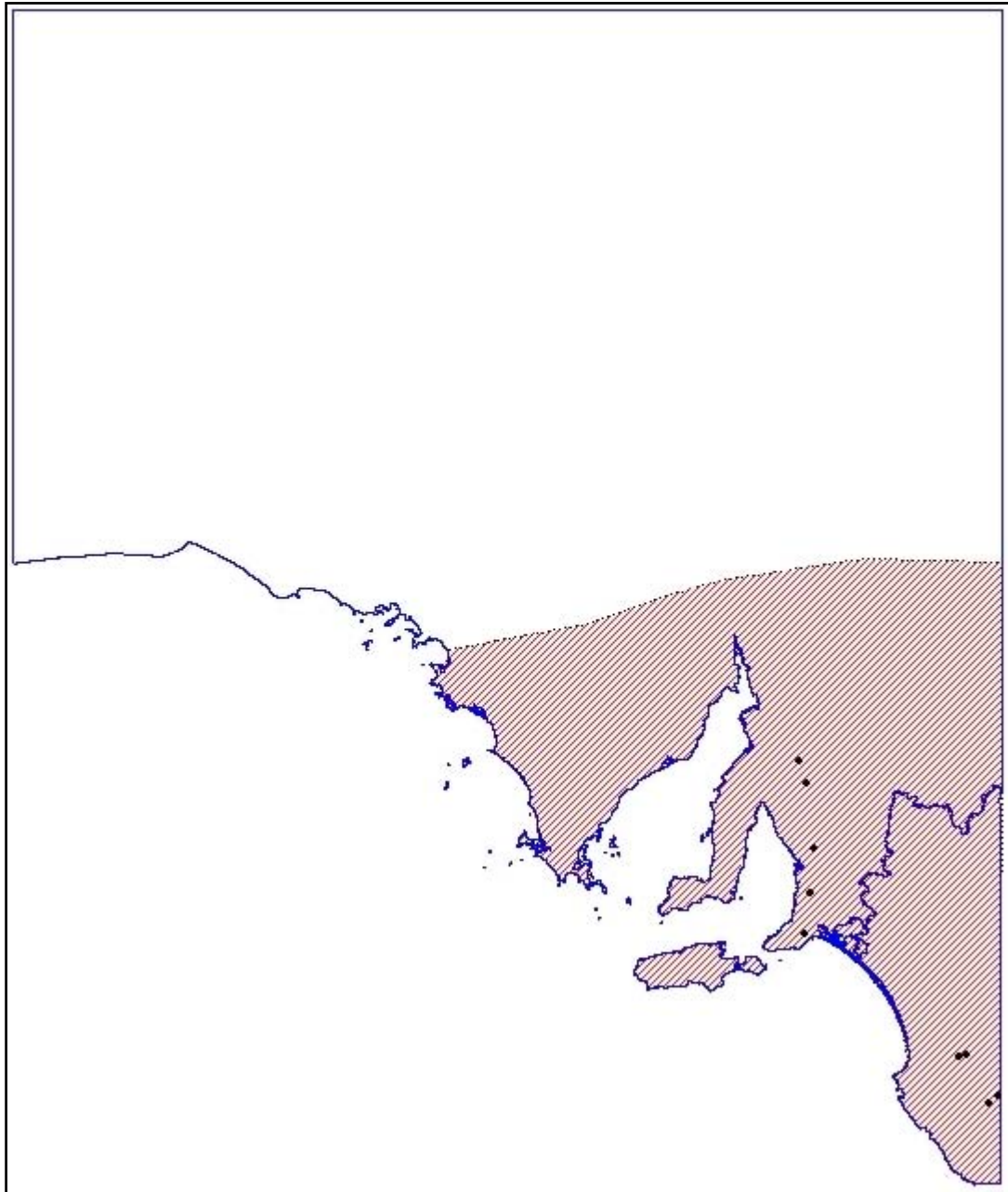


Figure 17. FROG CENSUS recording locations of the Painted Frog, *Neobatrachus pictus*. Published distribution range of this species is shown in the shaded area.

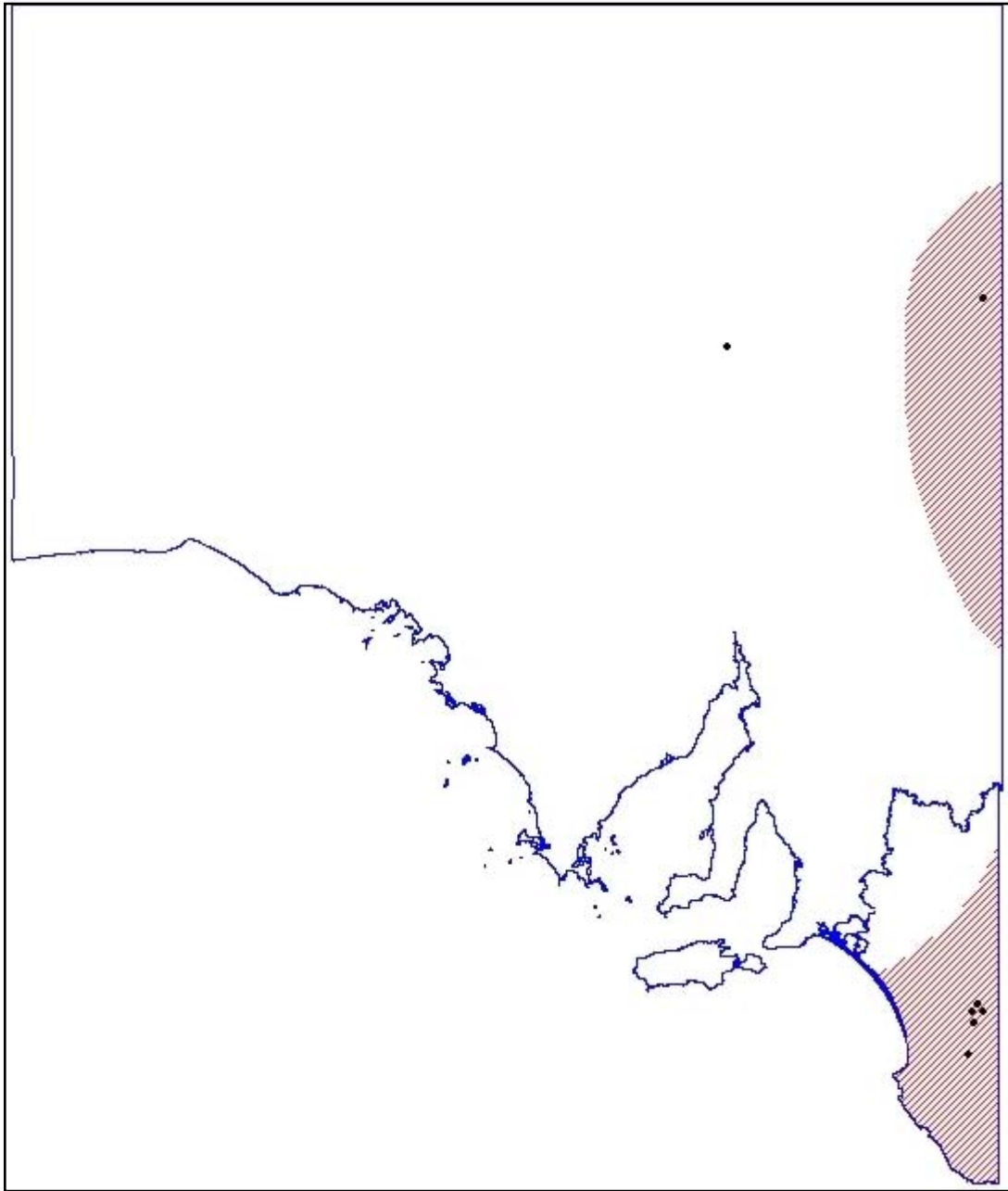


Figure 18. FROG CENSUS recording locations of Sudell's Frog, *Neobatrachus sudelli*. Published distribution range of this species is shown in the shaded area.

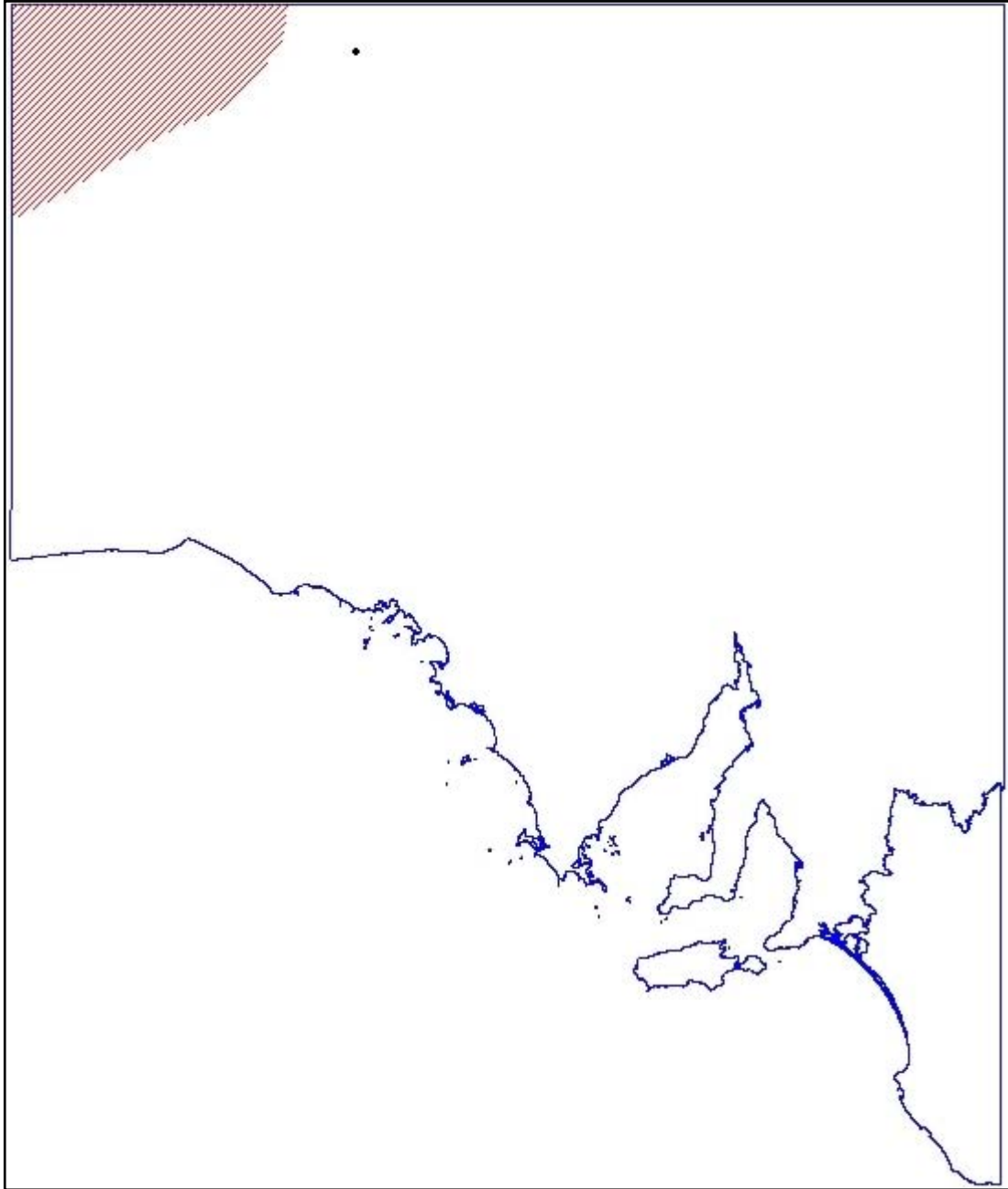


Figure 19. FROG CENSUS recording location of the Shoemaker Frog, *Neobatrachus sutor*. Published distribution range of this species is shown in the shaded area.

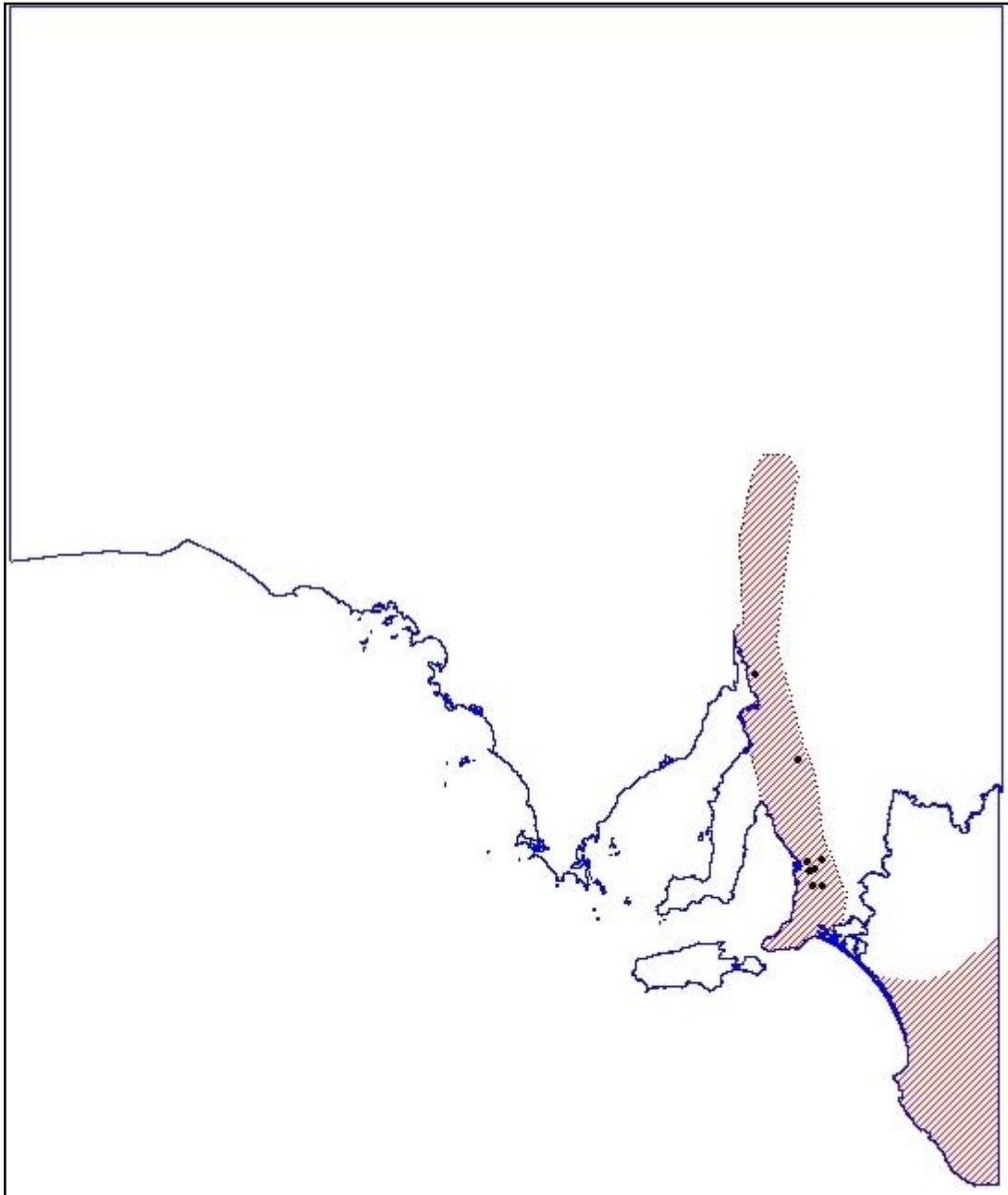


Figure 20. FROG CENSUS recording locations of Bibron's Toadlet, *Pseudophryne bibronii*. Published distribution range of this species is shown in the shaded area.

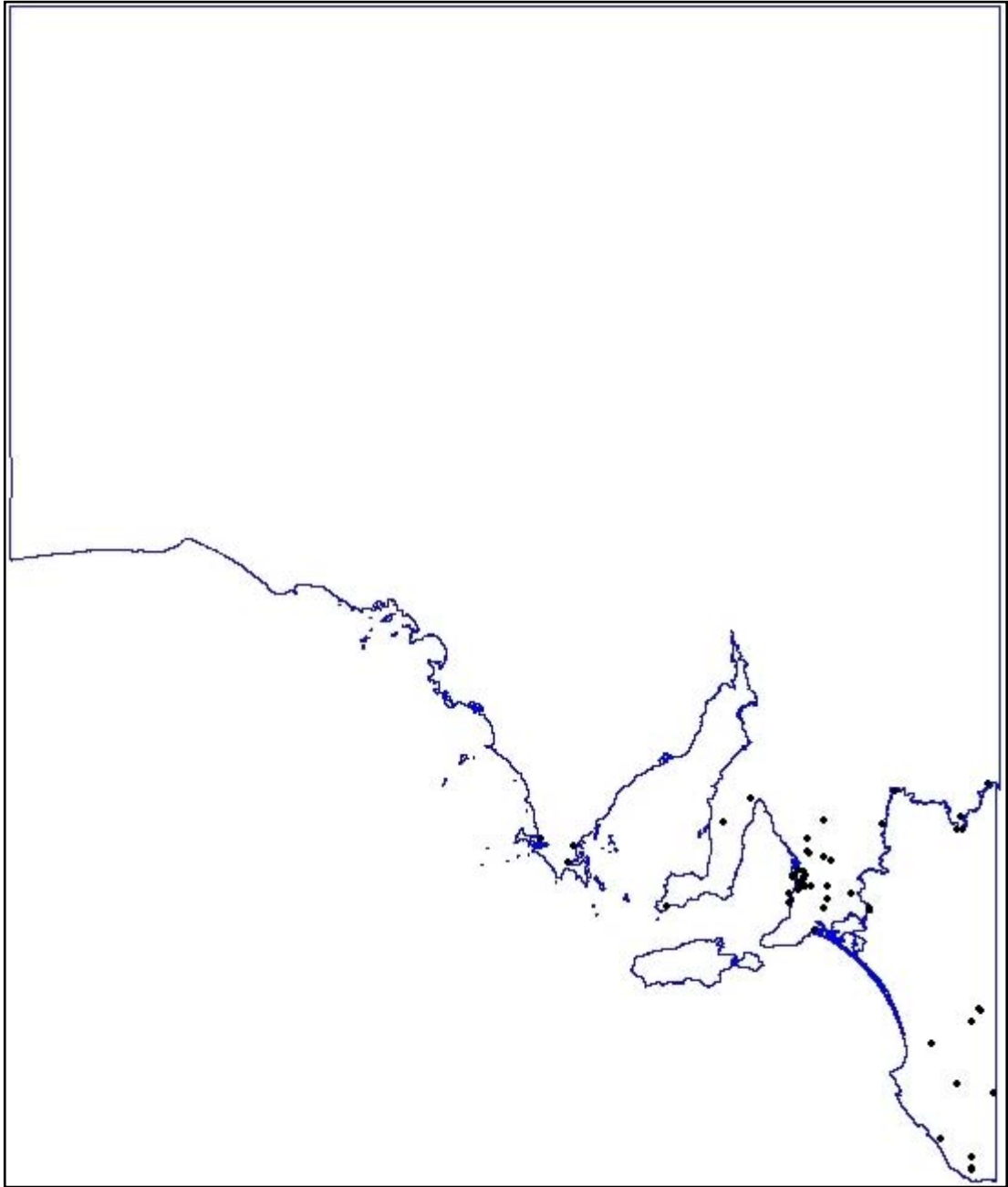


Figure 21. FROG CENSUS recording locations where no frogs were recorded.

Shoemaker Frog *Neobatrachus sutor* (Figure 19)

This species was also recorded for the first time in the 1998 FROG CENSUS. It was recorded outside its known range in the north of the State at Agnes Creek. The single recording was of many (10-50) individuals. Interestingly this recording was made on a video recorder and consequently showed the habitat and climate conditions at the site (no frogs were visible on the tape).

Bibron's Toadlet *Pseudophryne bibronii* (Figure 20)

Once again Bibron's Toadlet only represented a small number of recordings (10; 0.6%) but was recorded from all habitats except springs and wetlands. Half of the recordings were of only one individual (50%), but 40% of recordings were of few (2-9). All were within the northern part of its known range. The distribution of this species extends down to the South East but no recordings were made there. A recording taken at Mambray Creek in the southern Flinders Ranges indicated a healthy population with many (10-50) frogs calling.

No frogs recorded

Some sites had recordings made and no frogs calling (Figure 21) but all catchments recorded in had at least one site where frogs were recorded calling. Sites with no frogs recorded were concentrated in the Mount Lofty Ranges, Murray Valley, and South East of the State, all areas where the majority of FROG CENSUS recordings were taken.

3.4 Species diversity

There was an increase in species diversity at many sites in 1998. Table 6 shows the proportion of sites with more than two species in 1998. This was higher than for 1997. In all years the majority of sites only had one or two species calling together, with multiple species calling only rarely. In 1997 the maximum number of species recorded was five, at two sites. In 1998, 13 sites had five species, one site (Lyrup Reserve in Berri) had six species and one site (downstream of Purnong Landing on the River Murray) had seven species. Seven species is the maximum number of species ever recorded from one site during the FROG CENSUS. A nearby site at Purnong Landing had the highest number of species (5) in 1997.

Table 6. Number of locations with different numbers of species present. Some sites were recorded multiple times.

Number of species	Number of locations	% of total locations
1	326	40.1
2	261	32.4
3	141	17.6
4	65	8.1
5	13	1.6
6	1	0.1
7	1	0.1

3.5 Distribution of frogs in catchments of the Mount Lofty Region

This year an analysis was made of the distribution and diversity of frogs in each of the catchments in the Mt Lofty Ranges (Table 7 and Figure 22).

The Onkaparinga catchment had the largest number of recordings and also the equal highest number of species with six recorded. The Torrens catchment had the next highest number of sites, but only had a total of four species recorded. With only three recording sites, Tepko still had six species recorded, as did Gawler which had 45 recording sites. The River Murray forms part of the boundary for the Tepko catchment. This contributed to the large number of species recorded there as both Peron's Tree Frog and the Long Thumbed Frog are restricted to the Murray Valley region.

There did not appear to be a correlation between the number of sites recorded at and the number of species recorded within a catchment. The number of recordings made is probably relative to the human population in the area. Obviously there were some catchments with very few recordings which only had small numbers of species, but as there were also catchments which had a number of recording sites, for example the Light, and still only recorded a small number of species. It is reasonable to conclude from the data that environmental characteristics within the catchment are responsible for the diversity of frog species.

The annual average rainfall (Griffin and McCaskill 1986) appears to fit reasonably well with the distribution of sites with many species in the Mt Lofty Ranges. The catchments with the most species occur in the higher rainfall zones, with a corresponding decline in the number of species recorded in the regions experiencing lower rainfall. There is also a relationship between average rainfall and vegetation, with higher rainfall regions having the greatest occurrence of forested areas. It is probable that habitat requirements, including vegetation and water availability, are the primary factors in the distribution of frogs in the Mt Lofty Ranges. Any decreases in frog populations as a result of pollution are likely to occur on a site-specific level and, therefore, are unlikely to be detected at the catchment level.

Table 7. Recordings made in the Mt Lofty Ranges during the 1998 FROG CENSUS.

Catchment	Number of recording sites	Number of species
Adelaide Plains	4	2
Angas	17	4
Bremer-Barker	33	4
Brown Hill	1	2
Carrickalinga	3	3
Christies Creek	8	2
Currency Creek	5	4
Dry Creek	48	5
Ferries McDonald	1	2
Field River	12	4
Finniss River	11	4
Gawler	45	6
Goolwa	2	1
Hindmarsh	4	5
Ingleburne	2	3
Inman River	8	4
Light	12	3
Little Para	12	5
Long Gully	3	5
Long Marsh	1	3
Marne River	7	4
Milendella Creek	1	2
Myponga	6	4
New Salt Creek	1	2
Newman	1	1
Onkaparinga	131	6
Patawalonga	65	4
Pedlar Creek	13	4
Port Adelaide	9	4
Reedy Creek	1	2
Rocky Gully Creek	2	1
Saudergrove	3	5
Smith Creek	14	3
Stockyard-Wilderness	4	4
Tepko	3	6
Tookayerta	5	3
Torrens	78	4
Waterfall Creek	4	2
Willunga	2	1
Yankalilla	3	4
Yattagolinga	1	2

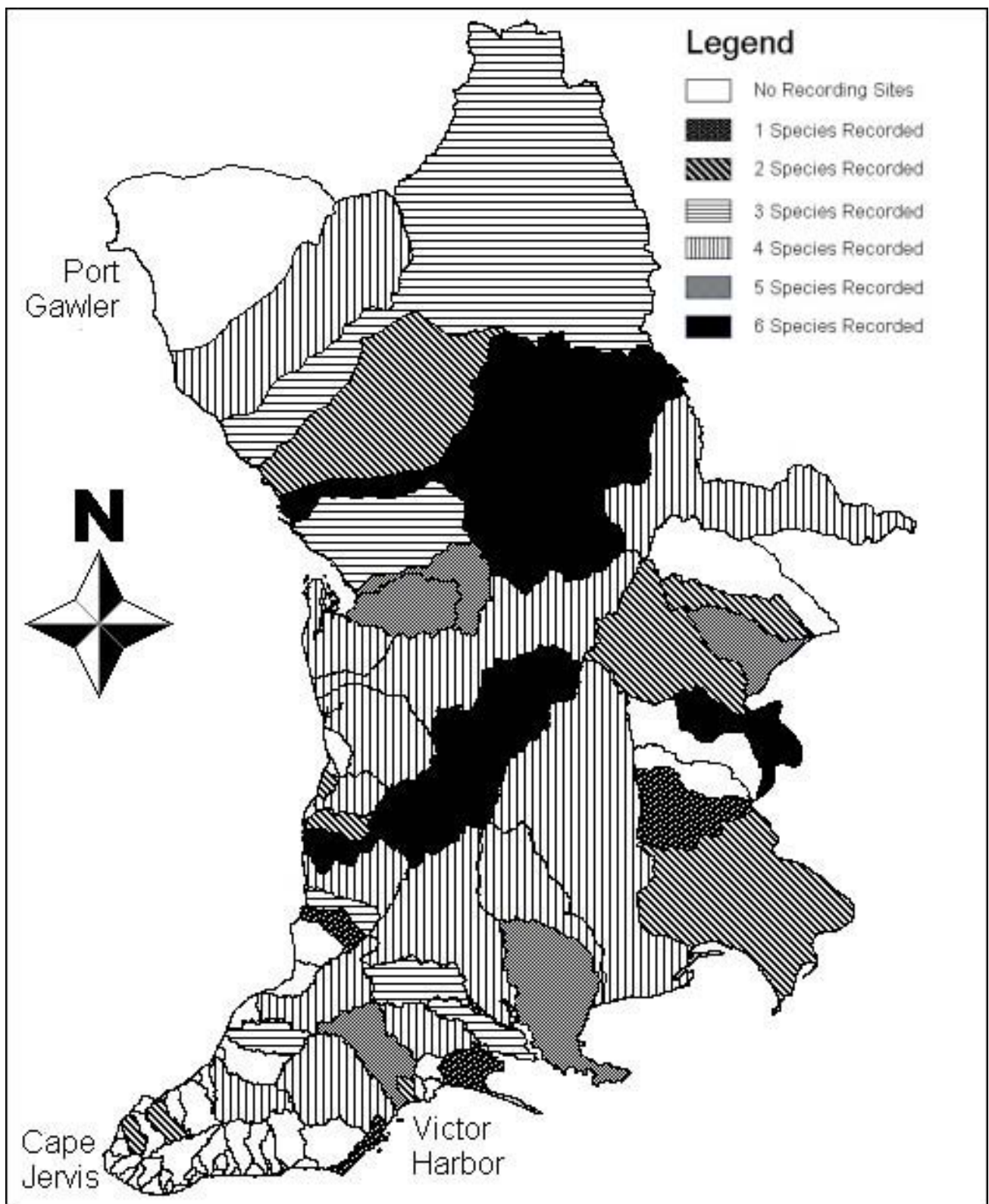


Figure 22. Frog species counts for catchments within the Mt Lofty Ranges.

3.6 Participant survey

The response to the participant survey was very good for a mail out, with a 45% response rate (339 responses). It is assumed that this proportion is representative of all FROG CENSUS participants. More females (65%) responded than males (35%) (Table 8). Of these responses 169 (56%) were from solo participants, 122 (40%) were from family groups and 10 (3%) were from school groups. Thus the majority of respondents were involved on their own, but a large number of family groups also participated. A number of school groups would not have been included in the survey as FROG CENSUS feedback was distributed during the school holidays. Groups were requested to have one member fill out the survey form. In spite of this a number of surveys were completed as a group, particularly by couples. In this case the demographics for the whole group (ie they responded as male and female) were collated.

Most respondents to the survey were from the 31–65 age group (75%) (Table 8). Given the large number of family groups involved this may not be indicative of the participant age group, as surveys from family groups may have been primarily filled out by representatives from the 31–65 year age group. The FROG CENSUS appears to be an easy programme accessible to all age groups. There was no age group from less than ten years to over 66 that did not have FROG CENSUS participants. Only four respondents (1%) said the FROG CENSUS was not an easy activity to participate in.

Due to their involvement in the FROG CENSUS the majority of respondents are now more aware of their local environment (Table 9). They now pay more attention to the frogs calling and the water quality of their local streams. An increasing awareness of water quality occurs with the number of years involved, as relatively more respondents involved for more than one year had a positive response. The awareness of participants to frogs calling in their area appears to increase immediately, probably because finding calling frogs is the initial activity that attracts participants to the programme, and it is also the major focus of the census.

Table 8. Age group and sex of participants in the FROG CENSUS, from mail out surveys. Total includes responses where sex was not specified.

Age group	Male	Female	Total
>10	2	4	8
11–18	10	10	23
19–30	7	11	21
31–65	82	148	258
66+	12	13	29

Table 9. Responses from participant survey questions on whether their involvement in the FROG CENSUS had increased their awareness of their local environment. Total includes responses where number of years involved was not given.

Number of years involved in the FROG CENSUS		1	2	3	4	5	Total
I now pay more attention to the frogs calling in my local area	Yes	77	60	50	74	36	314
	No	8	1	1	3	3	16
I now pay more attention to the water quality of my local waterways	Yes	62	53	43	69	36	277
	No	23	8	8	8	3	53

Table 10. Responses from participant survey questions about whether their involvement in the FROG CENSUS improved their knowledge of frogs and associated topics. Total includes responses where number of years involved is not given.

Number of years involved in the FROG CENSUS		1	2	3	4	5	Total
My knowledge has improved about the frogs in my local area	Yes	83	56	45	72	37	310
	No	2	5	6	5	2	21
My knowledge has improved about the frogs in South Australia	Yes	69	49	33	61	36	264
	No	16	12	18	16	3	70
My knowledge has improved about the role of frogs as environmental indicators	Yes	53	46	39	61	36	251
	No	32	15	12	16	3	79
My knowledge has improved about the role of the EPA in looking after our environment	Yes	57	40	38	51	33	217
	No	28	21	13	26	6	100
My knowledge has improved about catchment health	Yes	45	43	37	54	28	222
	No	40	18	14	23	11	108

The FROG CENSUS aims to not only increase awareness of the environment but educate the public about frogs, catchment health and how frogs can be used to monitor the environment, as well as making the public more aware of the role of the EPA. Table 10 shows the responses to questions on whether involvement in the FROG CENSUS has played a role in educating the participants. The overall response was positive, with over two thirds of all responses being yes to an improvement of knowledge about all topics. The area which was most improved was the knowledge of frogs in the local region (94%). The area which had the least improvement was catchment health (67% responses positive), but even this had far more positive responses than negative. Relatively more positive responses came from participants who had been involved for more than one year and knowledge tends to increase with the number of years involved with the FROG CENSUS.

Through their involvement in the FROG CENSUS many respondents (77%) can now identify at least some of the frog calls in their local area. Only a few respondents had visited the FROG CENSUS web-site (<http://www.epa.sa.gov.au/frogcensus>). All of the feedback from participants about the web-site was positive. Many complimented the access to the frog calls via the web page and said it was a very useful tool in helping them identify frogs themselves.

The feedback sent to participants, with information about the frog species recorded by them and a general information sheet with results from the whole FROG CENSUS, was very well received. Almost all (96%; 316) respondents stated that the feedback improved their knowledge of their local frogs and 90% said it improved their knowledge of the frogs in South Australia.

To find out more about the interests of participants they were asked if they would like to know more about the topics presented in Table 11. The biology of frogs was the only topic that the majority of participants did not want to know more about. The most popular topics were the role of frogs as biological indicators (63%), the health of South Australian waterways and other community environmental monitoring projects (59%).

Participants were also asked for any feedback or suggestions for improving the FROG CENSUS. The majority of the feedback was extremely positive as many respondents stated how much they enjoyed being involved in the census. Suggestions for improvement mostly focused on the timing of the census, access to information, increasing the participation of schools and increasing media coverage.

Table 11. Topics that FROG CENSUS participants are interested in learning more about.

I would like to know more about:	Yes	% of total	No	% of total
The distribution of frogs in South Australia	190	(54.5%)	150	(45.4%)
The biology of frogs	163	(49.4%)	167	(50.6%)
The role of frogs as biological indicators	208	(63.0%)	122	(37.0%)
The health of South Australian waterways	195	(59.1%)	135	(40.9%)
Community environmental monitoring projects in my local area	195	(59.1%)	135	(40.9%)

4. DISCUSSION

The 1998 FROG CENSUS was the most successful to date. The widening in the geographic range of sites sampled led to the inclusion of 5 species from arid areas of the State which had not previously been recorded by this programme.

4.1 Frogs of South Australia

Currently 28 species of frogs are known to occur in South Australia. Only one of these, the Streambank Froglet, *Crinia riparia*, is endemic to the State.

4.1.1 Novel species recorded

This year five new species were recorded. The inclusion of these species is due to the expansion of recordings taken in the northern region of the State where most of them naturally occur. The rain that occurred leading up to, and during frog week, enabled new participants from the arid zones to be involved.

One site, Agnes Creek, recorded two of these species (Trilling Frog (Figure 16) and Shoemaker Frog (Figure 19)), as well as the Green Tree Frog, outside of their known geographic range. Very little intensive sampling has been undertaken in the north of the State. M Tyler (pers comm) has sampled approximately 40 north-west of Marla with little success. Much of the fieldwork relies on ad hoc trips following seasonal rains with the hope that frogs have emerged and, consequently, in some cases it is possible that the frogs did not emerge until a few days after collection was terminated. Therefore, the known distribution of these species is based upon very few collection data. It is reasonable to assume that many of the frogs from the arid zone have a much wider distribution than has been reported in the literature, and this FROG CENSUS is a convenient way of determining just how widespread some of these species are. Museum records of some of these species do not appear to have been included in recent publications.

Water Holding Frog, *Cyclorana platycephala*

This is probably the best example of a frog used by Aboriginals. This frog, like many burrowing frogs, spends most of its life underground. It seals itself in a waterproof cocoon made up of layers of shed skin. Water is stored in the bladder or in pockets under the skin, and a slight pressure applied by hand causes the frog to release this water. The water is very fresh and after a drink the frog is released unharmed. The frog has a distinctive flat head and small eyes. The colour of the skin ranges from a dull grey to dark brown or green. The toes are completely webbed.

Size: males 42–64 mm; females 50–72 mm.

Habitat: Found in grasslands, temporary swamps, claypans, and billabongs. Its distribution is limited to the north of the State.

Breeding: Large amounts of spawn are laid in still water after floods. Tadpoles reach a maximum of 60 mm.

Advertisement call: A long, drawn out 'maw-w-w-w...maw-w-w-w'



Red Tree Frog, *Litoria rubella*

The Red Tree Frog 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 and granular, except for the throat of breeding males which is a very dark grey. The groin is yellow. 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: males 28–37 mm; females 34–43 mm.

Habitat: As well as inhabiting the arid regions of South Australia, this frog is also found along coastal fringes of other States and in southern New Guinea. During the day, the frog shelters under stones and bark. They are known to hide in moist water pipes during dry periods.

Breeding: Breeding coincides with summer rainfall or when the opportunity arises following widespread rains. Males will call from the ground within a few metres of the water. Golden eggs are deposited as a film floating on the surface.

Advertisement call: A loud screeching, high-pitched, distinctly pulsed note. Much like the screech of a seagull.



Spencer's Frog, *Limnodynastes spenceri*

Spencer's Frog is variable in colour and pattern ranging from dark grey or brown all over to pale grey with contrasting darker patches. The frog is restricted to the northern arid areas of the State.

Although it spends much of the time in burrows, the frog may emerge if the sand in creek beds is moist. They are also known to move far into the hills and ranges after rains.

Size: males 29–45 mm; females 33–46 mm.

Habitat: Usually associated with the arid zones of northern and central Australia, particularly with sandy beds of temporary creeks.

Breeding: About 1000 eggs are laid in a foam nest in rock holes of hills and ranges following heavy rains. Tadpoles may complete development in 40 days.

Advertisement call: A rapid 'ho-ho-ho'.

Trilling Frog, *Neobatrachus centralis*

The Trilling Frog is easily confused with other burrowing frogs. This is not surprising as many of the *Neobatrachus* species look very similar. 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.

Size: males 41–50 mm; females 41–55 mm.

Habitat: Found in South Australia's arid regions, especially in areas with clay soils near woodland and *Triodia* (spinifex or porcupine grass) covered sandhills.

Breeding: Calls from emergent vegetation next to water or when floating in water. The egg mass is deposited in long strings of small, pigmented eggs wound around vegetation. The eggs often drop to the bottom. The tadpoles are very pale grey, large (up to 57 mm) and spherical.

Advertisement call: A prolonged, loud and high pitched trill which carries over a long distance.



Shoemaker Frog, *Neobatrachus sutor*

Another burrowing frog living in the north of the State. As with many burrowing frogs it spends most of its life underground, emerging only to feed and breed following the infrequent rains in the region.

The Shoemaker Frog has gold skin with numerous splotches of black or brown. The toes are fully webbed.

Size: males 35–42 mm; females 34–51 mm.

Habitat: A burrowing species that inhabits claypans or other areas where water collects after summer rains.

Breeding: Breeds in claypans.

Advertisement call: A short series of taps, giving rise to the name, 'Shoemaker'.

4.1.2 Species not recorded

Thus far the FROG CENSUS programme has recorded 20 of the 28 frog species known to occur in the State. The species not recorded in any FROG CENSUS to date are:

- Knife-footed Frog, *Cyclorana cultripes*
- Main's Frog, *Cyclorana maini*
- Gunther's Frog, *Litoria latopalmata*
- Desert Froglet, *Crinia deserticola*
- Smooth Frog, *Geocrinia laevis*
- Desert Spadefoot Frog, *Notaden nichollsi*
- Western Toadlet, *Pseudophryne occidentalis*
- *Uperoleia* sp (probably *capitulata*, Small Headed Toadlet).

All of these species (with the exception of the Smooth Frog) are inhabitants of the more arid northern regions, and perhaps with the increasing range of recordings a future FROG CENSUS may include some of these less common species.

The EPA is planning a number of field trips to the South East with the hope of learning more about the distribution and current status of the Smooth Frog, *Geocrinia laevis*. This work will be carried out under a grant from the Wildlife Conservation Fund.

4.2 Frogs as indicators

It must be recognised that the FROG CENSUS approach does have limitations, many of which have been recognised by the participants in this programme. The distribution of sites sampled has always centred around the Adelaide region and does not give us a complete view of the whole State. In addition, participants often do not return to the same site each year, making it difficult to distinguish trends in species changes over time. Frogs do not call when they are not breeding and the FROG CENSUS may not coincide with the breeding season of all South Australian species. The timing of the census was changed in 1995 from late October – early November to early September to coincide with the time when more species were expected to be breeding (Goonan et al 1997). Regardless of the timing of the census, species which do not breed during Frog Week will not be picked up by the FROG CENSUS. Therefore, it may not be possible to detect all of the State's frog species using the current protocol.

4.2.1 Geographical variation

The number of species recorded in each of the regions of the State is listed in Table 12 (after Tyler 1977). Figure 1 shows the distribution of sites within these regions. The incidence of multiple species recorded in the Mt Lofty Ranges is listed in further detail in Table 7.

Table 12. Regional variation of species diversity in the 1998 FROG CENSUS.

Region	Number of species recorded
Evre Peninsula	2
Flinders Ranges	6
Kangaroo Island	4
Mt Lofty and Central Districts	6
Murray Valley	8
North East	5
North West	5
Nullarbor Plain	1
South East	8
Yorke Peninsula	1

Once again, the Murray Valley and the South East demonstrated the greatest frog diversity with eight species. For the first time in the FROG CENSUS we had recordings from the Nullarbor Plain, and a great increase in the number of recordings from the north of the State.

4.2.2 Comparisons with previous years

The increase in the number of species recorded seems to be as a result of the wetter conditions experienced leading up to the 1998 FROG CENSUS and also as a result of an increase in the range of recordings. There does not appear to be any obvious change to the abundance of frog species in the State as a whole, however, the minor reduction in the number of recordings of the Spotted Grass Frog, *Limnodynastes tasmaniensis*, is of concern. It is worth considering the possible impact of the recently discovered chytridiomycete fungus which seems to be killing frogs worldwide.

In 1997 the Brown-striped Marsh-frog, *Limnodynastes peroni*, was recorded from a site at Nuriootpa well away from its natural range in the South East. This species was not recorded outside its normal range in 1998. Future FROG CENSUS recordings may determine if the frogs are still present in Nuriootpa, or perhaps the small number of frogs which had somehow relocated did not survive in the much drier conditions in the area.

4.3 Community education and involvement

Education has a fundamental impact on public perceptions of the natural world (Kellert 1980). It is recommended that wildlife education programmes for the public should incorporate direct contact with wildlife in a natural setting (Dahlgren et al 1997). The FROG CENSUS is a hands on community environmental programme which has been shown to increase participants awareness of their environment and improve their knowledge in relation to frogs, particularly in their local area.

Knowledge of environmental issues has been highly correlated with a positive attitude towards these issues (Kellert 1980). The FROG CENSUS has increased the knowledge of participants about frog related issues and this may in turn affect the attitude of participants towards the environment. Participants are more aware of their local frogs and catchment health. The FROG CENSUS involves a wide variety of people from all age groups and geographic regions and thus may be an important

tool for educating the public and influencing attitudes towards catchment health in South Australia.

4.3.1 Suggestions for improvement from the community

The main suggestions from the public for improving the programme were related to the timing of the census. Many stated that they heard particular species calling either just before or after the census and that we need to either expand the time period we accept calls from or have more than one census. Either approach would lead to problems in coordinating the census, and keeping interest in the programme for the wider community.

Many participants requested increasing participation through schools as an obvious way to improve the programme. Currently a promotional flier is sent out to every school in the State through the Department of Education, Training and Employment. The recipient of the flier may not be someone who is interested in promoting the FROG CENSUS throughout the school, and teachers within the school who may be interested may not receive the information. Also to incorporate an activity into the school curriculum more notice may be required than is presently the case. Promoting the FROG CENSUS in a newsletter or paper which is received by all teachers, early in the second semester may improve the response from schools.

A number of participants recommended that an increase in promotion of the FROG CENSUS through local papers and radio interviews (both city and regional) would increase participation. Currently a media release is produced but what the papers include is beyond our control. However, we do note that most include an article leading up to the census and many also include a promotional picture of a frog. The Royal Show is also used to promote the FROG CENSUS.

Many participants also requested further access to the information from the FROG CENSUS. The FROG CENSUS web page has an excellent coverage of all information from previous censuses, including frog calls and colour pictures of each frog species. The problem with the web page is that not all participants have easy access to the Internet. The publication and distribution of previous FROG CENSUS reports and the availability of tapes of frog calls for purchase through retail outlets may remedy this situation.

4.4 Future directions

Further promotion of FROG CENSUS will be sent to all schools in the State in an attempt to increase their involvement in the programme. As in 1998 fliers will be sent to every school to advertise the census, but these will be supplemented with additional material to encourage those schools not currently involved to take part.

Field surveys are planned for the South East of the State to increase our knowledge of some of the rarer species in the area, and it is intended to try and recruit local amateur frog groups to assist in the field work, as well as informing the wider community of our progress and findings.

Currently FROG CENSUS activities are restricted to the second week of September. As frogs in some of the more remote regions may not be active during this time it would be better if participants in these arid areas could send in tapes at other times

to match the sporadic rainfall events in the north of South Australia. Further development of communication lines to send out and receive frog kits at times other than during frog week would also be rewarding to participants.

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FROG CENSUS 1998 DATASHEET

September 7-13th

FROG CENSUS represents a "snapshot" of where frogs occur and where they are absent in the waterways of South Australia, which include our rural and urban streams, drains and wetlands. The census involves a simple assessment of habitat health at the location you choose to visit, based on the assumption that healthy habitats provide suitable conditions for diverse frog populations and that less healthy habitats have fewer frogs and less diverse frog populations present.

During Frogweek, from the 7th to 13th September 1998 (only 1 day of recording is required), visit your location for approximately half an hour about 1-3 hours after dusk. At the start of the recording, state your name, the date, start time and location. Record the frogs calling at your location onto the cassette tape for 5 -10 minutes. On the label of the tape, write your name, date, start time and location.

On the datasheet record your name, address, contact telephone number, and most importantly a detailed description of the location that you visited. If you have the identification tapes attempt to identify the calls yourself, otherwise give some indication of the number of species heard calling and a measure of their abundance.

INFORMATION NEEDED FOR THE FROG CENSUS

- Where you recorded frogs calling; When you made the recordings; and What frogs you recorded (if possible).

Observers Name: _____	
Contact Address: _____ _____	
Post Code: _____	Telephone Home: _____
	Work / Mobile: _____
Do You Want to be involved next year?(Please Circle)	Yes / No
Location Description (Try to provide enough detail to enable us to find site on a map. Please use a separate datasheet for each site): _____	
is location the same as in (CIRCLE)	1994 1995 1996 1997 New
Grid Reference of Location and Type of Map Used: _____	
OR Street Directory Reference:	Year and Edition: _____
Page Number: _____	Grid Reference: _____
Nearest Town from Location (If known): _____	
Date of Observation (e.g. 8 Sept 1998): _____	
Time Range of Observation (e.g. 8.30-8.40 pm): _____	

HABITAT ASSESSMENT

Habitat Type (please circle one): pond dam stream drain
 reservoir wetland spring swamp

Comments: _____

WATER QUALITY and WEATHER

CIRCLE to indicate the condition of the site (you can circle more than one choice).

Water Flow: Still Flowing Slowly Flowing Quickly

Water Appearance: Clear Polluted Frothy Oily
 Muddy

Weather Conditions: 1. Windy / Still
 2. Overcast / Recent Rains / Dry (**indicate for 1 AND 2**)

FROGS HEARD CALLING

Please indicate your estimate of how many frogs you heard calling
 (NOTE it is very important to tell us if you heard no frogs)

Number of Calls Heard (circle):
 None One Few (2-9) Many (10-50) Lots (>50)

If you want to test your frog knowledge write the species you heard calling:

Species of Frog(s) Identified: 1. _____ 2. _____
 3. _____ 4. _____

Comments: _____

Now we need you to return your datasheet and tape in the **postage free** post-pak addressed to REPLY PAID 6360 Mr Peter Goonan Environment Protection Agency GPO Box 2607 ADELAIDE SA 5001. We will identify your frog calls and let you know the results of your recordings.

Office use only. Please leave blank.
FROG SPECIES PRESENT.

Species Number	Species 1	Species 2	Species 3	Species 4	Species 5
Species Name					
None					
One					
Few (2 - 9)					
Many (10 - 50)					
Lots (>50)					

**ENVIRONMENT PROTECTION AGENCY
 DEPARTMENT FOR ENVIRONMENT HERITAGE AND ABORIGINAL AFFAIRS**

Appendix 2. Survey sent to FROG CENSUS participants.

FROG CENSUS PARTICIPANT SURVEY

Please return by 08/01/1999

Name: (optional)
Suburb:
Age Group: under 10 11 - 18 19-30 31-65 66 plus (please circle)
Sex: male / female
Number of Years as a FROG CENSUS participant:
Please circle the category that relates to you: solo participant / school group / family group
Are you involved in any other environmental groups or activities? YES / NO

Please read the statements below and circle the category which corresponds to your opinion.

- 1. I found the FROG CENSUS an easy activity to participate in. YES / NO
2. As a result of my involvement with the FROG CENSUS I now pay more attention to:
i) the frogs calling in my area YES / NO
ii) the water quality of my local waterways YES / NO
3. My participation in the FROG CENSUS has increased my knowledge of:
i) frogs in my local area YES / NO
ii) frogs in South Australia YES / NO
iii) the role that frogs can play as biological indicators YES / NO
iv) the role of the EPA in looking after our environment YES / NO
v) catchment health YES / NO
4. I can now recognise at least some of the frogs in my area by their calls. YES / NO
5. The feedback that I have received from the FROG CENSUS has improved my knowledge about:
i) frogs in my local area YES / NO
ii) frogs in South Australia YES / NO
6. Have you visited the FROG CENSUS web-site YES / NO
http://www.epa.sa.gov.au/frogcensus/ (if NO go to Q. 7)

Do you have any comments about the web site
.....
.....

- 7. I would like to know more about: If yes please tick the box
i) the distribution of frogs in South Australia
ii) the biology of frogs
iii) the role of frogs as biological indicators
iv) the health of South Australian waterways
v) community environmental monitoring projects in my local area

Optional Feedback
Do you have any suggestions for improving the FROG CENSUS?
.....
.....

.....
.....
Thank you for your time and participation