

**HERPETOFAUNAL
OBSERVATIONS IN DISPARATE
HABITATS IN SOUTH AUSTRALIA,
NEW SOUTH WALES, AND
QUEENSLAND, AUSTRALIA**

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INTRODUCTION

An engaging challenge of Australian herpetology is the ratio of reptiles and amphibians to scientists - in the face of numerous taxonomic problems, there are relatively few scientists to resolve them. Keogh and Smith (1996:697) commented that 'while other areas of the world which have relatively fewer taxa and many more workers (i.e., North America and Europe) have resolved many species-level problems, Australia is still a virtual frontier of taxonomic research'. This sentiment, combined with the fact that Australia is home to more species of reptiles (ca. 765 species) and amphibians (ca. 210 species) than any other country in the world, makes the prospect of discovering undescribed species probable (Barker et al., 1995; Morell, 1999).

I explored three climatically and vegetatively diverse habitats (semi-arid chenopod shrubland, open-forest, and tropical rainforest) in the autumn of 1998 (Figs. 1-4). From 31 Aug - 12 Dec of that year, I participated in a field study at the 'Winters' Field Station approximately 150 km NNE of Adelaide, South Australia (Fig. 2). The research was conducted under the auspices of Prof. C. M. Bull of the Flinders University of South Australia. The purpose of the research was to add data to ongoing studies of the behaviour and ecology of the Shingleback Skink (*Tiliqua rugosa* - see Bull et al., 1993; Bull & Baghurst, 1998; Bull & Freake, 1999; Bull & Pamula, 1998). Between 5 and 8 Nov 1998 I explored the environs of Lake George, New South Wales (Fig. 3), and subsequently (18-26 Dec 1998) made

herpetofaunal observations in the rainforests of Cow Bay, Queensland (Fig.4).

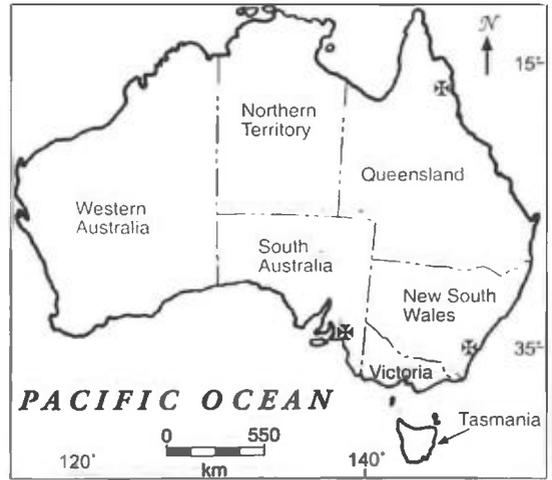


Fig. 1. Map of Australia. Symbols represent observation sites in South Australia, New South Wales, and Queensland.

MATERIALS AND METHODS

All the species listed below were identified using keys, photographs and descriptions noted in Barker et al. (1995), Cogger (1992), and Mirtschin & Davis (1992). I recommend all three books to anyone interested in conducting herpetofaunal observations in Australia, as well as Shine (1993) for an excellent discussion of the biology of snakes.

In South Australia, observations typically were made by conducting visual surveys, either on foot or road cruising by car. Some species were observed under refugia such as tin sheets and dead sheep carcasses. All observations were conducted during the day between 0900 and 1900 hours because temperatures usually were too low at night for herpetofaunal activity. On 28 Nov 1998, a drift fence (T-shaped, ca. 10 m long) with 2 pitfall traps (ca. 45 cm deep) was constructed in an area dominated by bluebush and left in place until 12 Dec 1998 in order to detect species that had been missed by the visual survey method (Greenbaum, 1999). Observations in New South Wales were conducted by visual survey or checking under sheets of tin that littered the ground. In Queensland, observations were made

by visual surveys by day and night. To minimize disturbance to nocturnal rainforest species, photographs were used to confirm identification.

SOUTH AUSTRALIA

The 'Winters' Field Site is located near Mt. Mary, South Australia (34°06' S, 139°26' E; Fig. 2), east of the Flinders ranges (Main & Bull, 1996). Characteristically, the summers are dry and hot and the winters cool and wet; mean annual precipitation is 270 mm (Bureau of Meteorology, 1975). During my visit, temperatures ranged from near freezing (1°C) at night to very hot (42°C) at midday. The area had been extensively cleared for sheep grazing; resulting vegetation damage and sheep scat (with accompanying bushflies) were ubiquitous (Kirkpatrick, 1994). Wilson (1990) noted that more than 60% of Australia's land surface is utilized for grazing, which results in habitat destruction and disruption of the natural ecosystem. The dominant vegetation of the area includes mallee eucalyptus trees (*Eucalyptus sp.*), bluebush (*Maireana sp.*), saltbush (*Atriplex sp.*), and spear grass (*Stipa sp.*) (Leigh, 1994). Bluebush has a high salt content and succulent leaves, and is resistant to fire; no bushfires were reported in the area during the field season.

Both western grey kangaroos (*Macropus fuliginosus*) and red kangaroos (*Macropus rufus*) were seen daily, although competition from sheep grazing has been known to markedly reduce kangaroo populations in some areas of Australia (Bayliss, 1987). Feral cats (*Felis catus*) were spotted on occasion, as well as the more frequently sighted feral foxes (*Vulpes vulpes*); both are noted predators of amphibians, reptiles, birds, and lambs (Rolls, 1969; Macdonald, 1984). The field station itself is a 120-year-old house built by the Winters family, and was constructed from a stone frame, rock walls and a tin roof.

Old pieces of tin littered the terrain in several areas and served as ideal refugia for many species of reptiles and frogs, including Eyrean Earless Dragons, *Tympanocryptis tetraporophora* (which was not detected in areas lacking tin refuges). The

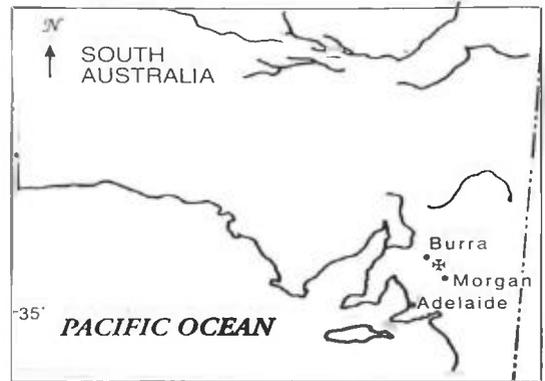


Fig. 2. Map of Australia showing the location of the Winters Field Station NNE of Adelaide, SA.

pitfall method of survey (Greenbaum, 1999) yielded 2 individuals of a skink (*Ctenotus uber*) that was undetected elsewhere and one unidentified species of scorpion. Baker (1986) reported catching one species of scorpion (*Urodacus manicatus*), as well as five species of lizards with pitfall traps in a similar habitat of South Australia. Reptiles and amphibians have been collected in pitfall traps in other studies in South Australia as well (Goonan et al., 1993; Read, 1995). Friend et al. (1989) and Greenberg et al. (1994) discussed the influence of trap design on diversity and numbers of species captured.

Two species of snake were previously reported at Winters in the past 50 years from anecdotal accounts. A 2.5-m carpet python (*Morelia spilota*), reported to have eaten several rabbits, was captured by a local landowner many years ago. In another account, a death adder (*Acanthophis sp.*) was described to have been sheltering under a felled eucalyptus tree. In the 14-year history of the Winters *Tiliqua* study, neither species has been sighted. Jason Ferris and Blaise Barrette reported species of reptiles at Winters in 1992-3 that I did not observe in 1998. They are as follows: Gekkonidae: Bynoe's Gecko (*Heteronotia binoei*); Agamidae: Painted Dragon (*Ctenophorus pictus*), Bearded Dragon (*Pogona barbata*), Five-lined Earless Dragon (*Tympanocryptis lineata*);

Scincidae: *Cryptoblepharus plagiocephalus*, *Lerista muelleri*, *Menetia greyii*, *Morethia adelaidensis*, *Morethia boulengeri*; Typhlopidae: *Ramphotyphlops* sp.; Elapidae: Western Brown Snake (*Pseudonaja nuchalis*), *Suta nigriceps*, *S. spectabilis*. I did not directly observe these taxa in the field or confirm species identification; they are omitted from Table 1.

SPECIES ACCOUNTS

Myobatrachidae

Limnodynastes tasmaniensis Günther, 1858; Spotted Grass Frog

3 records. 12 Sept 1998 - One adult observed under a sheet of tin during a light rain.

One adult observed under a flat rock situated beneath a frequently used water tank.

One adult heard calling in a cistern adjacent to the Winters house on several occasions throughout the field season.

Agamidae

Pogona vitticeps (Ahl, 1926); Central Bearded Dragon

Multiple records (>10). 1 Sept 1998 - One adult seen basking in road, another adult seen basking on a fence post. 12 Sept 1998 - One adult basking on ground adjacent to a bluebush. One juvenile found under a sheet of tin. This species was most common on warm, sunny days.

Tympanocryptis tetraporophora Lucas and Frost, 1895; Eyrean Earless Dragon

2 records. 9 Sept 1998 - One adult found sheltering under tin in an area of bluebush. A second individual was photographed under a piece of tin in November. The Winters locality is ca. 50 km southeast of the currently known range limit of this species (Cogger, 1992; Houston, 1998). Cogger (1992) noted that the status of this species is uncertain; it resembles *T. lineata*, which has been collected in past years at the Winters locality. The two species differ slightly in stripe pattern; *T. tetraporophora* possesses two preanal pores and two femoral pores (Houston, 1998).

Gekkonidae

Gehyra variegata (Duméril and Bibron, 1836); Tree Dtella

6 records. 3 Sept 1998 - One adult seen outside kitchen window at night, feeding on moths attracted to light at the window. 29 Oct 1998 - Two adult males fell from rafters in the ceiling of the house to the floor. One male was grasping the other's head in his mouth. Two other adults seen in an abandoned outhouse, ca. 20 m from the house; one juvenile seen in the house.

Scincidae

Cryptoblepharus virgatus (Garman, 1901); Cream-striped Shining Skink

10 records. 1 Sept 1998 - Several adults seen crawling among the cracks of the house. This species was observed on warm, sunny days throughout the field season.

Ctenotus uber Storr, 1969

2 records. 29 Nov 1998 - One adult caught in pitfall trap. 30 Nov 1998 - One adult caught in pitfall trap. This species probably had escaped detection from visual surveys because of its speed, alertness, and tendency to seek shelter near chenopod shrubs.

Eremiascincus richardsonii (Gray, 1845); Broad-banded Sand Swimmer

3 records. 11 Sept 1998 - One adult seen foraging on the floor of the kitchen inside the house; when picked up, the lizard tried to bite. The lizard was noted shortly after a light rain began. 29 Nov 1998 - Two adults seen foraging on the floor of the house.

Lerista punctatovittata (Günther, 1867)

1 record. 10 Sept 1998 - One adult caught under a piece of tin during a light rain. The individual immediately lost its tail which continued to wiggle for several minutes.

Tiliqua occipitalis (Peters, 1863); Western Blue-tongued Skink

2 records. 3 Oct 1998 - One adult seen under a chenopod bush in the afternoon. When disturbed, the lizard opened its mouth and repeatedly projected its bluish tongue. Another individual was observed crossing a road in November.

Tiliqua scincoides (White, ex Shaw, 1790); Eastern or Common Blue-tongued Skink

1 record. 26 Nov 1998 - One adult seen crossing a road on a warm afternoon. The animal did not try to bite when disturbed.



Juvenile Shingleback skink, *Tiliqua rugosa*, ca. 15 cm long. Photo by author.

Tiliqua rugosa Gray, 1825; Shingleback Skink or Sleepy Lizard

Multiple records (>1000). More than 50 adult lizards with radio transmitters were tracked twice a day. Lizards were also observed by road cruising

in the general vicinity of Winters. This species was the most common reptile at Winters. 17 Oct 1998 - Hottest day of season (42°C); most lizards with radio-transmitters could not be found above ground. Two adults were observed entering a rabbit burrow. 22 Oct 1998 - Collected 72 adult lizards in one day, breaking a 14-year-old record for the study. 28 Oct 1998 - Collected 73 adult lizards in one day. 29 Oct 1998 - Collected a juvenile lizard 18 cm long and 150 g in weight; juveniles rarely were seen throughout the field season. 4 Nov 1998 - Unusually humid; caught 82 adult lizards in one day (current record for the study). 17 Nov 1998 - An adult was observed walking in an area with many bluebushes and carrying a young bird in its mouth.

Varanidae

Varanus gouldii (Gray, 1838); Sand Goanna

7 records. 5 Oct 1998 - One adult seen crossing road. 15 Oct 1998 - Two adults seen fighting in the entrance to a rabbit burrow; only their heads could be seen outside of the burrow. 22 Oct 1998 - One large adult seen basking in the road. When disturbed the lizard rapidly ran up a tree. 30 Oct 1998 - Two adults seen fighting in a bipedal posture about 2 m from the rabbit burrow noted above. The fight lasted an hour, at which time one lizard ran into the burrow. The other lizard did not move for another 5 minutes. It retreated into a separate burrow leading into the same underground system. 17 Nov 1998 - Startled an adult basking near the road. It quickly ran off into a chenopod shrub. These lizards were observed on very warm days; no juveniles were seen. Thompson *et al.* (1992) first described the fighting behaviour of this species.

Elapidae

Pseudonaja textilis (Duméril, Bibron and Duméril, 1854); Eastern Brown Snake

33 records. 9 Sept 1998 - One juvenile seen under a sheet of tin. 10 Sept 1998 - One adult about 1 m total length (TL) photographed on the road; the snake was not disturbed by our car, but spread its hood and moved away when approached. 11 Sept

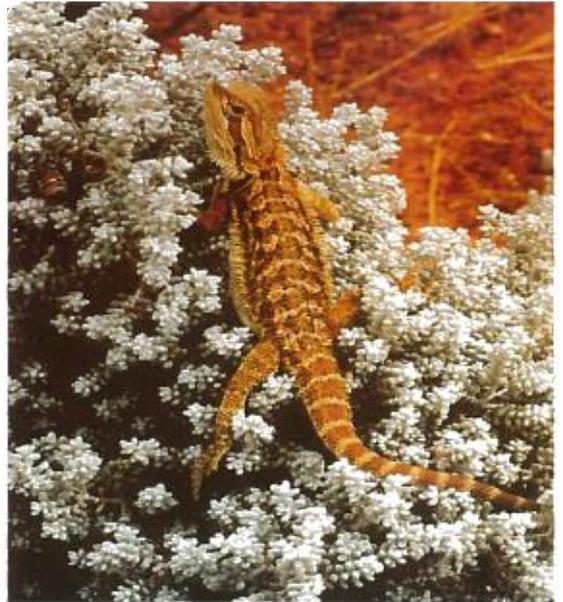


A pair of male Sand Goannas, *Varanus gouldii*, fighting over the rights to a large system of rabbit burrows.

Photos by author.



Giant tree frog, *Litoria infrafrenata*.



Subadult Central bearded dragon, *Pogona vitticeps*, on a bluebush. With the onset of maturity, the pattern observed in this specimen will fade to a uniform black or brown.

1998 - One adult seen emerging from a rabbit burrow. 18 Sept 1998 - One adult seen moving in open grassland. 30 Sept 1998 - One adult found dead on road (DOR); another adult was seen moving along the roadside 20 m from the DOR specimen. A large adult (ca. 1.5 m) seen moving in grass adjacent to another road. 5 Oct 1998 - One subadult seen near bluebush on a cool morning at 0900 hours. 9 Oct 1998 - One adult seen regurgitating a bird. 15 Oct 1998 - One subadult seen emerging from the same system of rabbit burrows that two sand goannas had been observed entering minutes before. 29 Nov 1998 - One large adult (ca. 1.25 m) seen trying to find an entrance to the Winters house. Most snakes were seen on warm, sunny days. If disturbed, most individuals fled; some raised their heads in an 'S' shaped loop and lunged at the aggressor.

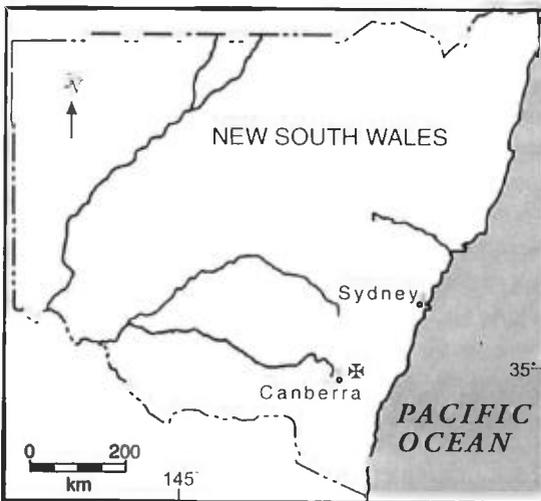


Fig. 3. Map of New South Wales showing the location of the observation site at Lake George.

NEW SOUTH WALES

On 8 Nov 1998 I explored a habitat of open-forest (sclerophyll forest) about 1 km east of Lake George in New South Wales (Fig. 3). Open-forest habitat is defined as a community that has 30-70% canopy cover (Gill, 1994). Just northeast of Canberra, ACT, the habitat is dominated by *Eucalyptus* trees and understory shrubs, herbs, ferns, and grasses. The site is west of a road in an

area bordered by two flowing streams. Cheney (1976) classified open-forest habitat as one of the most severe fire risks in Australia; it is common for these ecosystems to experience significant fires every 3 -5 years.

Together with similar habitats in Tasmania, open-forests represent one of the most important refuge sites for animals in Australia; their future is threatened by root rotting disease (*Phytophthora*) and bauxite mining (Gill, 1994). Annual temperatures range from close to freezing (2°) to warm (30°C), and the area receives over 600 mm of rainfall per year (Bureau of Meteorology, 1975).

SPECIES ACCOUNTS

Scincidae

Egernia cunninghami (Gray, 1832); Cunningham's Skink

6 records. Six adults caught under several sheets of tin and a pile of wooden fenceposts in an area of unshaded grass. Several other adults were seen but not captured.

Hemiergis decresiensis (Cuvier, 1829)

1 record. One adult caught underneath a log in an area of grassland shaded by trees.

Elapidae

Pseudonaja textilis (Duméril, Bibron and Duméril, 1854); Eastern Brown Snake

1 record. One adult seen basking adjacent to a pile of wooden fenceposts; the snake retreated into the woodpile when discovered.

QUEENSLAND

The Daintree Rainforest of Queensland's far north has an ancient history of 120 million years, and has recovered from catastrophes ranging from volcanic eruptions to chilling Ice Age winds (Nielsen, 1997). A recent addition to the World Heritage listing, the Daintree is completely protected from logging in an area stretching from Cooktown to Townsville (ca. 9000 square kilometers), and represents the largest continuous area of rainforest in Australia (Adam, 1992).

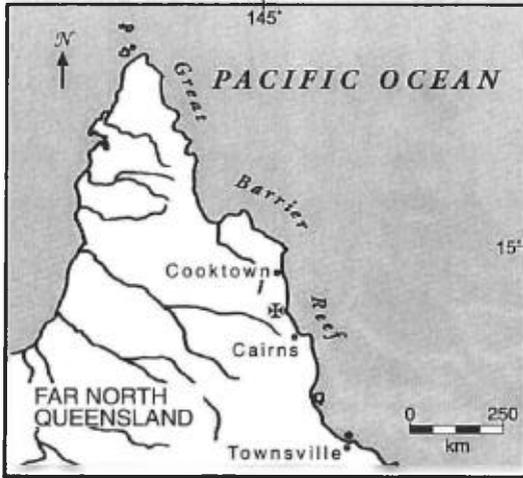


Fig. 4 Map of northern Queensland showing location of the observation site at Cow Bay.

Rainfall ranges between 2-4 m per year (Bureau of Meteorology, 1975). The habitat at the site I explored near Cow Bay, Queensland (Fig. 4), is classified as 'very wet', and receives the highest amount of rainfall of any coastal rainforest area between Cairns and Cooktown (Tracey, 1982). Observations were conducted from 20-26 Dec 1998, during the hot, stormy season just before the wettest time of the year. Annual temperature averages between 26 and 31°C (Bureau of Meteorology, 1956).

Webb & Tracey (1994) characterized the structure of the forest as 'complex mesophyll vine forest', with medium to high levels of soil nutrients. Tracey (1982:14) considered the tract of forest at Cow Bay to be the most complex rainforest structure in Australia (Type 1a) and 'represents the optimum development of rainforest in Australia under the most favourable conditions of climate and soil on the tropical humid lowlands'. Dominant forms of vegetation include palms, cycads, ferns, lianas, and hundreds of species of buttressed trees. Kirkpatrick (1994) noted that rainforest habitats often do not recover after severe fire damage, but the frequency of fires is either low or non-existent, because some rainforest vegetation will not burn. Uprooting damage by feral pigs (*Sus scrofa*) was ubiquitous

and may represent a direct threat to the herpetofauna of the region because the introduced mammals are known to prey on small vertebrates (Macdonald, 1984). Several species of treefrogs and skinks could not be identified to the species level with absolute certainty, and are not included in the accounts below.

SPECIES ACCOUNTS

Bufonidae

Bufo marinus (Linnaeus, 1758); Cane Toad
1 record. 21 Dec 1998 - One adult observed motionless adjacent to path on ground at night. Introduced to Australia in 1935 with the intention of controlling cane beetles, the amphibian is considered a pest. The toad will eat many species of reptiles and amphibians, and poisons any animals that prey upon it. The range of this species is spreading west and south to the Northern Territory and New South Wales, respectively (Cogger, 1992; Johnson, 1992).

Hylidae

Litoria gracilentia (Peters, 1869); Daintree Green Tree Frog
1 record. 21 Dec 1998 - One adult observed about 1.5 m from the forest floor, perched on a leaf at night.

Litoria infrafrenata (Günther, 1867); Green Tree Frog

1 record. 23 Dec 1998 - One adult observed about 0.5 m from the forest floor, perched on a liana at night.

Chelidae

Elseya latisternum Gray, 1867; Saw-shelled Turtle
5 records. 21 Dec 1998 - Three adults and two subadults observed in a stream flowing through forest without any penetrating rays of sunlight. All submerged once alerted to my presence. Afternoon.

Agamidae

Hypsilurus boydii (Macleay, 1884); Boyd's Forest Dragon

Multiple observations (>10). 21 Dec 1998 - One adult perched at eye-level on a liana. When disturbed, the lizard dropped to the ground and retreated by running bipedally. Afternoon. 23 Dec 1998 - One adult perched on a liana adjacent to a frequently used cabin; the animal remained motionless and was not noticed by more than a dozen people walking < 2 m away. Afternoon. This species was quite common at Cow Bay, although Cogger (1992) illustrated a very limited range within Queensland. While sleeping at night, the lizards tended to be perched higher if there was obvious disturbance by feral pigs on the ground below. This was an adaptation to avoid predation by the feral mammals.

Gekkonidae

Heteronotia binoei (Gray, 1845); Bynoe's Gecko
1 record. 22 Dec 1998 - One subadult observed under a hollow log at midday.

Scincidae

Carlia rubrigularis Ingram and Covacevich, 1989
Multiple observations (>10). 21 Dec 1998 - Numerous adults observed running across the forest floor during the day.

Boidae

Morelia amethystina (Schneider, 1801); Amethystine Python
2 records. 21 Dec 1998 - One subadult (ca. 1 m) was observed crawling on the forest floor at night, an hour later an adult (ca. 3 m) observed at base of a tree. When disturbed, the snake climbed up the tree out of reach in seconds.

Colubridae

Stegonotus cucullatus (Duméril, Bibron and Duméril, 1854); Slatey-grey Snake
1 record. 21 Dec 1998 - One adult observed foraging on the forest floor at night.

DISCUSSION

The amount of time spent making herpetofaunal observations in the three habitats differed by

orders of magnitude, a significant amount of diversity was found at each site. Da Silva and Sites (1995) noted that rare species in the New World tropics often are discovered randomly and one is more likely to find a given species as more time is spent in a given area. This observation is reflected in the number of species discovered at each site relative to the time spent searching. Despite the fact that the South Australian site was thoroughly explored for three and a half months, 13 of the 22 species reported by Ferris and Barrette (1992-3 field season at Winters) were never seen. It is possible that some of their identifications were erroneous (e.g., *Tympanocryptis lineata* and *Cryptoblepharus plagiocephalus* may be correctly attributed to *T. tetraporophora* and *C. virgatus*, respectively), or that environmental conditions in 1998 mitigated against the observation of certain taxa. However, two species (*Lerista punctatovittata* and *Tiliqua scincoides*) were observed on one occasion each in 1998, and would have been missed had I not been in the right place at the right time.

One can imagine that the diversity of species missed at the other two sites was because of the dearth of search time. My original purpose in traveling to Lake George was to observe Eastern Tiger Snakes (*Notechis scutatus*), which were supposedly common in the area; however, none were found. These observations should serve as a caveat to workers conducting biodiversity inventories in Australia or elsewhere. No matter how thorough a search may be in a given area, at a given time, the presence of certain species will invariably be missed. To maximize the effectiveness of herpetofaunal surveys, many collecting methods should be employed, and observations should be conducted in different years, times of year, microhabitats, times of day, weather conditions, and levels of anthropogenic environmental disturbance. For example, a recently-described frog (*Eleutherodactylus coffeus*) was found in the ground cover leaves of a coffee grove, and to date, has not been discovered in any other type of habitat (McCranie & Köhler, 1999).

Table 1. Summary of all species of reptiles and amphibians encountered. 'X' indicates location(s) where found.

Species	South Australia	New South Wales	Queensland
Bufonidae <i>Bufo marinus</i>			X
Hylidae <i>Litoria gracilentata</i> <i>L. infrafrenata</i>			X X
Myobatrachidae <i>Lymnodynastes tasmaniensis</i>	X		
Chelidae <i>Elseya latisternum</i>			X
Agamidae <i>Hypsilurus boydii</i> <i>Pogona vitticeps</i> <i>Tympanocryptis tetraporophora</i>	X X		X
Gekkonidae <i>Gehyra variegata</i> <i>Heteronotia binoei</i>	X		X
Scincidae <i>Carlia rubrigularis</i> <i>Cryptoblepharus virgatus</i> <i>Ctenotus uber</i> <i>Egernia cunninghami</i> <i>Eremiascincus richardsonii</i> <i>Hemiergis decresiensis</i> <i>Lerista punctatovittata</i> <i>Tiliqua occipitalis</i> <i>T. scincoides</i> <i>T. rugosa</i>	X X X X X X X X X	X X	X
Varanidae <i>Varanus gouldii</i>	X		
Boidae <i>Morelia amethystina</i>			X
Colubridae <i>Stegonotus cucullatus</i>			X
Elapidae <i>Pseudonaja textilis</i>	X	X	

The observations discussed in this paper are not meant to reflect the efforts of an exhaustive biodiversity survey by any means. However, they can bolster future efforts to document all species of reptiles and frogs known to occur in these areas of Australia. The most noteworthy of my observations include a range extension for the

Eyrean Earless Dragon (*Tympanocryptis tetraporophora*).

Because the few professional herpetologists in Australia cannot conduct such surveys in all areas of interest, it is hoped that amateurs will become interested in the diversity of animals in their vicinity and use the field guides mentioned herein

to make identifications. Basic data on distribution can be improved through such efforts, as well as information on behaviour, ecology, and other aspects of biology which may be of use to future workers. Although detailed field notes are the most desirable and useful pieces of information to professional herpetologists, even the most inexperienced novice can add to the growing body of knowledge by recording precise locality data and taking photographs to serve as a proxy for vouchered specimens.

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REFERENCES

Adam, P. (1992). *Australian rainforests*. Oxford: Clarendon Press.

Baker, G.H. (1986). Coleoptera, Scorpionidae, and Reptilia collected in pitfall traps in Englebrook National Trust Reserve, South Australia. *Trans. R. Soc. S. Aust.* **110**, 43-48.

Barker, J., Grigg, G. & Tyler, M. (1995). A field guide to *Australian frogs*. Chipping Norton: Surrey Beatty & Sons.

Bayliss, P. (1987). Kangaroo dynamics. In *Kangaroos: their ecology and management in the sheep rangelands of Australia*, 119-134. Caughley, G., Shepherd, N. & Short, J. (Eds.). Cambridge: Cambridge University Press.

Bull, C.M. & Baghurst, B.C. (1998). Home range overlap of mothers and their offspring in the sleepy lizard, *Tiliqua rugosa*. *Behav. Ecol. Socio.* **42**, 357-362.

Bull, C.M., Bedford, G.S. & Schulz, B.A. (1993). How do sleepy lizards find each other? *Herpetologica* **49**, 294-300.

Bull, C.M. & Freake, M.J. (1999). Home-range fidelity in the Australian sleepy lizard, *Tiliqua rugosa*. *Aust. J. Zool.* **47**, 125-132.

Bull, C.M. & Pamula, Y. (1998). Enhanced vigilance in monogamous pairs of the lizard, *Tiliqua rugosa*. *Behav. Ecol.* **9**, 452-455.

Bureau of Meteorology. (1975). *Climatic atlas of Australia*. Map set 5, rainfall. Canberra: Australian Government Publishing Service.

Bureau of Meteorology. (1956). *Climatic averages: Australia*. Melbourne: Commonwealth of Australia, .

Cheney, N.P. (1976). Bushfire disasters in Australia, 1945-1975. *Austr. For.* **35**, 263-270.

Cogger, H.G. (1992). *Reptiles and amphibians of Australia*. Melbourne: Reed Books.

Da Silva, N.J. & Sites, J.W. Jr. (1995). Patterns of diversity of Neotropical squamate reptile species with emphasis on the Brazilian Amazon and the conservation potential of indigenous reserves. *Conserv. Biol.* **9**, 873-901.

Friend, G.R., Smith, G.T., Mitchell, D.S., & Dickman, C.R. (1989). Influence of pitfall and drift fence design on capture rates of small vertebrates in semi-arid habitats of Western Australia. *Aus. Wild. Res.* **16**, 1-10.

Gill, A.M. (1994). Patterns and process in open-forests of *Eucalyptus* in southern Australia. In *Australian vegetation*, pp. 197-226. Grovers R.H. (Ed.). Cambridge: Cambridge University Press.

Goonan, P.M., Mann, A.L. & Marley, T.P. (1993). Fauna of the Brookfield Conservation Park in the Murray Mallee, South Australia. 2. Annotated checklist of the amphibians, reptiles and mammals. *Sth. Aust. Nat.* **68**, 4-14.

Greenbaum, E.B. (1999). Efficiency of three amphibian and reptile population estimation methods used at D'Arbonne National Wildlife Refuge, Union Parish, Louisiana. *Bull. Chicago Herpetol. Soc.* **33**, 191-193.

Greenberg, C.H., Neary, D.G. & Harris, L.D. (1994). A comparison of herpetofaunal sampling effectiveness of pitfall, single-ended

- and double-ended funnel traps used with drift fences. *J. Herpetol.* **28**, 319-324.
- Houston, T. (1998). *Dragon lizards and goannas of South Australia*. Adelaide: South Australian Museum.
- Johnson, K (main author). (1992). *The AUSMAP atlas of Australia*. Cambridge: Cambridge University Press.
- Kirkpatrick, J. (1994). *A continent transformed: human impact on the natural vegetation of Australia*. Melbourne: Oxford University Press.
- Keogh, J.S. & Smith, S.A. (1997). Taxonomy and natural history of the Australian bandy-bandy-snakes (Elapidae: *Vermicella*) with a description of two new species. *J. Zool. Soc. London* **240**, 677-701.
- Leigh, J.H. (1994). Chenopod shrublands. In *Australian vegetation*, pp. 345-367. Groves, R.H. (Ed.). Cambridge: Cambridge University Press.
- Macdonald, D. (Ed). (1984). *The encyclopaedia of mammals*. New York: Facts on File Publications.
- Main, A.R. & Bull, C.M. (1996). Mother-offspring recognition in two Australian lizards, *Tiliqua rugosa* and *Egernia stokesii*. *Anim. Behav.* **52**, 193-200.
- McCranie, J. & Köhler, G. (1999). A new species of rainfrog of the *Eleutherodactylus gollmeri* group from western Honduras. *Senckenb. Biol.* **79**, 83-87.
- Mirtschin, P. & Davis, R. (1992). *Dangerous snakes of Australia: an illustrated guide to Australia's most venomous snakes*. London: New Holland Ltd.
- Morell, V. (1999). The variety of life. *Nat. Geogr. Mag.* **195**, 6-31.
- Nielsen, L. (1997). *Daintree: jewel of tropical North Queensland*. Mount Molloy: Lloyd Nielsen.
- Read, J.L. (1995). Subhabitat variability: A key to the high reptile diversity in chenopod shrublands. *Aust. J. Ecol.* **20**, 494-501.
- Rolls, E.C. (1969). *They all ran wild: the story of pests on the land in Australia*. Sydney: Angus & Robertson Ltd.
- Shine, R. (1993). *Australian snakes: a natural history*. Ithaca: Cornell University Press.
- Thompson, G.G., Withers, P.C. & Thompson, S.A. (1992). The combat ritual of two monitor lizards, *Varanus caudolineatus* and *Varanus gouldii*. *West. Aust. Nat.* **19**, 21-25.
- Tracey, J.G. (1982). *The vegetation of the humid tropical region of North Queensland*. Melbourne: Commonwealth Scientific and Industrial Research Organization (Australia).
- Webb, L.J. & Tracey, J.G. (1994). The rainforests of northern Australia. In *Australian vegetation*, pp. 87-129. Groves, R.H. (Ed.). Cambridge: Cambridge University Press.
- Wilson, A.D. (1990). The effect of grazing on Australian ecosystems. In *Proceedings of the Ecological Society of Australia, Vol. 16. Australian ecosystems: 200 years of utilization, degradation and reconstruction*, pp. 235-244. Saunders, D.A., Hopkins, A.J.M. & How, R.A (Eds.). Chipping Norton: Surrey Beatty & Sons Pty. Ltd.