

A PRELIMINARY EVALUATION OF FROG ASSEMBLAGES IN THE PILLIGA FORESTS

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Abstract: This paper provides a preliminary evaluation of frog assemblages in the Pilliga forests, a geographically significant region in northern New South Wales. Spotlighting and call recognition surveys were conducted at 19 sites: 14 fire dams, three woodland sites and two built environs. A total of 11 species were detected, the most frequently recorded being *Litoria latopal mata* (broad-palmed rocket frog). Five species were also found at sites on built environs. Of particular interest, *Cyclorana alboguttata* (striped burrowing frog), a rarely seen species in this region, was recorded at one dam. A desktop assessment of species records was conducted to support the field data, accounting for 10 species that were not located in the surveys.

Key words: amphibian, biodiversity, call recognition, fire dam, frogs, spotlighting

INTRODUCTION

The Pilliga forests are the largest remaining continuous native forest section in New South Wales west of the Great Dividing Range. The ecology of the region has attracted attention for many features, including its distinctive forest structure (Whipp et al. 2012), rich bird community (Cleland 1919; Chisholm 1936; Date and Paull 1999) and as an important area for *Phascolarctos cinereus* (koala) (Barrott 1999; Kavanagh and Barrott 2001; Kavanagh et al. 2007; Robertson 2009; Milledge 2012), *Ninox connivens* (barking owl) (Debus 1997; Debus 2001; Kavanagh and Stanton 2009; OEH 2012) and a number of microchiropteran bat species (NSW NPWS 2000; Turbill and Ellis 2006; Parnaby et al. 2011; Milledge 2012).

Herpetofauna in the Pilliga forests was first highlighted by Bustard (1968), though interestingly he concluded the region was not a viable environment for frogs. Since then, herpetological study in the North West Slopes has been furthered by others (e.g. Date and Paull 1999, Murphy 2008), who have recognised the presence of amphibian species. Much of this work resides in unpublished literature and is not readily available in scientific literature.

Frogs are presumably underrepresented in biodiversity surveys due to the difficulty of surveying remote areas during suitable conditions for frog detection, such as high rainfall (J. Hatch, pers. comm.). This paper describes frog assemblages in the Pilliga forests from field data and secondary sources. The primary dataset was gathered by surveying a number of locations in different land tenure. Frog activity can be variable and often strongly influenced by seasonality and weather conditions (Brooke et al. 2000; Hauselberger and Alford 2005; Lemckert et al. 2013). For this reason, the data presented should not be regarded as an inventory

of the selected study sites; rather this paper is intended as a preliminary evaluation of amphibian species occurring within the region.

METHODS

Surveying was carried out on four one-week fieldtrips between October 2012 and April 2014. Substantial rainfall occurred prior to the first fieldtrip, facilitating water flow through the major drainage lines. In comparison, creek lines were dry on subsequent visits. Scattered precipitation occurred prior to two fieldtrips in November 2012 and March 2013. A fieldtrip in April 2014 came after a five-month period without rainfall, during which most dams had low water levels (less than 1 metre).

Study area and sites

The Pilliga forests lie on an area of valley floor, approximately 535 000 hectares in size. There are two broad geological sections: the southern, eastern and central ranges consist of low, rocky hills, and the remainder consists of a flat, sandy outwash. The most extensive vegetation type comprises of white cypress pine (*Callitris glaucophylla*), bull-oak (*Allocasuarina luehmannii*) and several *Eucalyptus* species, such as narrow-leafed ironbark (*E. crebra*), Blakely's red gum (*E. blakelyi*), Pilliga box (*E. pilligaensis*) and poplar box (*E. populnea*) (Kavanagh et al. 2007). Ephemeral sandy creek lines dissect the Pilliga forests, often supporting stands of rough-barked apple (*Angophora floribunda*) and river red gum (*Eucalyptus camaldulensis*). These flow only after prolonged periods of heavy rainfall, usually in late winter and early spring. Mean daily temperatures range from 33.5°C (maximum; January) to 2.2°C (minimum; July), and mean annual rainfall is 622.4 mm (Australian Government Bureau of Meteorology, Baradine station, 1944-2014).

This study was conducted at 14 fire dams and three woodland sites in four state forests, three national parks and three state conservation areas, and two sites in built environs (Table 1, Figure 1). The fire dams were set up for the dual provision of a fire-fighting resource and wildlife habitat. Although the dams fluctuate in water depth in response to climatic conditions, these tend to retain some amount of water even during severely dry summers.

Dunwerian Dam in Pilliga State Conservation Area (Figure 2) is a typical dam in the study area, with earth bank on all edges and forest vegetation at least 20 m from the banks. The forest types surrounding the dams were open woodland to dry sclerophyll forest of a *Callitris-Eucalyptus-Allocasuarina* association (Figure 3). Short stretches of heath vegetation were present at some sites: Dunwerian Dam, Salt Caves and Timmallallie Dams in Timmallallie National Park and Ridge Road Dam in Yarrigan National Park. Dams in Pilliga West and Merriwindi State Conservation Areas were surrounded with a short layer of grasses. The only dam to have observable floating vegetation was Ten Mile Dam in Jack's Creek State Forest. Some dead white cypress pines (*Callitris glaucophylla*) were present in a 40-m channel off Bark Hut Dam in Timmallallie National Park.

The three woodland sites were located in Cumbil and Euligal State Forests (Table 1). The Aloes and Rocky Creek Mill are the sites of former homesteads, which are now all but gone. The surveyed area of each site was less than 1 ha. Etoo Creek, an ephemeral creekline bound by river red gums intersects the Aloes site. There were two bores providing a source of water, which are the last relics of habitation. Like at the Aloes, most of the infrastructure at the Rocky Creek Mill site has been lost. A remnant well was one of the few built components that survived a wildfire in the summer of 1953-1954. The other water source identified was an ephemeral pool that contained water at the time of surveying (25 March 2013). Errenbri Road, the third woodland site, transverses open woodland dominated by white cypress pines and bull-oaks, with scattered narrow-leafed ironbarks. The ground cover and understory were sparse.

The two sites in built environs (Table 1) differ in their extent of development. In the Baradine Township, surveys were conducted at Baradine Creek and a public reserve that consisted of lawns, small pockets of heathland and dispersed bull-oaks, essentially a peri-urban area. The only evident water sources were those from scattered buildings, such as public toilets. The total surveyed area was approximately 1.2 ha. The second built environ site was a private estate located off Tie Road, approximately 8 km north of Baradine. The site bordered onto a section of Baradine Creek and consisted of a rustic homestead set on disused agricultural land. Apart from five narrow-leafed ironbarks, the site was cleared of native vegetation. A functional water tank and the homestead itself were the only water sources noted.

Table 1: Summary of site locations, including sampling dates (D/M/Y) and weather conditions (W = warm [$>26^{\circ}\text{C}$]; C = cool [$<15^{\circ}\text{C}$]; H = substantial humidity [$>80\%$]; R = recent rain [within seven days])

	Sampling dates	Weather conditions
CUMBIL STATE FOREST		
<i>Aloes</i>	13-14/11/2012	W
	15/11/2012	W, H, R
	16/11/2012	W, H
	17/11/2012	W
	25/03/2013	W, H, R
<i>Errenbri Road</i>	13-14/11/2012	W
	15/11/2012	W, H, R
	16/11/2012	W, H
	17/11/2012	W
EULIGAL STATE FOREST		
<i>Rocky Creek Mill site</i>	25/03/2013	W, H, R
JACK'S CREEK STATE FOREST		
<i>Ten Mile Dam</i>	27/03/2013	W, H, R
MERRIWINDI STATE CONSERVATION AREA		
<i>Log Road Dam</i>	28/03/2013	C, R
<i>Trap Yard Dam</i>	28/03/2013	C, R
	23/04/2014	C
	26/04/2014	C, R
MERRIWINDI STATE FOREST		
<i>Cumberland Dam</i>	28/03/2013	C, R
PILLIGA NATIONAL PARK		
<i>Etoo Creek Dam</i>	24/04/2014	C, R
PILLIGA STATE CONSERVATION AREA		
<i>Dunwerian Dam</i>	25/03/2013	W, H, R
PILLIGA WEST STATE CONSERVATION AREA		
<i>Yarraman Dam</i>	22/04/2013	C
TIMALLALLIE NATIONAL PARK		
<i>Bark Hut Dam</i>	25/04/2013	C, R
<i>Salt Caves Dam</i>	26/03/2013	W, H, R
<i>Timmallallie Dam</i>	31/03/2013	W
YARRIGAN NATIONAL PARK		
<i>Pig Road Dam</i>	29/03/2012	W, H, R
<i>Ridge Road Dam</i>	29-30/03/2012	W, H, R
<i>Treasure Dam</i>	29/03/2012	W, H, R
<i>Yarrigan Dam</i>	30/03/2012	W, H, R
BUILT ENVIRONMENT		
<i>Baradine Township</i>	13/10/2012	W, R
	13-14/11/2012	W
	15/11/2012	W, H, R
	16/11/2012	W, H
	17/11/2012	W
<i>Private estate off Tie Road</i>	28/03/2013	C, R

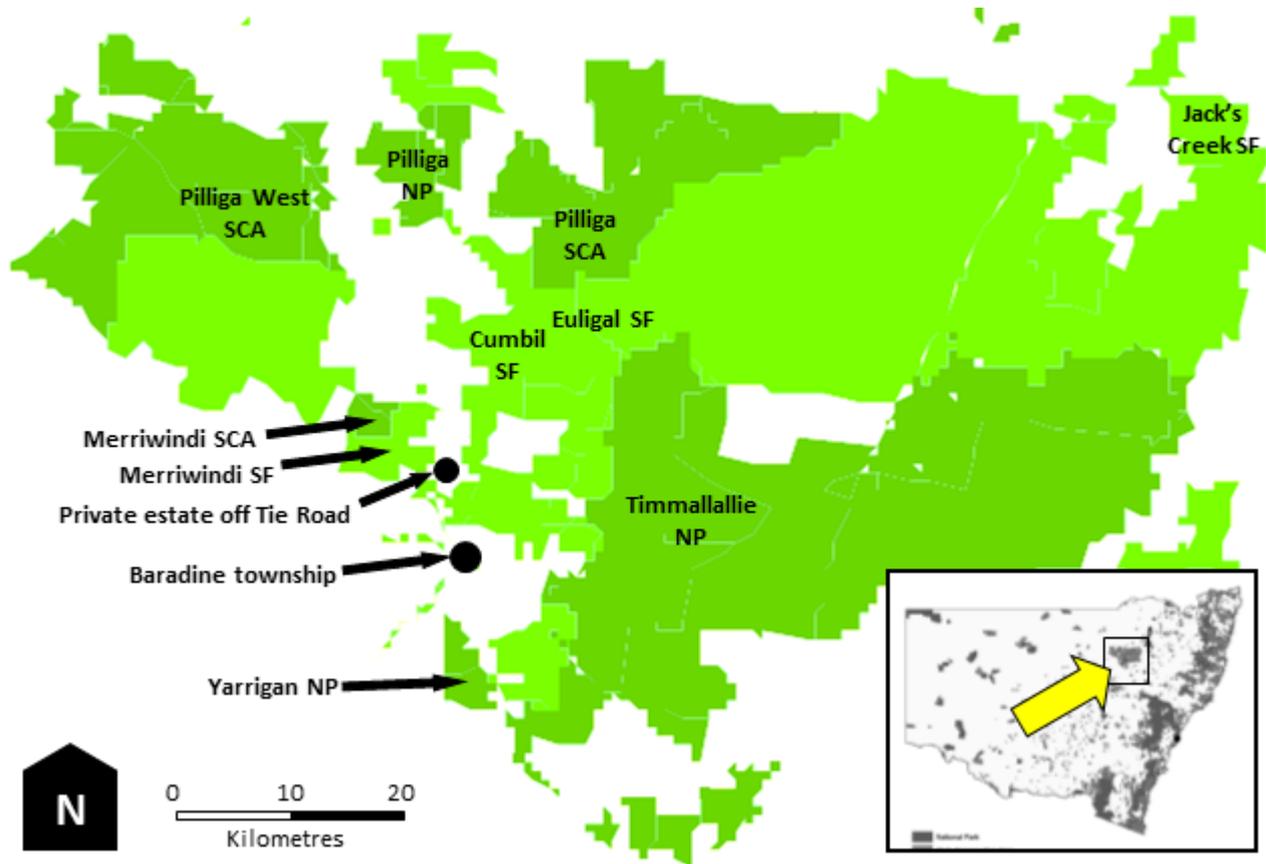


Figure 1: Map of the Pilliga forests, showing the state forests (SF), national parks (NP) and state conservation areas (SCA) where study sites were selected. Areas presented in light green are managed by the Forestry Corporation of NSW (state forests) and those presented in dark green are managed by NSW National Parks and Wildlife Service (national parks and state conservation areas). The inset map shows the location of the Pilliga forests in the context of New South Wales.

Field survey method

Spotlighting and call recognition surveys were conducted by one person (the author) within the first three hours of nightfall. Search effort per survey ranged from 30 min (minimum) to 60 min. A 210-lumen head torch (LED Lenser H14) was used for spotlighting. For fire dams, the immediate edges of the dam were spotlighted (at least 10 m radius), followed by a search around the vicinity for the remainder of the survey duration. Detected frogs were identified to species level, following taxonomy of Tyler and Knight (2011), and recorded on a presence/absence basis. Metamorphs were identified to species level and development stage with reference to Anstis (2013). At fire dams, the approximate distance of the frogs from the waterline was recorded.

Errenbri Road was surveyed differently to the above method. Observations at this site were made opportunistically during fieldwork for another project and therefore, no survey area for replication was defined. The site was traversed according to the work required and search effort was not confined to the first three hours of nightfall. Search effort ranged from four to six hours per evening, and was sporadic within these periods.



Figure 2: Dunwerian Dam, Pilliga State Conservation Area. Photo: M. Mo



Figure 3: *Callitris-Eucalyptus-Allocasuarina*-association woodland. Photo: M. Mo

Desktop assessment

Records were obtained from the Atlas of Living Australia (ALA 2014) and Atlas of NSW Wildlife (OEH 2014) databases to produce a baseline species list for the Pilliga forests. Species listed were validated with distribution information provided by Anstis (2013). This resulted in records for *Cyclorana cultripes* (knife-footed frog) being omitted, as the species occurs further north of the study area.

The results of the present study were complemented with species lists provided by six previous studies. The inclusion of these data broadens the geographical scope of this paper to cover the entirety of the Pilliga forests (Figure 4). The northwestern portion of the Pilliga forests was covered by NSW NPWS (2000) and OEH (2012), overlapping some of the area used for the present study. Both these studies involved spotlighting, call recognition and active ground searches, and in the latter, pitfall traps were also used. NSW NPWS (2000) also covered the southeastern portion, as did NSW NPWS (2002) and Murphy (2008), who focused on the Pilliga Nature Reserve and Timmallallie Dam respectively. The northeastern portion was covered by Milledge (2012), not overlapping with the portion of Jack's Creek State Forest covered by the present study. Date and Paull (1999) was the most widespread study,

conducted across all state forest estate. These studies also used the combination of detection methods described above.

RESULTS

Frog species detected during current study

The present study recorded 11 frog species; five Hyloid species (genera *Cyclorana*, *Litoria*), two Myobatrachid species (genus *Crinia*) and four Limnodynastid species (genera *Limnodynastes*, *Platyplectrum*) (Table 2). Species richness at dams ranged from one to five (mean = 2.2).

Litoria latopalmata (broad-palmed rocket frog) (Figure 6a) was the most frequently recorded species, present at 65% of sites ($n = 11$) (Table 2, Figure 5). This species was not found more than 50 m from water and was absent from non-dam sites. The next most frequently recorded species was *L. caerulea* (common green tree frog) (Figure 6b), present at 41% of sites ($n = 7$) (Table 2, Figure 5). They were detected at distances greater than 50 m from the dam edges and also at sites devoid of surface water bodies, e.g. Errenbri Road in Cumbil State Forest.

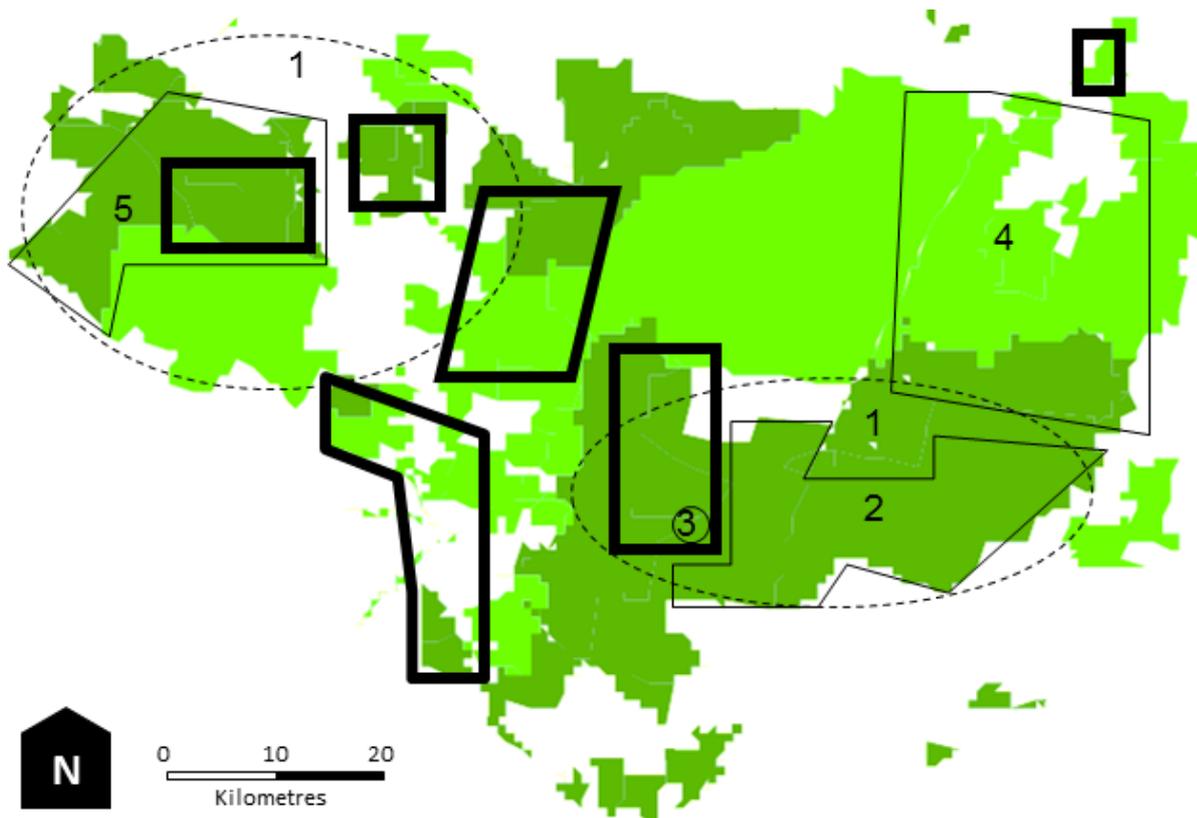


Figure 4: Area coverage of the present study and six other surveys. The area covered by the present study is represented by bold boundaries. Key: (1) NSW NPWS 2000 – broken lines; (2) NSW NPWS 2002; (3) Murphy 2008; (4) Milledge 2012; (5) OEH 2012. A sixth study, Date and Paull (1999) was conducted across all state forest estate (light green).

Table 2: Frog species detected at each site. Abbreviations: Ca = *Cyclorana alboguttata*, Lc = *Litoria caerulea*, Ll = *Lit. latopalmata*, Lp = *Lit. peronii*, Lr = *Lit. rubella*, Cs = *Crinia signifera*, Cp = *Crin. parinsignifera*, Lf = *Limnodynastes fletcheri*, Lta = *Lim. tasmaniensis*, Lte = *Lim. terraereginae*, Ns = *Neobatrachus sudelli*, Po = *Platyplectrum ornatum*.

	Ca	Lc	Ll	Lp	Lr	Cs	Cp	Lf	Lta	Ns	Po
FIRE DAMS											
Ten Mile Dam		+	+		+					+	+
Log Road Dam		+	+		+						
Trap Yard Dam			+			+	+				
Cumberdeen Dam		+									
Etoo Creek Dam									+		
Dunwerian Dam			+								
Yarraman Dam	+							+			
Bark Hut Dam			+	+							
Salt Caves Dam			+		+						
Timmallallie Dam		+	+	+						+	
Pig Road Dam			+								
Ridge Road Dam			+								+
Treasure Dam			+								
Yarrigan Dam			+								
WOODLAND SITES											
Aloes		+		+					+		+
Errenbri Rd		+									+
Rocky Creek Mill											+
BUILT ENVIRON											
Baradine township				+					+		
Tie Rd estate		+		+	+						+

Platyplectrum ornatum (ornate burrowing frog) was recorded at 35% of sites (n = 6), including all non-dam forest sites (Table 2; Figure 7a). This species was seen at two dam sites, but not in close proximity to the water (>15 m distance from the waterline). Individuals were often located in open areas on ant trails. One was observed picking up ants with its tongue as they passed within 2 cm of its anterior. This occurred near Ridge Road Dam, Yarrigan State Forest. *Platyplectrum ornatum* was one of five species found in the built environ sites. The others were *L. caerulea*, *L. peronii*, *L. rubella* (desert tree frog) and *Limnodynastes tasmaniensis* (spotted grass frog).

Metamorphs were found at two locations: *Litoria latopalmata* at Salt Caves Dam, and *Crinia signifera* (common eastern froglet) (Figure 7b) in a pig wallow near Trap Yard Dam. The latter were observed during the day, with numerous individuals actively moving across the shallow water and mud. All metamorphs located were of developmental stage 43 (Anstis 2013), capable of some terrestrial movement.

Desktop assessment

The desktop assessment produced 21 species, 10 which were not recorded in the present study (Table 3). Literature identified seven species not recorded in the present study: *Cyclorana platycephala* (waterholding frog), *Pseudophyrne bibroni* (Bibron's

toadlet), *Uperoleia laevigata* (smooth toadlet), *U. rugosa* (wrinkled toadlet), *Limnodynastes salmini* (salmon-striped frog), *L. terraereginae* (northern banjo frog) and *Notaden bennettii* (crucifix toad). Three species listed in the baseline species list (ALA 2014; OEH 2014) were not recorded in the present study or literature (Date and Paull 1999; NSW NPWS 2000; NSW NPWS 2002; Murphy 2008; Milledge 2012; OEH 2012), but were confirmed by personal communications – *Crinia sloanei* (Sloane's froglet), *Cyclorana verrucosa* (rough frog) (T. Brassil and M. Murphy, pers. comm.) and *L. dumerilii* (eastern banjo frog) (M. Murphy, pers. comm.).

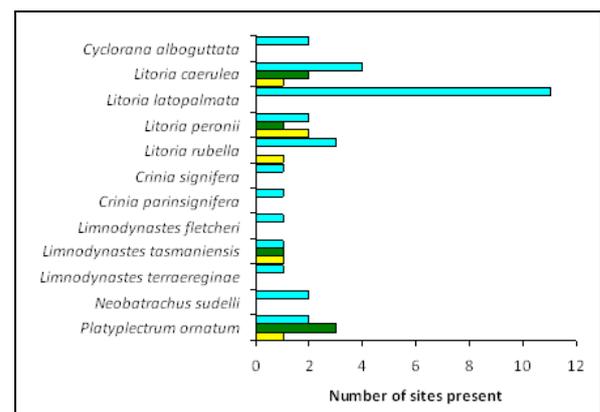


Figure 5: The number of sites frog species were detected at. Dam sites (blue), non-dam sites (green) and built environs (yellow)

Table 3: Frog species detected in the present study and six other surveys. The area coverage of these surveys is shown in Fig. 4. The baseline species list was generated from atlas records (ALA 2014; OEH 2014).

	Present study	Date and Paull 1999	NSW NPWS 2000	NSW NPWS 2002	Murphy 2008	Milledge 2012	OEH 2012
<i>Cyc. alboguttata</i>	■						
<i>Cyc. platycephala</i>		■					
<i>Cyc. verrucosa</i>							
<i>Lit. caerulea</i>	■	■	■	■		■	■
<i>Lit. latopalmata</i>	■	■	■	■	■	■	■
<i>Lit. peronii</i>	■	■	■	■	■	■	
<i>Lit. rubella</i>	■	■	■	■		■	
<i>Crin. signifera</i>	■	■				■	
<i>Crin. parinsignifera</i>	■	■	■			■	
<i>Crin. sloanei</i>							
<i>Pseud. bibroni</i>		■		■		■	
<i>U. laevigata</i>						■	
<i>U. rugosa</i>		■	■			■	■
<i>Lim. dumerilii</i>							
<i>Lim. salmini</i>						■	
<i>Lim. fletcheri</i>	■	■	■			■	■
<i>Lim. tasmaniensis</i>	■	■	■	■		■	■
<i>Lim. terraereginae</i>		■	■	■	■		
<i>Neo. sudelli</i>	■	■	■		■		
<i>Not. bennettii</i>		■	■				
<i>Plat. ornatum</i>	■	■	■	■		■	

DISCUSSION

There is continuing concern for amphibians amid a global decline (Tyler 1991; Berger et al. 1999). In response, there is an evident need to gather baseline data on the distribution of frog populations. In Australia, there has been an increasing amount of work carried out on the conservation status and ecological requirements of frogs (e.g. Murray and Hose 2005; Hero et al. 2006), but a large proportion has focused on coastal areas (Campbell 1999). This study is one of few published accounts of frog assemblages in the Pilliga forests (see also Murphy 2008; Milledge 2012; Murphy and Murphy, in press).

This study recorded a total of eleven species in the field. Three of these (*Litoria latopalmata*, *L. caerulea* and *Platyplectrum ornatum*) were found at >30% of sites. A further 10 species were identified in the desktop assessment. When abundant, frogs play an important role in energy flow, especially in wetland and aquatic ecosystems (Orchard 1999). In particular, they are a major component of the diet of the Pale-headed Snake *Hoplocephalus bitorquatus* (Shine 1983; Fitzgerald et al. 2010), a threatened species with a stronghold in the Pilliga forests.

Fossorial-retreating species that only surface after substantial rainfall – *Cyclorana platycephala*, *C. verrucosa*, *N. bennettii*, *P. bibroni* and *Limnodynates terraereginae* (Robinson 1998) – would be underrepresented in many studies. Such conditions were absent in the present study, which probably

limited detection of these species. The detection of *N. bennettii* is particularly sporadic. A number of repeat visits were required before specimens were observed during flood conditions in November 2010 (T. Brassil, pers. comm.).

Crinia signifera and *C. parinsignifera* were notably scarce in the present study, despite high abundance in other parts of their distribution (Healey et al. 1997; Hazell et al. 2001). Few calling males were heard during present surveys, even though the surveys were conducted during core calling seasons of both species (Lemckert and Mahony 2008) and rainfall had occurred within seven out of 20 survey days.

The detection of *Cyclorana alboguttata* (Figure 8) at Yarraman Dam, Pilliga West State Conservation Area is a significant finding. This species is not often recorded in the Pilliga forests, evident by its absence from the six previous surveys (NSW NPWS 2000; NSW NPWS 2002; Murphy 2008; Milledge 2012; OEH 2012). The first documented sighting was by Murphy and Murphy (in press) in Merriwindi State Conservation Area. Further sightings occurred close to Baradine during flood conditions in November 2010 (T. Brassil, pers. comm.). Almost nothing is known of the behaviour of *C. alboguttata* (Tyler and Knight 2011); in part due to the limited seasonal opportunities to locate them and other *Cyclorana* species. Presumably, this is a primary factor attributing to the low presence of this genus in biodiversity survey data. The Pilliga forests represent part of the southeastern

boundary of the distribution of *C. alboguttata* (Anstis 2013).

The study area is characterised by ephemeral water sources and most frog species can be located anywhere in Pilliga forests after prolonged periods of substantial rainfall (M. Murphy, pers. comm.). In this study, fire dams were targeted as these habitat structures are one of few obvious places to conduct frog surveys under normal conditions. Fire dams are a permanent source of water and therefore provide a more stable habitat than ephemeral creek lines. One overseas study suggested that small wetlands have a disproportionately greater role in metapopulation dynamics of some wetland taxa (Gibbs 1993). In relation to biodiversity surveys, the fire dams offer opportunities to detect most frog species irrespective of the availability of major rainfall events.

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Figure 6: (a) Broad-palmed Rocket Frog *Litoria latopalmata*, Ten Mile Dam, Jack's Creek State Forest, and (b) Common Green Tree Frog *L. caerulea*, the Aloes, Cumbil State Forest. Photos: M. Mo.



Figure 7: (a) Ornate Burrowing Frogs *Platyplectrum ornatum*, the Aloes, Cumbil State Forest, and (b) Common Eastern Frog *Crinia signifera* metamorph, near Trap Yard Dam, Merriwindi State Conservation Area. Photos: M. Mo.



Figure 8: Striped Burrowing Frog *Cyclorana alboguttata*, Yarraman Dam, Pilliga West State Conservation Area. Photo: M. Mo.