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Observations of Giant Burrowing Frogs *Heleioporus australiacus* (Limnodynastidae) in the Mitchell River catchment, East Gippsland, Victoria

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Abstract
Within Victoria, limited records of the threatened Giant Burrowing Frog have been obtained in recent decades. This paper describes 16 records of calling Giant Burrowing Frogs from four tributaries of the Mitchell River system in the Mount Alfred State Forest and Mitchell River National Park, Victoria. Stream condition was a major determinant of calling activity, with calling detected only in pools with no or slow flow, within first, second and fourth order streams, often with sandstone bases. Calling was not always closely associated with rainfall, and occurred across most seasons. (*The Victorian Naturalist* **132** (5) 2015, 128–133)

Keywords: amphibian, breeding habitat, calling behaviour, *Heleioporus australaicus*

Introduction

The threatened Giant Burrowing Frog *Heleioporus australiacus* (Fig. 1) is a large, cryptic amphibian from south-eastern Australia (Gillespie 1990; Penman *et al*. 2004). Its known range extends from east of Walhalla in Victoria along the Great Dividing Range to Newcastle in NSW, where it has been recorded from various forested habitat types (Gillespie 1990; Penman *et al*. 2004). Despite this wide distribution, limited records exist towards the southern extent of its range in Victoria where it is now considered Critically Endangered compared to a national listing of Vulnerable (DSE 2013). It is so rarely encountered that until recently information on the species' ecology barely extended beyond a limited number of incidental observations (Gillespie 1990; Daly 1996; Penman *et al*. 2004) and a description and sonagram of the call (Littlejohn and Martin 1967). Recent studies on radio-tagged individuals in south-eastern New South Wales investigated important ecological aspects, including spatial ecology, burrowing locations, habitat requirements and meteorological influences on movement (e.g. Lemckert and Brassil 2003; Penman *et al*. 2005a, 2006b, 2008), but there is little information on breeding sites and calling behaviour (Gillespie 1990; Daly 1996; Penman *et al*. 2006c). Anstis (2013) provides an account and illustrations of the life history and larval development of the species in the Sydney area.

The present paper details observations of Giant Burrowing Frogs calling from streams in the Mitchell River catchment in East Gippsland, Victoria.

Methods

Study area

The study area primarily included the Stony Creek catchment (a tributary of the Mitchell River) within the Mount Alfred State Forest and lower Mitchell River National Park, East Gippsland, Victoria. The area is located approximately 220 km east of Melbourne and 20 km north-west of Bairnsdale. Elevation is largely between 50 and 300 m. The vegetation is dominated by Lowland Forest on the ridges and upper slopes, typically with Lowland Herb-rich Forest in the gullies. Dominant overstorey species include *Eucalyptus globoidea, E. cypellocarpa, E. polyanthemos* and *E. consideniana,* and dominant understorey species include *Pomaderris aspera, Acacia dealbata, A. mearnsii, Cassinia* spp., *Gahnia radula, Goodenia ovata, Kunzea* sp., *Lepidosperma* spp., *Lomandra longifolia, Pteridium esculentum* and *Stypandra glauca.*

Surveys

Between 2003 and 2008 two observations of calling Giant Burrowing Frogs were obtained incidentally during nocturnal surveys targeting large forest owls. Between April 2011 and

Fig. 1. A male Giant Burrowing Frog in a typical calling posture and location.

May 2014, 17 periodic targeted surveys for Giant Burrowing Frogs were conducted throughout the Mount Alfred State Forest and Mitchell River National Park, primarily after rainfall (>5 mm) and when it was expected that ephemeral streams would contain water. All surveys were nocturnal and involved either walking along streams listening for calls (usually 200–700 m), or 10 minute listening surveys near roads close to streams. Most surveys were conducted <3 h after dark. When a Giant Burrowing Frog was heard, attempts were usually made to observe the individual and obtain site coordinates using a GPS unit. The site was revisited during daylight hours to measure the water body (maximum width and depth), and record surrounding vegetation. At three sites where calling had been noted, an automated audio recording device (Song Meter SM2+, Wildlife Acoustics, Massachusetts, USA), was deployed in an attempt to record calling behaviour for 3 h after sunset. When repeat visits detected an individual within close proximity to a recent previous detection (within 15 m), it was considered to be the same individual, even if occupying a different nearby pool or stretch of creek.

Meteorological data were obtained from a weather station at Glenaladale (Site no. 58270) (Bureau of Meteorology) located approximately 5 to 10 km from the study area. Average annual rainfall for the years 2002–2013 was 696 mm (± 127 mm).

Results

Sixteen records of calling Giant Burrowing Frogs were obtained from four separate streams. The probable total number of individual males was nine, with repeat observations of several individuals suspected (Table 1). One female was observed incidentally. It should be noted that searches for egg-masses and tadpoles were not conducted during surveys; however, Giant Burrowing Frog tadpoles were conspicuous throughout the creek at Site B over a nine month period from the initial surveys undertaken in Autumn 2011 until early Summer the same year (searches along the creek itself beyond this date were not undertaken).

Table 1. Calling sites of male Giant Burrowing Frogs.

Site ID	Stream order	Stream/ pool width	Max. pool depth (<2 m from frog)	No. of distinct calling sites	No. of individual frogs	Dominant plant species within 30 m
A	4	~10 m	?	?	2	*Eucalyptus tereticornis, E. globoidea, Brachychiton populneus, Dodonaea viscosa*, *Kunzea* sp., *Cassinia sp*.
B	2	2–3 m	5–40 cm	6	4	*E. cypellocarpa, E. globoidea, E. polyanthemos, Pomaderris aspera, Elaeocarpus reticulatus, Hakea eriantha, Acacia dealbata, A. mearnsii, Cassinia sp., Bursaria spinosa, Lomandra longifolia, Lepidosperma sp., Gahnia radula, Olearia lirata, Pteridium esculentum, Goodenia ovata.*
C	2	~3 m	50 cm	1	1	*E. cypellocarpa, E. globoidea, E. polyanthemos, Pomaderris aspera, H. eriantha, Kunzea* sp., *Acacia pycnantha, L. longifolia, Cassinia sp., Gahnia radula, Goodenia ovata.*
D	1	0.8 m	30–70 cm	2	2	*E. globoidea, E. cypellocarpa, E. consideniana, A. dealbata, Kunzea* sp., *Gahnia radula, Stypandra glauca, Cassinia sp., Pteridium esculentum.*

Site descriptions

Calling was heard from first, second and fourth order streams (Table 1). All calling sites were within pools in streams with no, or very limited, flow (Fig. 2). The width of streams/pools occupied by calling males ranged from 0.8 m to ~10 m, with pool depth ranging from <5.0 to 70.0 cm (Table 1). The second and fourth order streams where Giant Burrowing Frogs were present have a sandstone base (Fig. 2a).

Calling locations

Giant Burrowing Frogs were observed in their calling position on 14 occasions (Table 2). While calling, all individuals were partially submerged in water (Fig. 1), usually either in shallow water or perched on a prominent rock or log in a deeper pool. One frog was floating while calling. Individuals suspected of being observed more than once occupied different calling locations, sometimes in neighbouring pools.

Influence of weather and stream condition

The role of rainfall in stimulating calling varied. Most detections followed recent rainfall (< 7 days: a product of survey bias), but the two incidental records were obtained 13 and 15 days since rainfall of >5 mm (Table 3). Temperature and humidity were not recorded during these two calling events (in February and August), but at other calling times air temperature ranged from 10.1 to 17.5^{0}C, with 65 to 97% relative humidity. Wind strength was mostly calm during surveys (<10 km/h), but three detections occurred with light breeze (10–20 km/h). Although numerous surveys were undertaken when creeks were flowing moderately, all calling events were at times of no or slow creek flow.

Table 2. Calling locations of male Giant Burrowing Frogs.

Description of calling site	No of observations
Edge of stream/pool in small depression or recess and well hidden/ sheltered	3
Edge of stream/pool in a relatively exposed location	6
Standing on a prominent rock in stream/pool	3
Standing on a log in log-debris in a stream/pool	1
Floating while calling	1

Fig. 2. Calling sites of Giant Burrowing Frogs in the Mount Alfred State Forest. (a) Site B, second order stream; (b) Site D, first order stream.

Calling behaviour

Frequency

Song Meters, programed to operate continuously for three hours after sunset (at three sites), recorded Giant Burrowing Frogs calling on four consecutive nights at one site. These data indicated that calling could be almost continuous, commencing an unknown time prior to sunset and usually averaging 18–19 (range 16–21) calls per minute for virtually the entire recording. This calling rate appeared similar to those of other Giant Burrowing Frogs heard (unless they were disturbed), and is consistent with rates reported by Littlejohn and Martin (1967).

Disturbance

The response of calling individuals to disturbance varied. In some cases observer presence and torchlight caused cessation of calling for several minutes, even at considerable distance (e.g. sometimes >20 m away); calling often recommenced at a slow rate and low volume. Calling could also be disturbed by vehicles passing nearby. Conversely, some individuals seemed relatively oblivious to disturbance, continuing to call when approached and observed by torchlight.

Calling season and weather influence on detectability

Calling was recorded during five separate months of the year, extending over late Winter, Spring, late Summer and Autumn (Table 3). Rather than reflecting optimal calling periods, these detections were more likely an artefact of local conditions and survey bias, but they do suggest that calling can occur throughout much of the year if conditions are suitable.

Under optimal conditions (no wind) and when frogs were calling from exposed locations, calls could be heard up to 300 m away. However, in less favourable circumstances, calls could be difficult to detect at a distances less than 30 m.

Table 3. The influence of rainfall events on the calling of Giant Burrowing Frogs. A rainfall event is the accumulated rainfall over consecutive rain days (<4 days), calculated from the last rain day. #Song Meters did not detect calling again after this date, *includes an observation of a female close to two calling males on 17/3/12.

Site	Detection date/period	Stream order	No. individuals	Days since last rainfall >5 mm	>10 mm	>30 mm	Rainfall in previous six months (ml) and percent of long-term average
A	13/2/2003	4	2	13	68	75	133 (38%)
B	30/8/2007	2	2	15	15	15	503 (144%)
B	10–11, 16–17/4/2011	2	3	0–1	0–1	18	384 (110%)
C	11/4/2011	2	1	0	0	18	384 (110%)
B	30/9/2011	2	1	0	0	0	279 (80%)
D	11–17/3/2012#	1	3*	1–7	1–7	1–7	609 (174%)

Discussion

Calling and breeding sites of the Giant Burrowing Frog were similar to those described previously; primarily pools with minimal flow from first and second-order streams (Gillespie 1990; Daly 1996; Penman *et al.* 2006c). Of interest was the detection within the fourth order stream; such streams usually have strong flow and therefore do not provide suitable breeding habitat. But this observation was made in an exceptionally dry period when the stream comprised only a series of pools. In contrast, the upper section of a highly ephemeral first order stream also provided suitable conditions. This record followed heavy rainfall (~170 mm), and the calling site was at virtually the highest location that could temporarily hold water (a flooded burrow of a Common Wombat *Vombatus ursinus*: Fig. 2b). Interestingly, the pools dried completely within six weeks, and remained dry for the following 15 months.

These examples demonstrate that Giant Burrowing Frogs are capable of using a diverse range of sites to attempt breeding, but breeding opportunities can be highly variable and often limited temporally, being influenced by factors including rainfall (and other meteorological effects), hydrology, geology and stream order. This is especially applicable to first, third and fourth order streams because they often provide either fast-flowing water or no water. This highlights the importance of streams with sandstone bases that can hold water in pools for long periods, especially some second order streams, allowing increased breeding opportunities and successful tadpole development (e.g. Daly 1996; Penman *et al.* 2006c). In the Sydney Basin larval life-span extends over 3 to 11 months (Anstis 2013).

Although weather conditions and recent rainfall can stimulate calling (Daly 1996; Penman *et al.* 2006c), the incidental detections of calling 13 and 15 days following rainfall of >5 mm indicate that recent rainfall is not essential for calling to occur. Instead, stream condition/flow appeared critical for stimulating calling. However, despite considerable monitoring during seemingly conducive conditions (appropriate season, limited or no stream flow, temperature >10.0^{0}C, limited wind, recent rainfall >5mm) at sites where Giant Burrowing Frogs had previously recently been active, the detection of calling was rare. Calling activity sometimes differed dramatically between consecutive nights, with frogs calling consistently one night and seemingly being inactive the next, despite apparently similar and suitable climatic conditions. The factors that stimulate calling behaviour and breeding require detailed investigation.

Conservation

Few records of Giant Burrowing Frogs have been obtained in recent decades in Victoria, and the population reported here is currently the only known extant population in the state (Victorian Biodiversity Atlas; Nick Clemann, Graeme Gillespie pers. comm.). Its status has recently been elevated to Critically Endangered in Victoria (DSE 2013). The Mount Alfred State Forest is of particularly high conservation value for the Giant Burrowing Frog, and it is of serious concern, therefore, that potential

threats, notably clear-fell logging and frequent prescribed fires (Penman *et al.* 2005b, 2006a), are regularly undertaken throughout the area. Although the impacts of these practices on the Giant Burrowing frog are poorly understood, implementing additional protective measures throughout the region to conserve important habitat should be a priority. Undertaking studies on the species in the area is a crucial step in helping to inform such future management actions.

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Eighty-nine Years Ago

FROGS IN A FERNERY

Nearly a dozen frogs are at home in my shade-house, and earn their lodging as enemies of slugs and 'slaters', caterpillars, and other pests among the ferns. Several of my pets are Golden Bell-frogs, *Hyla aurea*, one of the handsomest of all known species: others are Common Brown Tree-frogs, *H. ewingii*. The latter are the most confiding; but three of the green and golden frogs, domiciled in the fernery about a year ago, are so tame now that they rarely attempt to jump when touched or taken in the hand. Recent arrivals are wary: The early inhabitants have favourite spots, where they rest during the daytime—their hunting is done after dark. A hanging basket is the 'habitat' of one Brown Tree-frog. It is seen there every day, with green fronds all about it. *H. aurea* is said to include small frogs in its dietary, but, so far, none of the examples in my shade-house has eaten a diminutive neighbour. Tree-frogs especially make interesting pets, and some of the Australian species are dainty and beautiful. —C. BARRETT

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