

## Note and Record

### A note on polyvinyl chloride (PVC) pipe traps for sampling vegetation-dwelling frogs in South Africa

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#### Introduction

Vegetation-dwelling frogs are challenging to sample. They can climb out of traditional traps, and many are furtive (Myers *et al.*, 2007; Pittman *et al.*, 2008). PVC pipe traps, which mimic natural features frogs use for shelter, may provide a useful technique (e.g. Boughton, Staiger & Franz, 2000). Pipe trapping has been used to sample tree frogs of the family Hylidae in the United States (e.g. Boughton, Staiger & Franz, 2000; Liner *et al.*, 2008 and Farmer *et al.*, 2009), but it is increasingly used elsewhere (e.g. Laurencio & Malone, 2009 and Ferreira *et al.*, 2012), even for nonhylids (Coqui Frog Working Group, 2006).

African vegetation-dwelling frog genera, such as *Leptopelis*, *Afrixalus* and *Hyperolius* (see Channing, 2001; du Preez & Carruthers, 2009), may be attracted to artificial refugia of PVC pipe traps. If so, pipe trapping would augment sampling techniques for African anurans, which are little studied (Trimble & van Aarde, 2010, 2012) despite conservation needs (Measey, 2011), and could facilitate sampling outside the breeding season, reduce observer and detection bias (see Bailey, Simons & Pollock, 2004; Willson & Gibbons, 2010) and allow fundamental and applied ecological studies, such as habitat selection (e.g. Johnson, Knouft & Semlitsch, 2007; Pittman *et al.*, 2008), migration/dispersal (e.g. Johnson, 2005) and management effects (e.g. Muenz *et al.*, 2006; Rice *et al.*, 2011). In this preliminary assessment, we provide the first evidence that it is possible to capture African frogs in PVC pipe traps in the field. However, capture success was low,

so we encourage more research on alternate trap designs and in other habitats.

#### Methods

Our study was conducted in the South African coastal forest within 2.3 km of the east coast, along a 25-km section between the Umlalazi River and Richards Bay Harbour. The area harbours a high species richness and concentration of threatened frogs (Measey, 2011; Maritz, 2007; Table 1).

We installed 30 pipe trap arrays in terrestrial habitats  $\geq 300$  m from water bodies and  $\geq 500$  m from each other, divided evenly among five vegetation types: coastal forest, degraded forest, acacia woodland, eucalyptus woodlot and sugar cane cultivation. We placed a further six arrays in coastal forest  $\leq 30$  m from a water body and  $\geq 50$  m apart. Each array consisted of four 60-cm-long, white PVC pipes. We inserted two pipes (one of 16 and 44 mm internal diameter) 10 cm into the ground near the base of a tree. We attached another of each diameter pipe together and affixed them vertically from their top at a height of 2 m up the tree trunk. Caps on the bottom of these pipes allowed retention of standing water (added at installation), and a hole drilled 15 cm from the bottom prevented flooding (Boughton, Staiger & Franz, 2000). We installed pipes on a variety of tree species (e.g. white stinkwood, *Celtis africana*; horsewood, *Clausena anisata*; sweet thorn, *Acacia karroo*; and *Eucalyptus* sp.) with circumference at breast height of 10–200 cm ( $\bar{x}$  = 53.7 cm, SD = 41.2 cm). At five sugar cane cultivation arrays, there were no trees, so all four pipes were inserted into the ground.

Pipe traps were installed progressively from February 17 to March 21, 2012 (summer/rainy season); we monitored arrays for 14–34 days ( $\bar{x}$  = 21.7, SD = 7.3). As per agreements with landowners, arrays in cultivation and woodlots were removed after 14–15 days, while others remained for the study duration. We checked each array during daylight hours on an intermittent schedule as logistics allowed, that is, 5–9 times per array at intervals of 1–9 days ( $\bar{x}$  = 3.4, SD = 0.7). We identified and measured

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**Table 1** Vegetation-dwelling frog species expected in the area, species incidentally recorded in the area during the survey (location of observation is denoted NW = near water, Tr = terrestrial, Tr/NW = terrestrial and near water) and inventory of captures in PVC pipe traps indicating array location (NW = near water, Tr = terrestrial), pipe diameter and location (G = ground, T = tree), Snout-urostyle length (SUL) of frog and habitat type (AW = acacia woodland, DF = degraded forest, F = forest)

Frog Atlas species <sup>a</sup>	Incidentally recorded	Pipe trap captures
<i>Afrivalus delicatus</i>		
<i>Afrivalus fornasinii</i>	NW	NW (44 mm G pipe, SUL = 35 mm, F) NW (44 mm T pipe, SUL = 35 mm, F)
<i>Afrivalus spinifrons</i>	Tr	Tr (44 mm G pipe, SUL = 23 mm, DF)
<i>Hyperolius argus</i>	NW	
<i>Hyperolius marmoratus</i>	NW	NW (outside of T pipe, F)
<i>Hyperolius poweri</i>		
<i>Hyperolius pickersgilli</i>	NW	
<i>Hyperolius pusillus</i>	Tr/NW	
<i>Hyperolius semidiscus</i>		
<i>Hyperolius tuberilinguis</i>	Tr/NW	NW (44 mm T pipe, SUL = 27 mm, F) Tr (44 mm G pipe, SUL = 29 mm, AW)
<i>Leptopelis mossambicus</i>		
<i>Leptopelis natalensis</i> <sup>b</sup>	Tr/NW	

<sup>a</sup>The South African Frog Atlas Project recorded twelve species of *Leptopelis*, *Afrivalus* and *Hyperolius* in the two quarter-degree squares spanned by our study area (ADU, 2011). Nomenclature follows du Preez & Carruthers (2009) except *Hyperolius poweri* (see Channing *et al.*, 2013).

<sup>b</sup>*L. natalensis* was not captured in pipes despite occurring in the area. Worth noting, however, is that on two occasions we released incidentally caught *L. natalensis* individuals at the base of tree in which we had hung a set of pipes, and both frogs climbed the tree, went into a pipe and remained there for some time.

frogs found in traps and released them  $\geq 50$  m away. We also noted frogs observed incidentally (i.e. coincidentally or during casual searches) during the study period.

## Results and discussion

We checked 36 arrays 219 times over 34 days (43 times for the six arrays near water and 176 times for the 30 terrestrial arrays). We caught five frogs in pipes (Table 1), a trap success of 2.3% by array-checking instances or 0.6% by pipe-checking instances. One capture on the outside of a pipe was not included in calculations (Table 1). Sparse captures prevented statistical analyses, but trap success appeared higher near water than away, 7% of array-checking instances versus 1.1%. We incidentally observed eight species (Table 1). Trapping success was lower than that reported in the Americas, for example, 79% (Bartareau, 2004), 23% (Myers *et al.*, 2007), 2.5–4.3% (Pittman *et al.*, 2008) and 6% (Ferreira *et al.*, 2012) (though some of these studies included recaptures). Several factors that might have contributed to our low trapping success are given as follows:

1 Pipes might not have provided attractive refugia. Frogs discriminate between refugia attributes (e.g. Boughton,

Staiger & Franz, 2000; Bartareau, 2004; Johnson, Knouft & Semlitsch, 2007; Johnson, Mahan & Semlitsch, 2008; Hoffmann, Johnson & McGarrity, 2009). Many design factors have been investigated in relation to capture success (e.g. diameter, length and colour); while our 44-mm-diameter pipes appeared more effective than 16 mm and ground and tree pipes both worked, other trap designs could be investigated (see Boughton, Staiger & Franz, 2000; Bartareau, 2004; Johnson, Knouft & Semlitsch, 2007; Myers *et al.*, 2007; Johnson, Mahan & Semlitsch, 2008; Pittman *et al.*, 2008; Ferreira *et al.*, 2012).

2 Natural refugia provided by plants may have out-competed pipes (Hoffmann, Johnson & McGarrity, 2009). *Dracaena alectrifomis* and *Strelitzia nicolai* are prevalent in the undergrowth, and their leaf axils provide hiding places for frogs (du Preez & Carruthers, 2009).

3 The sampling period may have been too short for frogs to find the pipes (Myers *et al.*, 2007), which could have compounded the effects of competition with natural refugia.

In conclusion, we caught three species in PVC pipe traps and found an additional species on the outside of a pipe, demonstrating that the technique can be used to trap

African frogs of the family Hyperoliidae. However, trap success was low, and we captured species also encountered incidentally. We encourage further assessment of PVC pipe trapping for African vegetation-dwelling frogs to support amphibian ecological studies. Altering trap design, using traps in areas with less abundant natural refugia and installing traps a few months prior to sampling should be investigated to improve success. Further experiments could elucidate which trap designs work for which species.

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