Notes on ....

Surface activity of arid-adapted frogs

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Abstract. The arid-adapted *Neobatrachus sutor* and *Pseudophryne occidentalis* are most surface active immediately after heavy rain. The number of these frogs caught in pit-traps declined rapidly over a four day period after rain ceased. As we found no evidence of breeding, we concluded that *N. sutor* had come to the surface to feed, most probably on termites which we observed in very large numbers. We estimate the number of occasions that these two species of frogs could have been surface active, based on rainfall data, to be $\geq$ 9 and $\geq$ 17 yr^{-1} respectively.

Key words: *Neobatrachus sutor, Pseudophryne occidentalis,* frogs, abundance, activity

Introduction

Arid-adapted frogs spend most of their lives buried underground waiting for rain (Morton *et al.* 1993; Predavec & Dickman 1993; Read 1999). Some form cocoons (*e.g. Neobatrachus sutor*; Withers 1995) and others find a moist location under rocks or vegetation to minimise water loss and survive for extended periods (*e.g. Pseudophryne occidentalis*; Tyler 1994). These frogs surface immediately after heavy rain. Read (1999) reported that surface activity of *Neobatrachus centralis* in the chenopod shrubland around Olympic Dam was not restricted to rainfall events, but they were mostly found surface active after more than 5 mm of rain; *N. centralis* was active for up to 20 days after heavy rain, and disappeared just before the ponds dried out. Morton *et al.* (1993) reported that arid-adapted frogs (*Neobatrachus* spp, *Notaden nichollsi*, *Uperoleia micromeles* and *Cyclorana maini*) were most abundant immediately after heavy rains and their numbers 'tailed off' within about two days of the cessation of showers. They suggested that arid-adapted frogs do not always attempt to breed when they emerge, coming to the surface to feed and replenish energy stores in preparation for a further period of inactivity.

We report here on activity periods for *N. sutor* and *P. occidentalis* immediately after two rainfall events at Ora Banda (30° 22'S, 121° 03'E; Eastern Goldfields region) during January/February 2003.

Materials and methods

We surveyed small terrestrial fauna at four sites in the Ora Banda area. Frogs were captured in either 20 L PVC bucket pit-traps or 150 mm PVC stormwater pipes. Forty-eight pit-fall traps were arranged in eight rows of six pit-traps (alternating bucket and pipe) in the undisturbed areas. We also had 36 pit-traps in six rows of six on the sides and 36 pit-traps in six rows of six on the top of the mining waste dumps. A fly-wire drift fence joined each line of six pit traps. All pit-traps were open on the nights of 28 January to 4 February 2003. The Paddington gold mine (within 25 km of all sites) recorded 6 mm of rain on 27 January, 15 mm on 28 January, 9 mm on 2 February and 2.5 mm on 3 February. Summer thunderstorms are often very localised and rainfall can vary appreciable over a few kilometres as it did on these two occasions. Puddles and pools of water were evident along the roadside for two days after each rainfall event. Other than where runoff accumulated near the base of mining waste dumps, we found no substantial pools of water in areas not disturbed by mining activity two days after rain ceased. However, water along roadsides remained for a longer period. Night searches for frogs were undertaken on 1st and 2nd February at all four sites.

Results

Seventy six *N. sutor* and 288 *P. occidentalis* were captured during the seven nights of trapping. We found a few *P. occidentalis* in some of the larger ponds on the top of a waste dump during the day. Both species of frogs were most abundant the first night after heavy rain and the number pit-trapped rapidly declined to very low levels by three to four days after the rain ceased (Fig 1).

Having driven approximately 60 km around the study sites at night we heard only one *N. sutor* calling from a pond and a large number of *P. occidentalis* calling from a variety of locations. We saw no tadpoles in residual ponds after the rain, but the water was very coloured and visibility was very poor, so if tadpoles were in the ponds they may not have been seen. We did not search for *P. occidentalis* eggs in moist tunnels.

A large number of termite alates were observed during the build up to the first thunderstorm and on the night it first rained. We observed many swarms of termites active on the surface of logs and the leaf litter mid-morning on the first day after heavy rain.

Discussion

Arid-adapted frogs come to the surface after heavy rain for two purposes, to breed and to restore energy reserves. Presumably, if there is insufficient rain to enable frogs to successfully breed then they feed and again go to ground waiting for more suitable conditions.

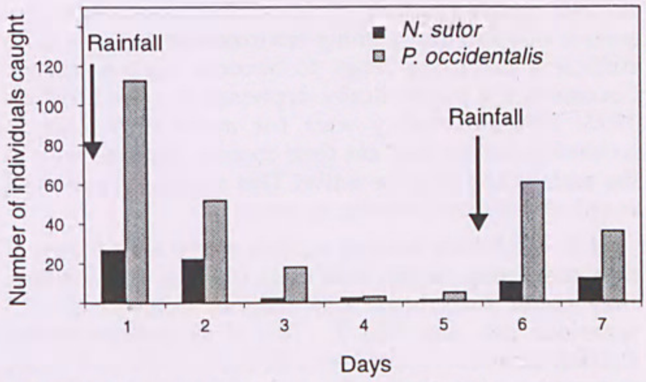

Figure 1. Number of *N. sutor* and *P. occidentalis* caught in pit-traps after rainfall.

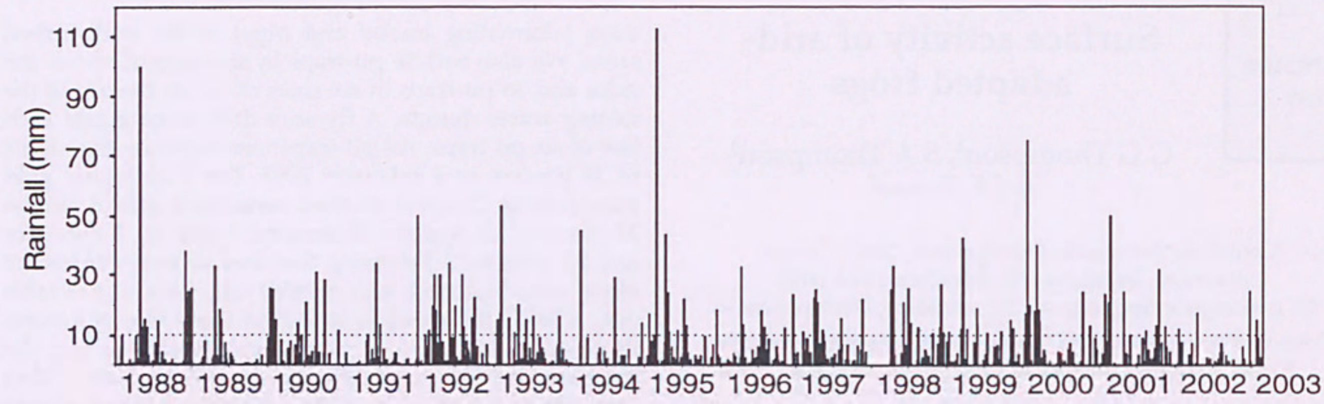

Figure 2. Rainfall measured on a daily cycle at the Placer Dome Asia Pacific Paddington gold mine, near Ora Banda. Dotted line shows the 10 mm level of rainfall.

Main (1968) reported that *N. sutor* breeds only in February and March, whereas *P. occidentalis* breeds between January and June. *Neobatrachus sutor* has a tadpole life of about 40 days and *P. occidentalis* has a larval development period of 30-40 days (Main 1968). The lack of large ponds likely to be present for four to five weeks in the undisturbed areas around Ora Banda precluded breeding by *N. sutor*.

We are convinced that most of the *N. sutor* that came to the surface after the rain on 27-28 January and 2-3 February did not breed but could have fed on the abundance of termites, and possibly other invertebrates. Diets of *N. sutor* and *P. occidentalis* are unknown; however, it is highly likely they eat a variety of invertebrates with a high proportion of termites, as Read (1999) reported *N. centralis* eating a wide variety of invertebrates but predominantly ants. Predavec & Dickman (1993) reported that diets of the arid-adapted sympatric *N. nichollsi*, *Cyclorana australis* and *N. centralis* in south-western Queensland varied but consisted mainly of Formicidae, Isoptera and Coleoptera.

Read (1999) reported that most *N. centralis* were caught on the surface after a minimum of 5 mm of rain. Our unpublished terrestrial fauna data for Ora Banda from September 2000 to June 2002 indicate that 5 mm of rain was insufficient to bring a substantial number of *N. sutor* to the surface (we only caught the occasional frog with 5 mm or less rain), but 4-6 mm of rain is sufficient for *P. occidentalis* to be surface active. *Pseudophryne occidentalis* can be found under rocks and leaf litter in moist locations when it has not rained for some time. They deposit their eggs on damp soil in tunnels and tadpoles emerge at an advanced stage of development when the tunnels flood with water (Main 1968; Tyler *et al.* 1994). A small amount of rain sufficient to create a few surface puddles and a damp environment appears to be sufficient for these frogs to become surface active. Cocooned and metabolically depressed *N. sutor* (Withers 1993, 1995) probably wait for more rain than *P. occidentalis* before they eat their cocoon, dig their way to the surface and become active. This species lays its eggs in ephemeral ponds during summer.

If *P. occidentalis* become surface active after 5 mm of rain, then using rainfall data since 1988 we calculate that they could have been active on an average of 17.5 occasions per year (Fig 2). This is an underestimate. Rainfall data are recorded for a 24 hour period and if rain occurred across a recording period this would have increased the number of opportunities for this species to be active. Similarly, we do not know if cumulative rainfall over a short period that provides a total in excess of this amount is also sufficient for this species to become surface active. If *N. sutor* require a minimum of 10 mm of rainfall to emerge then they could have been active on a minimum average of 9.3 occasions per year, but if they require 20 mm of rain this would have reduced the number of occasions they could have been active to 3.7 occasions per year. If *N. sutor* responds to cumulative rainfall over shorter periods then these will also be underestimates. Opportunities for *N. sutor* to successfully breed are obviously less than those to feed as they require temporary ponds that will last for at least 40 days (Main 1968) and to have formed during February and March. Because we are unsure of how much rain is required to create ponds that will last for at least 40 days during summer, we could not estimate the number of breeding opportunities over the last 15 years.

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