Notes on ....

Are backfilled burrows a predator protection strategy for the Spinifex Hopping Mouse?

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Abstract. Backfilled burrows belonging to *Notomys alexis* (Spinifex Hopping Mouse) were excavated in the Pilbara of Western Australia. The size and shape of one of these burrows is described, and it is postulated that the backfilling of burrows by the occupants is a protection strategy against predators such as large goannas and perhaps large snakes.

Keywords: *Notoyms alexis,* Pilbara, burrows

Introduction

During a pre-clearing fauna survey of the Fortescue Metals Group railway line corridor in the Pilbara looking for species of conservation significance (*e.g.* Mulgara, Bilby) numerous burrows that were slightly smaller in diameter than the size of Mulgara burrows were located. Some of these had been backfilled such that there was a mound of fresh soil covering an entrance. Some of these mounds were covered with recent mammal tracks. Three of these burrows were dug up to investigate what animal had dug the burrow and why it might have backfilled a burrow entrance.

Notomys spp. are small, bipedal, nocturnal hopping mice that are found in the arid and semi-arid regions of Australia (Watts & Kemper 1989). *Notomys alexis* is a small rodent with a body mass of about 45g that has a uniform light brown dorsal surface and a grey-white underbelly (Strahan 1983). Both sexes have a throat pouch. It uses a burrow to avoid the heat of the day and burrows often contain a small family group (Strahan 1983).

Materials and methods

A backfilled burrow was located in an ephemeral creek bed (UTM Datum WGS 84, 50697331E, 7618711N) that drained into the Yule River in the Pilbara of Western Australia. The area to the north of the burrow had been burnt 2–3 months earlier but the creek bed contained numerous small trees to about 3m and a ground cover of spinifex. The burrow was excavated initially with a shovel and then by hand. The length and depth of each arm of the burrow was measured along with the diameter of the burrow and the two 'pop' (*e.g.* rapid exit hole) holes. Two other burrows were excavated (UTM Datum WGS 84, 50733800E, 7548461N) in a spinifex sand plain just north of the Chichester Range.

Results

The first burrow excavated was located in sandy substrate, and below a depth of about 300mm the soil was noticeably more moist (*e.g.* tendency to for soil particles to stay together) than near the surface.

An oval shaped mound of loose soil that covered the entrance to the burrow was about 1.045m in length and 300mm in width (Figure 1). The surface of the mound of soil at the burrow entrance was soft and covered in recent tracks of at least one small mammal. Given that there had been a brief shower of rain the previous day that had covered exposed tracks in the area, we presumed that the tracks on the entrance mound were made during the previous night. The burrow entrance was adjacent to a spinifex bush and lead under one side of the bush. The first 300mm of the entrance to the burrow was backfilled with soft soil.

The burrow was mostly circular with a diameter of 70–80mm, except for the two vertical shafts that lead to the 'pop' holes that were about 20mm in diameter. The burrow contained two long arms that lead to separate 'pop' holes. A branch off one of these arms ended about 300mm below the surface (Figure 1). At the end of each of the major arms the burrow changed direction so that a narrower vertical tunnel lead to a 'pop' hole that opened to the surface. On the surface there were no obvious signs that these 'pop' holes had been used nor was there a mound of soil to suggest they had been excavated from the surface.

An adult male and female *N. alexis* were caught in the burrow. We presumed from the lack of tracks and fresh

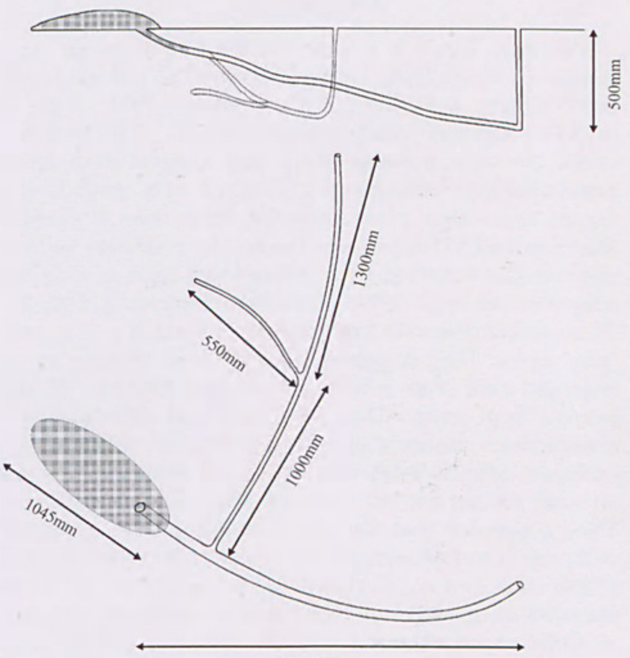

Figure 1. Plan and elevation of one of a *N. alexis* burrow excavated.

diggings around the entrance to the 'pop' holes that these entrances were not being used, but we could not be certain of this. If this was the case, then the occupants were opening the main entrance each evening and closing it before morning. However, as there was no soft soil around the 'pop' holes to indicate the presence of tracks, they may have been using these holes to enter and leave their burrow.

A second burrow complex in red sandy soil vegetated with spinifex containing 13 openings and one backfilled entrance was excavated. Three of these openings were approximately circular with a diameter of 60–80mm and a fourth was 90–110mm in diameter. Two of these burrow entrances were under the edge of spinifex bush and two were in the open. In addition, there was one burrow entrance that had been backfilled and was under the edge of a spinifex hummock. The pile of soil at the entrance was soft and recently deposited. These five entrances had sloping tunnels leading away from the opening. The maximum depth of this burrow was about 600mm. In addition, there were nine 'pop' holes, all 20–30mm in diameter, opening on top of a near vertical shaft. Four of these were in the open and five either adjacent to or in a spinifex hummock. A *N. alexis* was caught in a nearby Elliott trap on the previous night. No other small mammals were caught in the vicinity of this burrow.

A third burrow complex containing three large openings (60–80mm dia.) and four smaller 'pop' holes (»20mm dia.) was also excavated in red sandy soil vegetated with spinifex. One of the larger openings was about 100mm from a spinifex hummock and the other two were under the hummock. Two of the 'pop' holes were under a spinifex hummock and two were in the open. Two *N. alexis* ran from this burrow when it was being excavated. None of the entrances were backfilled.

Discussion

Notomys alexis is a well studied rodent in the field (Dickman *et al.* 1999; Letnic 2003; Letnic and Dickman 2005; Murray & Dickman 1994; Predavec 1994; White *et al.* 2006). Strahan (2000) reported that *N. alexis* burrows could be over a metre deep and consist of a large horizontal nest chamber that is lined with small twigs, leaves and other plant material, from which vertical shafts ascend to the surface. The entrance to these vertical shafts is characterised by a lack of loose sand around the aperture. Lee *et al.* (1984) provided a diagram of a typical *N. alexis* burrow with four branches all leading to surface 'pop' holes. They suggested that the nest chamber is an enlarged area from which the various branches of the burrow lead away. They indicated that extensive and conspicuous mounds of soil build up at the burrows entrance (chuck-hole), but these are scattered by the animals so that the burrows are often difficult to locate. They suggested that the 'chuck-holes' can be 'plugged' with soil. The horizontal branches referred to by Strahan (2000) and Lee *et al.* (1984) were present in all three burrows excavated but there was no evidence of plant material or an enlarged nest chamber, but all burrows contained vertical shafts that ended with the aperture devoid of loose soil (*i.e.* 'pop' hole). Burrow entrances away from spinifex hummocks were easily detected. Interestingly, Woolley (1990) reported Mulgara (*Dasycercus cristicauda*) dig burrows with a single entrance with one or two vertical shafts that rise to the surface to form a small 'pop' hole similar to what we described above. We have dug out numerous Mulgara burrows in the Pilbara (unpublished data) but have never noticed a vertical shaft with a narrow aperture at the surface. We have also found similar holes with backfilled entrances in the northern Goldfields, approximately 30km south of Wiluna.

It would be very difficult for *N. alexis* to shift soil from their burrow up a vertical shaft. Therefore, the probable reason why there was no mound of soil around these 'pop' holes was because these openings were not being used to remove soil from the burrows.

The energetic cost associated with closing an burrow entrance could be appreciable (White *et al.* 2006), particularly if it was to be opened regularly. So why go to all the effort, and why only block one of the entrances in the larger burrow complexes? We have speculated on three possible reasons for backfilling the burrow entrance. Firstly, it could be to maintain the ambient burrow temperature. We discarded this possibility as there was little likelihood of air movement deep in the burrow where *N. alexis* would spend most of the day and soil temperature was most likely to be the major determinant of ambient air temperature in the horizontal arms of the burrow. Burrow temperature is also likely to be affected by heat loss from animals in the burrow. Secondly, closing the entrance could be used to maintain the relative humidity of the burrow, but we discarded this alternative for the same reason as above. In addition, Lee *et al.* (1984) reported the communal use of burrows resulted in an increase in burrow temperature and humidity. The third reason was as a predator protection strategy. During our searches for Mulgara and Bilby burrows along the railway line corridor that will run about 260km south from Port Hedland we found evidence that goannas and large snakes often visited mammal burrows.

Adult *V. gouldii* in the area have a body mass of about 300–350g. Many of the entrances and main tunnels in the burrows excavated were large enough for an *V. gouldii* to search most of the burrow complex. However, the narrower vertical shafts were probably too narrow for an adult *V. gouldii* to fit through. Given that they are excellent diggers, they could enlarge the shaft from the 'pop' hole but this would give the occupant(s) time to escape. It is possible that a backfilled burrow could be dug out by a *V. gouldii*, but while it was clearing the entrance the occupants could escape via one of the 'pop' holes.

Small snakes that prey upon *N. alexis* could probably fit down the 'pop' hole but they would find it difficult digging through the entrance mound. Larger snakes (*e.g. Aspidites melanocephalus, Pseudechis australis*) seen in the area may have difficulty accessing the burrow via the 'pop' holes because of their narrowness. It therefore seems reasonable to suggest that the effort associated with closing the main burrow entrance is a strategy to protect the occupants from reptilian predators. Whether these backfilled entrances were regularly being opened is unknown. Similarly, we were unsure whether *N. alexis* used the 'pop' holes to enter and exist burrows, but we found no evidence of tracks around these holes to suggest that was happening.

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