

## Survey protocol for the northern hopping-mouse *Notomys aquilo*.

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### Introduction

Most records of the northern hopping-mouse *Notomys aquilo* are from Groote Eylandt but there are specimens from the upper Cadell River in central Arnhem Land and there are reports of tracks and signs of the species in eastern Arnhem Land (Woinarski *et al.* 1999). The species was first described in 1921 from specimens caught more than 50 years previously in “Cape York” (northern Queensland), but there have been no subsequent records from the eastern side of the Gulf of Carpentaria. Woinarski *et al.* (1999) collated all then known information on the distribution and habitat of the species. They concluded that the species is difficult to trap and is unknown to Indigenous landowners in some areas where it occurs, and conclude that it is “something of an invisible species, and likely to be overlooked in reconnaissance surveys.” The species is listed as “Vulnerable” under national, NT and Queensland legislation.

Following publication of the recovery plan for this species in 2004 (Woinarski 2004), recovery actions were partly funded by an NHT program in mid 2006. This project aimed to explore a range of sampling techniques, establish a monitoring program, identify habitat requirements for the species on Groote Eylandt and derive conservation advice. Results from this project provide the first substantial data on survey methods and abundance for this species.

Initial trapping using Elliott small mammal traps and a range of baits confirmed their trap-shyness. Spotlighting from vehicles and on foot produced a small number of records, but these techniques were deemed not suitable as the basis of a broader monitoring program (Ward *unpublished*). The protocol developed below is based on searches for the spoil heaps characteristic of northern hopping-mouse burrow systems. Excavation of a burrow and capture of northern hopping-mice from it have proved the link between spoil heaps and hopping-mouse burrow systems. It is not clear how long spoil heaps remain identifiable, how long hopping-mice use a particular burrow system, or how many individuals use a typical burrow system, but these factors are currently being studied by the Anindilyakwa Land Council (B. Rankmore and G. Enever, *pers. comm.*). The protocol (or with slight variants) has been adopted by the Anindilyakwa Land Council and GEMCO Pty. Ltd. in their pre-clearing surveys for the species on Groote Eylandt.

Woinarski *et al.* (1999) found that signs of northern hopping-mice were significantly associated with the diversity of bush-peas (Family Fabaceae) and/or a 10-50% cover of hummock grasses. They concluded that most records for the species are from tall coastal dune systems, but that the species can also occur more inland in habitats with deep sandy soils. The species' abundance was highest in areas of shrubland (dominated either by *Acacia* species or *Hakea arborescens*; Fig. 1a), wet heaths or coastal

grasslands. Subsequent studies on Groote Eylandt using the protocol below have found similar densities of signs (spoil heaps) in sandy eucalypt woodlands (in the centre of the island; Fig. 1b) and on vegetated coastal dunes in the Umbakumba area (*Ward unpublished*).

a.



b.

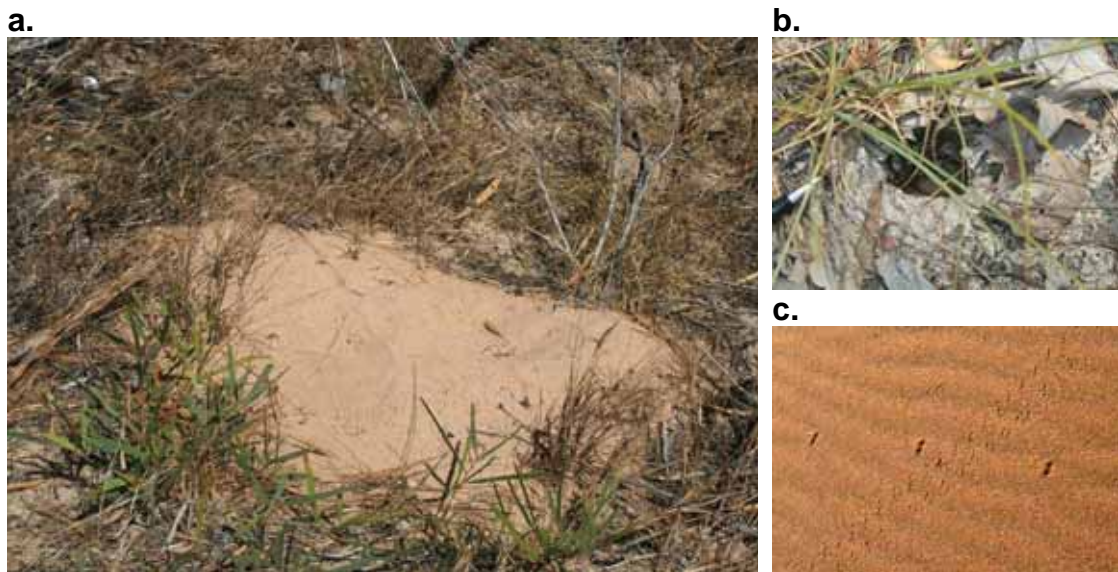


**Figure 1. Habitats on Groote Eylandt occupied by northern hopping-mice.** a. stable vegetated coastal dunes (here in the Umbakumba area), and: b. flat sandy woodland (Kings Crossing, near the centre of the island).

### *Spoil heaps and other signs of hopping-mice*

Spoil heaps are piles of sand produced when hopping-mice dig their complex burrow systems. The sand in the spoil heaps is typically of a different colour to the more-weathered surface sand, the heap is generally more than two A4 pages in size, and rises to about 10cm above the surface (Fig. 2a). Because of the way the burrows are dug, there is no obvious hole where the sand in the spoil heap has come from. This is in obvious contrast to piles of sand produced when monitors (goannas), bandicoots, dingos, wallabies, etc. dig a hole.

Hopping-mice enter and exit burrow systems via c. 2.5cm diameter holes that show no spoil around them and are typically 1-2 m away from the main spoil heap. These pop-holes (Fig. 2b) are often difficult to find (they may be plugged by the hopping-mice or obscured by leaves, and the spoil heap is usually more obvious). Tracks of hopping-mice may be seen, but only those of a hopping-mouse moving at speed (hopping) are distinguishable from those of other small rodents (Fig. 2c). These hopping tracks show pairs of small dints in the sand and Thomson recorded them being between 12 inches (30cm) and 24 inches (60 cm) apart, depending on the speed of travel (Dixon & Huxley 1985). Tracks are very difficult to find in vegetated areas, particularly where there is a heavy litter layer.



**Figure 2. Signs of hopping-mice: a.** spoil heap; **b.** pop-hole (pen on left for scale); **c.** tracks (here of a spinifex hopping-mouse from Central Australia).

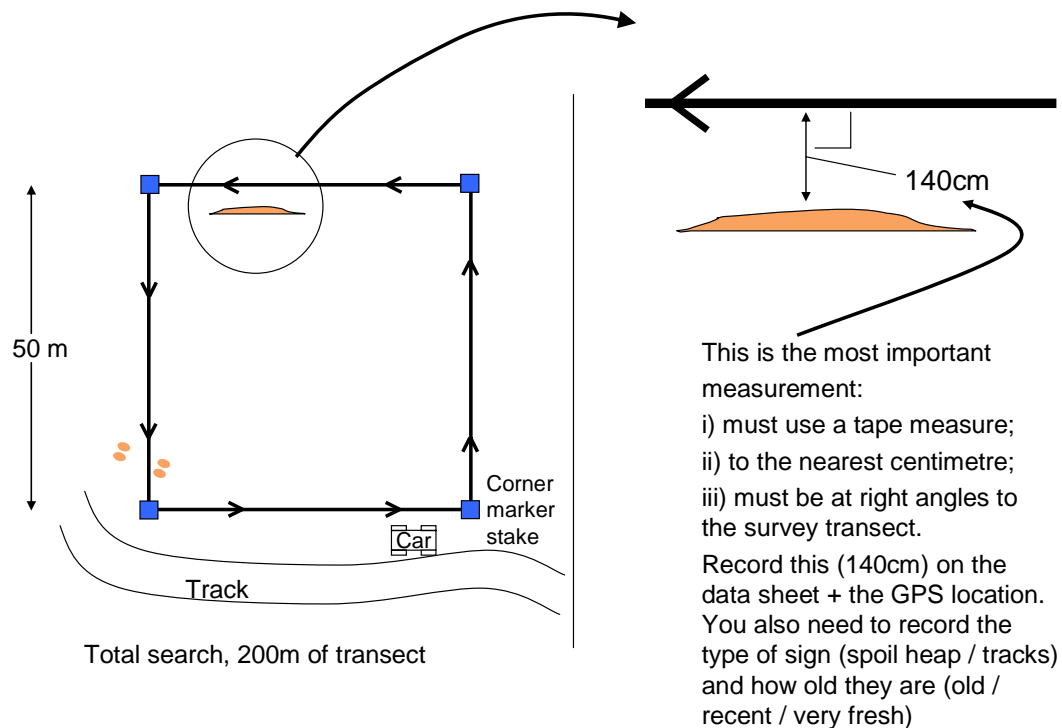
## **The Protocol**

### *Survey plot*

Searches for spoil heaps, or other signs of northern hopping-mice, are carried out at a series of 200m-long transects. Permanent transects (i.e. transects that are revisited in future counts) need to be marked with metal stakes at the ends and at intervals between them so that an observer can easily walk from

one to the next while searching for signs. In the project described above each transect was in the shape of a square, with 50m on each side, so that the observer ended back at the starting point, typically close to a track and vehicle (Fig. 3). One-off transects can be straight 200m lines, and surveys for northern hopping mice by EWL Sciences for GEMCO Pty. Ltd. have consisted of numbers of these transects through a larger survey area linked by non-survey walks in-between (R. Firth and J. Smith, *pers. comm.*).

## Layout of transect and measurements



**Figure 3. The layout of transects for detecting signs (with an emphasis on finding spoil heaps) of northern hopping-mice and the measurements that need to be recorded for each sign found.**

### Survey procedure

Searches for spoil heaps or other signs of northern hopping-mice are best carried out by two people.

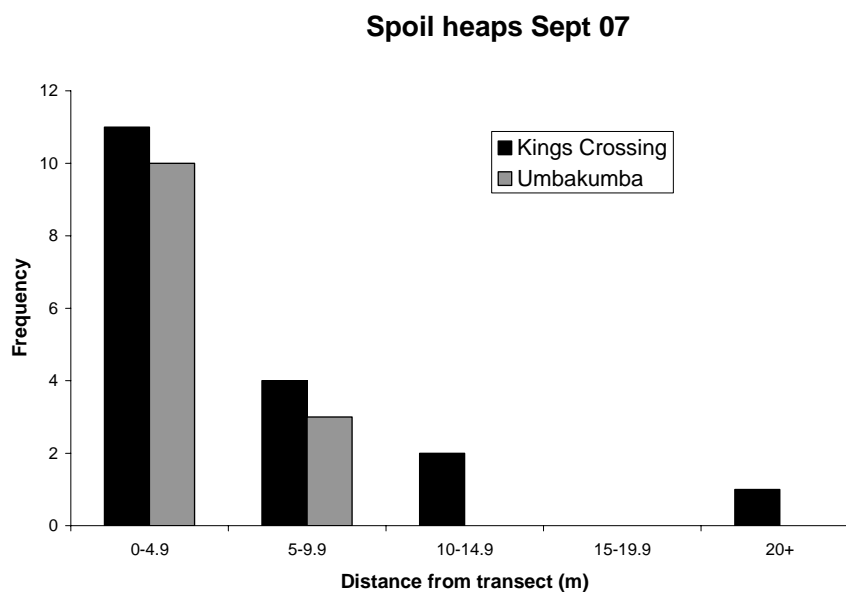
- i) Only one person walks the transect looking for signs
- ii) Second person uses a GPS to locate the next marker or corner post and they guide the searcher to it. If a long straight once-off transect is being walked, this person should navigate the transect, leaving the searcher to look for signs. If the second person finds signs they should not tell the searcher until after the transect is completed, and these signs should be recorded separately
- iii) Person one then walks a straight line from one stake to the next searching for signs (spoil heaps, pop-holes, tracks).

- iv) Don't go searching off the straight line – this is important. You can walk out to check whether something is a sign or not, but come straight back to the transect line before you continue on
- v) When you find a sign, you need to record
  - the GPS location (write the GPS waypoint number on the data sheet);
  - the type of sign – spoil heap, pop holes, tracks;
  - whether they are old, fresh or very fresh signs;
  - the distance from the transect line to the signs (at right-angles) – measure this accurately with a tape-measure and record it on the data sheet to the nearest centimetre. Measure from the closest point to the transect line (see Fig. 3).

It should take 10-15 minutes to walk each transect carefully.

### Data Analysis

The survey protocol provides a series of measurements of the distances of spoil heaps or other signs from the transect lines. The distribution of these measurements gives an indication of the detectability of signs in that type of habitat, and from this you can calculate the effective area of habitat that has been surveyed by these transects and the density of signs within that area. These analyses are best done by modelling the data using a program like DISTANCE ([www.ruwpa.st-and.ac.uk/distance/](http://www.ruwpa.st-and.ac.uk/distance/)).



**Figure 4. Distribution of distances of spoil heaps from the transect line in two survey areas on Groote Eylandt (Umbakumba and Kings Crossing) walked in September 2007.**

### Detectability and survey effort

Spoil heaps are the most visible signs of the presence of northern hopping-mice. In two sets of 30 transects on Groote Eylandt, surveyed in September 2007, a total of 15 spoil heaps were seen in 12 of 30 transects in vegetated dunes in the Umbakumba region, and 21 spoil heaps in 14 of 30 transects in sandy woodland around Kings Crossing near the middle of the island. No

tracks or pop-holes were found in either set of transects. Spoil heaps ranged from zero (i.e. directly on the transect) to 20.8 metres from the transect (Fig. 4). Preliminary analyses of the data indicate densities of approximately 3.5 spoil heaps.ha<sup>-1</sup> in these regions, and that 30 transects provide sufficient data to produce density estimates with reasonable power to detect change over time or in response to changed management regime (T. Griffiths pers. comm.). However, in areas with lower densities of hopping-mice and their burrow systems, larger numbers of transects are probably needed. Exploratory surveys of northern hopping-mice in new areas should consider doing at least 60 transects per habitat type.

## References

- Dixon J.M. and Huxley, L. (1985) Donald Thomson's Mammals and fishes of northern Australia. Nelson, Melbourne.
- Woinarski, J.C.Z. (2004). *National multi-species Recovery Plan for the Carpentarian Antechinus Pseudantechinus mimulus, Butler's Dunnart Sminthopsis butleri and Northern Hopping-mouse Notomys aquilo, 2004-2008*. (NT Department of Infrastructure Planning and Environment: Darwin.)  
<http://www.environment.gov.au/biodiversity/threatened/publications/recovery/p-mimulus-s-butleri-n-aquilo/index.html>
- Woinarski, J.C.Z., Gambold, N., Wurst, D., Flannery, T.F., Smith, A.P., Chatto, R., and Fisher, A. (1999) Distribution and habitat of the northern hopping mouse *Notomys aquilo*. *Wildlife Research* 26, 495-511.