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EFFICIENT PITFALL TRAP DESIGNS FOR SURVEYING SMALL VERTEBRATES

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INTRODUCTION

Surveys of small vertebrates generally utilize a variety of techniques such as aluminium box traps, pitfall traps, snap-traps, diurnal and nocturnal searching of microhabitats, predator scat analysis and monitoring of tracks and other signs. The survey techniques used will be strongly influenced by the type of information required, and it is important that the aims of any trapping program be clearly specified by the land manager. If information is sought on a particular species, or species group, the type of trap required may need to be specifically tailored for this species. Phascogales (wambengers), for example, seem to be able to escape from most pitfalls but are readily captured in metal box traps; the reverse is true for smaller marsupials such as *Sminthopsis* and *Cercartetus*.

This paper discusses pitfall traps (comprising tins, PVC piping or plastic buckets sunk into the ground) which have proven particularly effective for detecting small mammals, reptiles and amphibians. Such pits are usually deployed as "driftlines" in long rows linked by 20 to 50 m of drift fence (e.g. insect mesh about 25 cm high, partly buried in the ground to guide animals to the traps) with about 5 to 10 m between pits.

A great variety of materials, designs and sizes have been utilized in pitfall/drift fence traps, but there have been few attempts to quantitatively examine the efficiency of various configurations. Of particular interest to the land manager wishing to carry out a survey of a national park or reserve under his or her jurisdiction is:

i) what is an optimal size and material for the pit?

ii) what type and length of drift fence should be used, if any?

iii) how should the traps be laid out, (e.g. as lines of pits connected by a long fence, or as a grid or transect of independent pits)?, and

iv) where repeated and frequent sampling sessions are involved, can drift fences be left in place between sessions without negatively influencing capture rates?

This note discusses these aspects of pitfall/drift fence design by utilizing new data (Friend *et al.* in press) from a recent experiment which tested the relative efficiency of various configurations in semi-arid habitats within the Western Australian wheatbelt. These experiments were conducted in two localities:

i) Tutanning Nature Reserve (32°31'S, 117°23'E) near Pingelly, and

ii) Durokoppin and East Yorkrakine Nature Reserves and privately owned native vegetation north of Kellerberrin (31°38's, 117°43'E).

Pitfall Size and Materials

We compared capture rates in large 28 cm diameter 20 litre plastic buckets ("Rheem" brand) with those in 16 cm diameter PVC piping (both types 40 cm deep) and found that an overall very significant advantage is gained by using large pits. Large pits facilitate capture of both small and large animals, whilst small pits tend to catch few large elongate animals such as large skinks and goannas. Lizards such as these travelling along the drift fences at speed tend to run over the tops of small pits, but fall into large ones. More rotund animals, such as small mammals, tend to be captured equally often in both sizes.

Our experiments did not examine the influence of pitfall depth on capture rates but evidence exists (How *et al.* 1984) that some animals, particularly mammals such as hopping mice (*Notomys* spp) can jump out of shallow pits. Certain frogs (e.g. *Limnodynastes dorsalis* and various *Litoria* spp) also probably escape with ease. We regard 40 cm as a minimum depth, and 60 cm as preferable, particularly in sandy country where digging is relatively easy.

Plastic buckets as we used ("Rheem" 20 litre with snap on/snap off lids) are a relatively cheap and readily obtainable pitfall trap, but are only 40 cm deep. The sides however, are near-vertical and of smooth texture, and these pits appear to be more difficult for arboreal geckoes to climb out of than the PVC stormwater type. Furthermore, these buckets are available in UV resistant plastic, and this is an essential feature for long term durability.

Two or three 5 to 10 mm diameter holes should be drilled in the bottom for drainage, and 30 mm squares of aluminium insect screening glued securely over each hole on the inside. The plastic around each hole should be roughened to improve adhesion. Alternatively, the holes could be drilled in the sides about 10 mm above the bottom.

Drift Fences

Our data, along with those from other earlier studies, indicate that the addition of a drift fence to one or several pit traps significantly improves capture rates. In our experiments we tested single pits equipped with no fences, 2.5 m long fences and 7.0 m fences and found that the number of captures increased in direct proportion to the length of drift fence; this was true of all animal groups except geckoes. Although such a result is expected on theoretical grounds, it is also anticipated that overall capture rates will no longer increase once a certain "optimal" length of fence is reached, since animals will not travel beyond this distance along a fence. The optimal length of drift fence per pit is unclear from our experiments, but between 7 to 10 m is probably a good compromise.

A convenient and easily-handled material for drift fences is black fibreglass insect screening, and a 1 m wide roll can easily cut into three so that the fence is about 30 cm high. Small sharpened jarrah stakes (each 40 cm long, 2 cm square) spaced at 2 to 3 m intervals can be used to support the fence, with the lower edge of the screening buried about 5 cm in the ground. An alternative is aluminium screening which is semi self-supporting but more difficult to handle. Once erected, a small gap about 10 cm high and the width of the top of the bucket should be cut in the bottom of the fence above the trap; this improves trapping efficiency and allows animals through when the traps are closed.

One disadvantage of insect screening (compared with sheet metal or solid plastic) is that arboreal species such as geckoes may be able to climb over the drift fence; this explains their lack of response to increasing fence length (see above). However we consider that low cost, and the ease of handling and erecting fibreglass screening far outweighs this disadvantage.

Trap Layout

In our experiments a conventional "drift line" arrangement of pits (five pits spaced at 7 m intervals and connected by a single 30 m long permanently-erected drift fence) was compared with a similar number of "independent" pits spaced at 20 m intervals each with a 7 m permanently-erected drift fence. The independent traps recorded significantly more captures (48 versus 12), and considerably more species (14 versus 4), than the conventional drift line traps. The independent traps, laid out as a grid or transect, enable a relatively large area to be sampled. Such a configuration may encompass more home ranges of the larger species and thus detect both more individuals and more species than the driftline arrangement. Furthermore, a short 7 m permanently-erected rift fence may not obstruct animal movements to the same extent as a very long fence; hence individuals will not change movement patterns and avoid the area as they might with a conventional driftline.

Temporary Versus Permanent Drift Fences

We compared large pits equipped with permanently-erected 7 m drift fences with similar traps where the fences were removed between monthly sampling sessions. Overall, similar total numbers of animals were captured in the two designs, but different responses were recorded between different faunal groups. These results probably reflect behavioural attributes of different species groups.

The species favouring the pits with temporary fences (frogs, blind snakes and legless lizards) are mostly fossorial (soil burrowing) in habits, and feed on ground-dwelling invertebrates such as ants and termites. Such vertebrate species are probably attracted to these pits by the soft, freshly disturbed soil along the fences. Conversely, the species captured more often in permanently-fenced pits (small mammals, lizards and geckoes) are primarily above-ground invertebrate feeders and perhaps use the fences as foraging zones where invertebrates accumulate.

Permanently-erected drift fences represent an enormous saving in effort and time when repeated sampling is involved. Their reduced effectiveness in capturing fossorial species could probably be greatly overcome by periodically disturbing soil along the fences with a small hand rake. We are currently testing the influence of such soil disturbance along permanent fences.

An Efficient Design

From our studies in the wheatbelt we are able to offer some advice on pitfall design to district or regional staff who wish to carry out faunal surveys of parks and reserves under their control. It must be remembered, however, that for optimal results in a general faunal survey, a range of biological survey techniques should be used.

For pitfalls we recommend the use of large UV-resistant plastic buckets of around 25 to 30 cm diameter and at least 40 cm depth. These should be installed in a grid or transect at between 10 to 20 m spacing, and each pit should be equipped with a 7 to 10 m long drift fence which bisects the top of the pit. The bottom 5 cm of the drift fence should be buried in a shallow trench, and the fence supported by 4 or 5 small jarrah stakes or bent 8 gauge wire. For ease of handling, black fibreglass insect screening is recommended for drift fences, and these may be left in place if repeated and frequent sampling is involved. A small gap (10 cm high x the pit diameter) may be cut out above the pit to allow animals through when the lids are closed. Soil alongside the fence could be disturbed each time the pits are opened. Lids should be firmly in place whenever pits are not being checked on a daily basis.

We recommend such designs over the more conventional narrow PVC pitfalls linked by very long continuous drift fence. Although the buckets are slightly more expensive (approximately 1.5 times the cost of small PVC pits), the extra cost and effort required to install large pits with short fences in a grid or transect is quickly offset by the increased efficiency of such designs.

FURTHER READING

Friend, G.R., Smith, G.T., Mitchell, D.S. and Dickman, C.R. (in press). Influence of pitfall and drift fence design on capture rates of small vertebrates in semi-arid habitats of Western Australia. *Australian Wildlife Research.*

How, R.A., Humphreys, W.F. and Dell, J. (1984). Vertebrate surveys in semi-arid Western Australia. *In "Survey Methods for Nature Conservation"* (eds. K. Myers, C.R. Margules and I. Musto) Vol. 1, pp. 193-216. CSIRO Division of Water and Land Resources, Canberra.

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