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The effect of funnel trap type and size of pitfall trap on trap success: implications for ecological field studies

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Abstract. Funnel and pitfall traps that are set in association with drift fences are powerful tools for field herpetologists. Innovations in trapping techniques continue to improve capture rates, portability and affordability of trap materials, and to decrease construction and installation time. In this paper we test a new design for funnel traps and test the effect of pitfall trap size on trap success. Our new funnel trap design was significantly easier and quicker to construct, but captured fewer specimens than the traditional design. There was no significant difference in the capture rates of the two sizes of pitfall trap that we tested. This finding was confirmed by a second, more extensive field survey. The implications of trap efficacy on ecological investigations are discussed.

Introduction

Pitfall and funnel traps set in combination with drift fences (Gibbons and Semlitsch, 1981) have been used extensively to sample populations of snakes, lizards and amphibians (Enge, 2001). Traps offer many advantages that improve the success of specimen collection (e.g., Attum, Covell and Eason, 2004; Greene et al., 1999), the accuracy of population measures (Sutton, Mushinsky and McCoy, 1999; Kuhnz et al., 2005) and diversity estimates (Campbell and Christman, 1982). Advantages of trapping include, but are not limited to, the facilitation of the simultaneous sampling at several sites, standardisation of sampling effort, improvement in capture efficiency, especially when surveying is for extended periods of time, and more accurate species richness measures. Trapping, if conducted in a standardised way, can even improve the robustness of comparisons between sites that are widely separated geographically and are in differing habitat types, or in cases when sampling is conducted during different years by different researchers.

Although trap design and construction have become relatively standardised in recent years, continuing innovation (Christiansen and Vandewalle, 2000; Casazza, Wylie and Gregory, 2000; Malone and Laurencio, 2004; Mao, Yen and Norval, 2004) is still further improving capture rates, portability and affordability of trap materials, and reducing construction and installation time. Testing of the effectiveness of these innovations is an important component in the development of new trapping techniques since it allows for the capture rates of new designs to be calibrated against old designs. Measuring the effort required to construct the funnel traps is another important consideration as large numbers of funnel traps are required for comprehensive trapping surveys.

Capture rates are an important factor in the conclusions of ecological studies and faunal inventories. The impact of various trapping techniques on capture rates is thus an important consideration in the design, execution and conclusion of such studies. Sampling effects can result in "rare" species going undetected as limited samples are likely to exclude such species and thus misinforming both species richness estimates and community structure assessments. Additionally, certain trap characteristics may favour the inclusion of particular species in a sample while excluding others. Robust scientific studies can limit the sources of variation

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mentioned above and are thus more valuable in their ability to inform management decisions than studies in which such variation is not controlled.

In this paper we describe and test a new design for funnel traps, and test the effect of pitfall trap size on trap success. Additionally we discuss other trap characteristics that may affect funnel and pitfall trap success and the implications of variable capture rates for ecological studies.

Materials and methods

We tested various trap characteristics during two field surveys that were conducted at Suikerbosrand Nature Reserve, Gauteng Province, South Africa (26°30′S; 28°15′E). The reserve is located approximately 40 km south of Johannesburg, is approximately 18 000 ha in extent and incorporates the major portion of the Suikerbosrand, a high lying plateau named for the abundant Highveld Protea, *Protea caffra* (Afrikaans: *Suikerbossie*) which occurs there. Altitude on the reserve ranges from 1545 to 1917 metres above sea level. Rainfall is highly seasonal, with most of the annual mean of 675 mm falling in summer, between October and March. Vegetation is classified as grassland (Low and Rebelo, 1996) but there are also stands of *Acacia karoo*, which form small areas of woodland.

Funnel traps

Funnel traps consist of a tube with inverted funnels at both ends (Fitch, 1987; Simmons, 2000). Traditionally, funnel traps have been constructed from aluminium or metal fly mesh (Simmons, 2000) fixed into position with staples. We evaluated a new design of funnel trap in which we used the top third of 2-litre plastic Coca-Cola bottles as the funnels. Since Coca-Cola bottles are readily available world-wide, and are relatively rigid, we reasoned that their incorporation would decrease costs and effort of construction. We measured the effort of construction of these 'Plastic-Entrance Funnel Traps' and compared this measure to the effort required for making the conventional 'Mesh-Entrance Funnel Traps'. Time taken for two builders to construct 24 funnels and insert and secure the 24 funnels of each type of trap was recorded to the nearest second. Construction times were compared using an Analysis of Covariance (ANCOVA) with "builder" coded as a covariable. We then measured and compared the capture rates of Plastic-Entrance Funnel Traps and Mesh-Entrance Funnel Traps set under identical conditions in order to evaluate the effectiveness of the new design.

Pitfall traps

Pitfall traps consist of buckets that have been dug into the ground so that their rims are at ground level (Campbell and Christman, 1982). We tested for differences in capture success of small (5-litre) and large (10-litre) pitfall traps during both herpetofaunal field surveys. Small pitfall traps were 200 mm deep with a diameter of 210 mm, compared to large pitfall traps that were 250 mm deep with a diameter of 260 mm. Although pitfall traps only differed in depth by 50 mm, large pitfall traps had circumferences' of 157 mm greater than small pitfall traps.

Experimental design

In 2004, ten trap arrays were installed at predetermined sites as required by another study (Masterson et al., unpublished data). Each array consisted of eight funnel traps (four Mesh-Entrance Funnel Traps; four Plastic-Entrance Funnel Traps), eight pitfall traps (four small; four large) and four drift fences of 8 m each (fig. 1A). Drift fences were standardised during each survey. For this survey, drift fences were constructed by stapling 400 mm high, transparent plastic sheeting to wooden stakes and burying the bottom 100 mm of plastic. The second, more extensive survey used nine trap arrays, each consisting of eight funnel traps (captures from these funnel traps were not considered in this study), five pitfall traps, and four drift fences of 9 m each (fig. 1B). Standardised drift fences were constructed by stapling 400 mm high, black plastic sheeting to wooden stakes and burying the bottom 100 mm of plastic. We placed raised cover boards over both large and small pitfall traps. Cover boards were constructed from plywood and measured 300 mm on each side. They were installed by propping them against the wooden stakes at the ends of each drift fence so that one side of the cover board was raised approximately 50 mm from ground level. Thus, cover boards did not impede access of herpetofauna to the pitfall, but shaded pitfalls effectively. The 2004 survey tested the effectiveness of the novel funnel trap design, while the 2004 and 2006 surveys evaluated the effect of pitfall size on capture rates. Trap position within each array was randomly selected by drawing position numbers without replacement from the pool of possible positions. Random trap placement was considered the simplest way to control for the effects of environmental gradients such as slope, aspect, direction to water etc.

Traps were checked twice daily from 15 March 2004 to 13 April 2004 during the 2004 survey, and once daily from 1 December 2005 to 4 April 2006 during the 2006 survey. All captured herpetofauna were removed, identified, marked and released within 50 m of the trap array. The type of funnel trap or size of the pitfall trap was recorded for each specimen, along with the specimen's Snout-Vent Length (SVL). Frogs and lizards were marked using toe clipping (same two toes of each specimen; Nature Conservancy Council, 1983) and snakes were marked using ventral scale clipping (after Fitch, 1987).

Captures for all herpetofauna in each trap type were grouped by week. Separate analyses were run for the pitfall trap data and the funnel trap data, but the statistical design of each was the same. Captures from central pitfalls during the 2006 survey were excluded from analysis as these pitfalls capture disproportionately more specimens as they are fed by four drift fences.

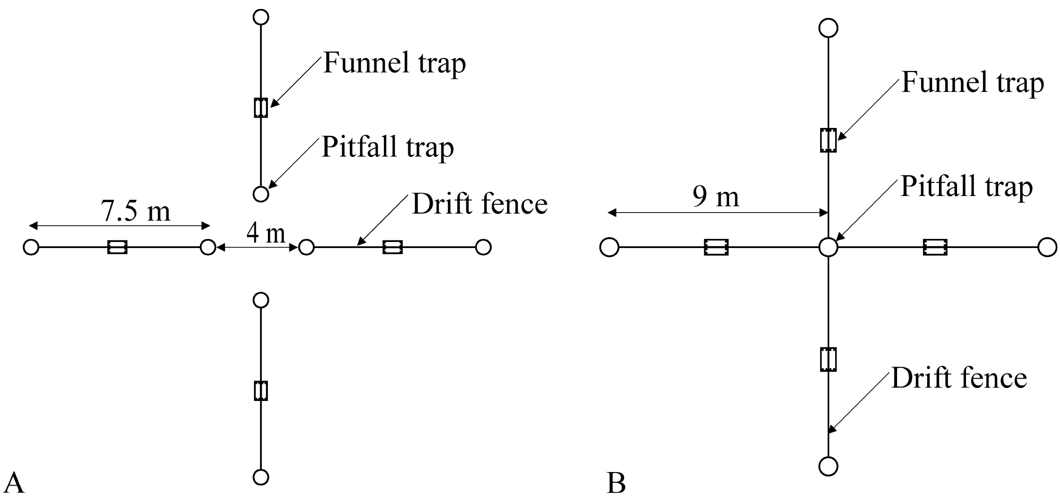

Figure 1. Plan views of the array layouts for the first (A) and second (B) field surveys conducted at Suikerbosrand Nature Reserve.

We used a Repeated Measures ANOVA (alpha = 0.05) to test for differences in capture rates between Plastic-Entrance Funnel Traps and Mesh-Entrance Funnel Traps, and between small and large pitfall traps using Statistica ver 6 (StatSoft Inc., 2002). We used Sørensen's Similarity Quotient (Sørensen, 1978) to assess the species similarity of the herpetofauna captured in the two types of funnel traps.

Results

Field surveys

During the two field surveys, 1 618 specimens, representing 23 species, comprising seven frog species, seven lizard species and nine snake species were captured. Apart from *Typhlops bibronii* and *Pseudaspis cana*, all species were represented by more than one specimen. *Causus rhombeatus*, *Dasypeltis scabra*, *Lamprophis aurora*, *Psammophis crucifer* and *Pseudaspis cana* were only captured in funnel traps and *Cordylus vittifer*, *Nucras lalandii* and *Typhlops bibronii* were only captured in pitfall traps. The 2004 survey produced 147 specimens representing 19 species (six frog species, five lizard species and eight snake species) while the 2006 survey produced 1 471 specimens representing 16 species (six frog species, seven lizard species and three snake species). Details of the catch for each survey are given in table 1.

Funnel trap construction

Plastic-Entrance Funnel Traps required significantly less effort to construct (ANCOVA: $F_{3,95} = 117.60$; $P < 0.01$), since the plastic funnels were prepared more quickly (ANCOVA: $F_{1,47} = 169.99$; $P < 0.01$; fig. 2A), and were secured into mesh tubes significantly more quickly (ANCOVA: $F_{1,47} = 21.72$; $P < 0.01$; fig. 2B). However, the Plastic-Entrance Funnel Traps produced significantly lower capture rates (mean $\pm$ SE $= 0.43 \pm 0.33$ specimens $\cdot$ array^{-1} $\cdot$ week^{-1}) than traditional Mesh-Entrance Funnel Traps (mean $\pm$ SE $= 1.23 \pm 0.33$ specimens $\cdot$ array^{-1} $\cdot$ week^{-1}) (RM-ANOVA: $F_{1,18} = 6.19$; $P < 0.05$; fig. 3).

Capture rates of large (mean $\pm$ SE $= 0.73 \pm 0.23$ specimens $\cdot$ array^{-1} $\cdot$ week^{-1}) and small pitfall traps (mean $\pm$ SE $= 1.32 \pm 0.23$ specimens $\cdot$ array^{-1} $\cdot$ week^{-1}) were very similar and did not differ significantly during the first field survey (RM-ANOVA: $F_{1,18} = 1.63$; $P = 0.22$; fig. 4). Similarly, the 2006 survey also produced similar capture rates for large (mean $\pm$ SE $= 2.54 \pm 0.38$ specimens $\cdot$ trap^{-1} $\cdot$ week^{-1}) and small pitfall traps (mean $\pm$ SE $= 2.22 \pm 0.38$

Table 1. Results for the field surveys showing captures from all trap types. The 2004 survey was conducted at the Suikerbosrand Nature Reserve between 15 March 2004 and 13 April 2004 while the 2006 survey was conducted between 1 December 2005 and 4 April 2006.

	2004 survey					2006 survey			**Grand total**
	Pitfall Traps		Funnel Traps		**Total**	Pitfall Traps		**Total**	
	Large	Small	Plastic	Mesh		Large	Small		
Frogs									
Bufo gutturalis	3	9	1	3	**16**	45	109	**154**	**170**
Cacosternum boettgeri	1	7	5	2	**15**	342	426	**768**	**783**
Kassina senegalensis	1	4		1	**6**	164	209	**373**	**379**
Schismaderma carens	6	12	2	1	**21**				**21**
Tomopterna cryptotis	9	7	1	2	**19**	60	34	**94**	**113**
Tomopterna natalensis		2		2	**4**	7	9	**16**	**20**
Xenopus laevis						1	1	**2**	**2**
Sub-total	**20**	**41**	**9**	**11**	**81**	**619**	**788**	**1407**	**1488**
Lizards									
Agama aculeata distanti				1	**1**		1	**1**	**2**
Cordylus vittifer						2	1	**3**	**3**
Gerrhosaurus flavigularis	5	9	2	11	**27**	12	7	**19**	**46**
Nucras lalandii							2	**2**	**2**
Panaspis wahlbergi	1	1	1		**3**	5	9	**14**	**17**
Trachylepis capensis	1	2	1	6	**10**	10	10	**20**	**30**
Trachylepis varia			1	5	**6**	1		**1**	**7**
Sub-total	**7**	**12**	**5**	**23**	**47**	**30**	**30**	**60**	**107**
Snakes									
Aparallactus capensis			1	2	**3**				**3**
Causus rhombeatus				3	**3**				**3**
Crotaphopeltis hotamboeia	1			3	**4**	1		**1**	**5**
Dasypeltis scabra				2	**2**				**2**
Hemachatus haemachatus			1		**1**	2		**2**	**3**
Lamprophis aurora				3	**3**				**3**
Psammophis crucifer			1	1	**2**				**2**
Pseudaspis cana				1	**1**				**1**
Typhlops bibronii						1		**1**	**1**
Sub-total	**1**		**3**	**15**	**19**	**4**		**4**	**23**
All Taxa	28	53	17	49	**147**	653	818	**1471**	**1618**

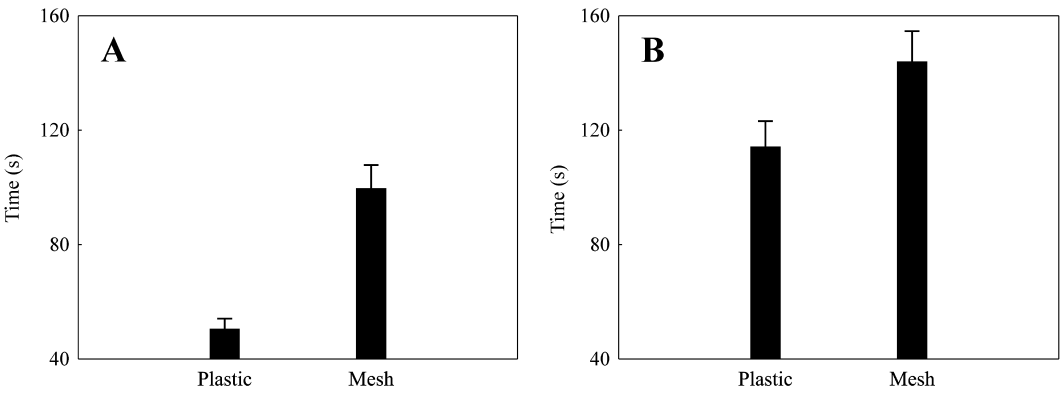

Figure 2. Mean time to (A) prepare funnels and (B) insert and secure funnels into mesh tubes. Error bars indicate 95% confidence limits.

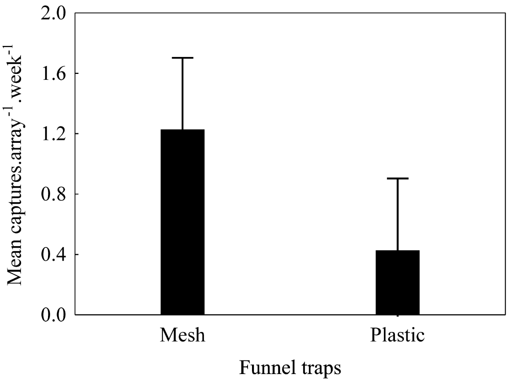

Figure 3. Mean weekly capture rate of reptiles and amphibians from Mesh-Entrance Funnel Traps (Mesh) and Plastic-Entrance Funnel Traps (Plastic). Error bars indicate 95% confidence limits.

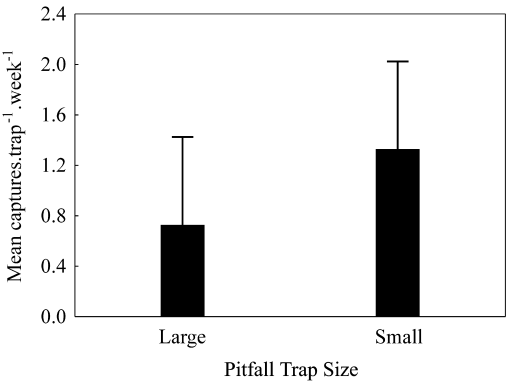

Figure 4. Mean weekly capture rates of reptiles and amphibians from large (10-litre) and small (5-litre) pitfall traps during the first field survey. Error bars indicate 95% confidence limits.

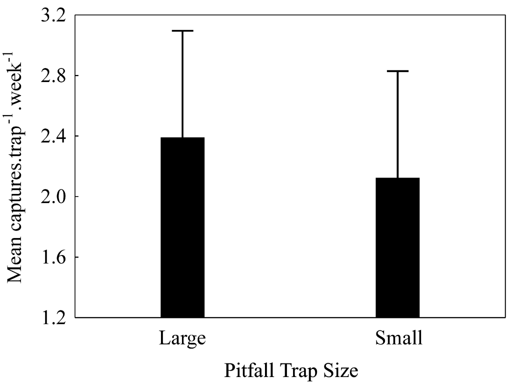

Figure 5. Mean weekly capture rates of reptiles and amphibians from large (10-litre) and small (5-litre) pitfall traps during the 2006 survey. Results confirm no effect due to pitfall trap size. Error bars indicate 95% confidence limits.

specimens · $\text{trap}^{-1} \cdot \text{week}^{-1}$) that did not differ significantly (RM-ANOVA: $F_{1,16} = 0.37$, $P = 0.55$; fig. 5).

The Sørensen's Similarity Quotient for the two types of funnel traps indicated a 47.4% overlap between the suites of species captured during the 2004 survey. Of the species that were caught in a single funnel trap type during the 2004 survey, 80% were captured in Mesh-Entrance Funnel Traps.

Discussion

We found that Plastic-Entrance Funnel Traps had significantly lower capture rates than Mesh-Entrance Funnel Traps. This finding was disappointing as our analysis indicates the Plastic-Entrance Funnel Traps can be constructed significantly faster (in approximately 65% of the time) and are more robust than Mesh-Entrance Funnel Traps. Additionally, the different types of funnel traps captured different numbers of species (11 species and 17 species for Plastic-Entrance and Mesh-Entrance Funnel Traps respectively) and showed little similarity in the suites of species captured. Our data indicate that Mesh-Entrance Funnel Traps out-perform Plastic-Entrance Funnel Traps and that Plastic-Entrance Funnel Traps are unsatisfactory for surveying herpetofauna.

There was no significant difference between the capture rates of pitfall traps of different sizes, even after a second extensive survey that captured 1 471 specimens in pitfall traps alone. Large and small pitfall traps captured similar numbers of species in both field surveys (nine species each for large and small pitfall traps during the 2004 survey; 14 and 12 species for large and small pitfall traps respectively during the 2006 survey) with a high degree of congruence in the suites of species captured (66.7% and 62.5% for the 2004 and 2006 surveys respectively). Thus five-litre pitfall traps appear to be as effective as 10-litre pitfalls suggesting that the additional effort and costs involved in installing larger pitfall traps is not rewarded by improved capture rates.

Measures of the number of animals captured by a trap represent the difference between number of initial captures and the number of escapes before the trap is checked. Differences in the capture rates of different types of funnel traps could thus be due differences in capture rate, escape rate, or a combination of the two. Factors that could influence capture and escape rates include the texture of the funnel, the appearance of the funnel, the shape of the trap entrance relative to the drift fence, and patterns of air movement through the trap.

The texture of the funnel may influence capture rates in that the smooth nature of the plastic funnels could prevent small reptiles from gaining access to the trap, whereas mesh funnels provide more traction and easier access to the trap. Our data support this hypothesis as Mesh-Entrance Funnel Traps captured 23 lizards (species that are most likely to be deterred by a slippery plastic surface as a result of their small claws) while Plastic-Entrance Funnel Traps captured only five lizards. Once an animal was captured in a funnel trap, the opacity of the plastic may have contributed to an increased likelihood of escape. The opacity of the plastic allows for better discrimination between the funnel aperture and the funnel than relative to mesh funnels and increases the chances of trapped herpetofauna locating the "exit". We hypothesise that the escape rate in the Plastic-Entrance Funnel Traps is greater than that of Mesh-Entrance Funnel Traps due to the opacity of the plastic funnels. Finally, anecdotal evidence suggests that animals may detect air movement and use this to find escape routes when trapped. Plastic-Entrance Funnel Traps may have directed air through the funnel aperture, advertising an escape route.

A tight fit between the funnel trap and the drift fence is critical for good capture rates. A small gap between a drift fence and a funnel trap provides a route around the trap that reduces the trap's efficacy. Plastic-Entrance Funnel Traps were not malleable like the Mesh-Entrance Funnel Traps and so while every effort was made to ensure that there was no gap between the trap and the drift fence, the installation of these traps was slightly more difficult.

We believe that the texture, opacity and shape of the plastic funnels played an important role in the low number of captures that the Plastic-Entrance Funnel Traps recorded. The estimated impacts of these factors on the ease of trap access and escape provide testable hypotheses on trap dynamics and the relative importance and contribution of each factor.

The difference in the number of captures recorded from the different types of funnel traps is supported by the similarity quotient produced when comparing the species suites captured by the two types of funnel traps. Low capture rates from the Plastic-Entrance Funnel Traps reduce the probability of a particular species being shared by both trap types (table 1) since Plastic-Entrance Funnel Traps are likely to capture a smaller proportion of the entire sample pool of species than Mesh-Entrance Funnel Traps, particularly over short sample periods.

Like funnel traps, the efficacy of pitfall traps is determined by various inherent and contextual factors. Examples of inherent factors include colour (Crawford and Kurta, 2000), pit diameter, pit depth (Brown, 1997) and damage, whereas shading and proximity to the fence edge are examples of contextual factors. Two important characteristics of a pitfall trap are the depth and diameter. It is logical that pit diameter is important in situations where pitfall traps are installed without drift fences (e.g., Attum, Covell and Eason, 2004; Kok, du Preez and Kok, 1997), since this is the only factor likely to affect the probability of an individual encountering the pitfall trap. In situations where drift fences guide the animals towards the pitfalls, pit diameter is less likely to play as great a role in determining capture rates, and pit depth, which may affect the ease of escape, becomes more important. The large pitfall traps we used in our surveys were only 25% deeper than the small pitfall traps despite the two-fold difference in volume and it appears that the similar depths of the pitfall traps used resulted in similar capture rates and possibly similar escape rates. Brown (1997) measured escape rates of *Rana temporaria* and *Bufo bufo* from pitfall traps that were 33% and 90% deeper than her smallest pitfall trap and found no difference in escape rates. This implies that, at least for certain taxa, capture rates may not be determined by pitfall trap depth.

The result of the similarity index analysis indicates that less than half of all species captured in funnel traps were common to both Mesh-Entrance and Plastic-Entrance Funnel Traps, with 80% of the unique species being caught in only Mesh-Entrance Funnel Traps. This indicates that the low level of congruency in captured species from the two types of funnel traps is mainly the result of the inability of the Plastic-Entrance Funnel Traps to capture herpetofauna. In contrast, the two types of pitfall traps yielded a similarity quotient of 66.7% during the 2004 survey and 62.5% during the 2006 survey with eight of the eleven species and 10 of the 13 species being shared by both trap types during the 2004 and 2006 survey respectively.

Data from the pitfall traps collected during the 2004 survey indicate that pitfall traps of different size capture very similar suites of species (Sørensen's Similarity Quotient = 66.7%). Pitfall trap captures from the 2006 survey produced a similar result (Sørensen's Similarity Quotient = 62.5%). An observation arising from the 2006 survey was the successful capture of snakes in pitfall traps. Although the 2004 survey produced a single snake capture from a pitfall trap, the snake was a small juvenile measuring less than 200 mm SVL. During the 2006 survey, four snakes were captured, including two adult *Hemachatus haemachatus* in excess of 600 mm SVL and an adult *Typhlops bibronii* in excess of 300 mm SVL. We believe that it was the inclusion of raised covers above the pitfall traps that resulted in these captures as the snakes could easily have escaped from the pitfalls but appeared to have chosen the pitfall traps as retreats. Although we did not test for an effect of these covers (i.e., we did not measure capture rates with and without coverboards during the same survey), we believe that they improved pitfall trap capture rates and their effect on efficacy is worthy of further investigation.

Certain traits predispose individuals of particular taxa to capture in different traps types. We have previously discussed how captures of small lizards in Plastic-Entrance Funnel Traps may have been limited by the smooth entrance to those traps. Additionally, highly active organisms are more likely to encounter traps (of any kind) but may escape more frequently, particularly if a trap type provides for an easier escape route such as we have described for Plastic-Entrance Funnel Traps.

While trapping techniques and the trends in capture rates discussed above have been described from a grassland habitat, their application to other habitats should not be excluded. However, we suggest that these methods are particularly well suited to habitats in which habitat structure is simple (i.e., those lacking a major vertical component), such as those found in deserts and to a lesser degree savannas, as most of the taxa move on the ground and are thus susceptible to being trapped by our traps.

The use of various trapping techniques in surveying herpetofauna can greatly improve the quality of data obtained during the survey period. However, technique dependent differences in capture rates can have profound effects on survey results and interpretation of those results that are likely to inform management decisions. The variation in results arising from the different sampling regimes in this study highlights the need for such trap evaluation and calibration experiments. An improved understanding of these effects can facilitate improvements in experimental design and data interpretation.

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References

Attum, O., Covell, C., Eason, P. (2004): The comparative diet of three Saharan sand dune skinks. Afr. J. Herpetol. **53**: 91-94.

Brown, L.J. (1997): An Evaluation of Some Marking and Trapping Techniques Currently Used in the Study of Anuran Population Dynamics. J. Herpetol. **31**: 410-419.

Campbell, H.W., Christman, S.P. (1982): Field Techniques for Herpetofaunal Community Analysis. In: Herpetological Communities, p. 193-200. Scott, N.R. Jr., Ed., US. Fish. Wildl. Serv., Wildl. Res. Rep. 13.

Casazza, M.L., Wylie, G.D., Gregory, C.J. (2000): A funnel trap modification for surface collection of aquatic amphibians and reptiles. Herpetol. Rev. **31**: 91-92.

Christiansen, J.L., Vandewalle, T. (2000): Effectiveness of three trap types in drift fence surveys. Herpetol. Rev. **31**: 158-160.

Crawford, E., Kurta, A. (2000): Color of Pitfall Affects trapping Success for Anurans and Shrews. Herpetol. Rev. **31**: 222-224.

Enge, K.M. (2001): The Pitfalls of Pitfall traps. J. Herpetol. **35**: 467-478.

Fitch, H.S. (1987): Collecting and Life History Techniques. In: Snakes: Ecology and Evolutionary Biology, p. 143-165. Seigel, R.A., Collins, J.T., Novak, S.S., Eds, McGraw Hill, New York.

Gibbons, J.W., Semlitsch, R.D. (1981): Terrestrial Drift Fences with Pitfall Traps: An Effective Technique for Quantitative Sampling of Animal Populations. Brimeleyana **7**: 1-16.

Greene, B.D., Dixon, J.R., Whiting, M.J., Mueller, J.M. (1999): Reproductive Ecology of the Concho Water Snake, *Nerodia harteri paucimaculata*. Copeia **1999**: 701-709.

Kok, D.J., du Preez, L.H., Kok, A.C. (1997): Anuran Diversity in Pure Grassland as Determined by Pitfall Trapping. J. Afr. Zool. **111**: 437-440.

Kuhnz, L.A., Burton, R.K., Slattery, P.N., Oakden, J.M. (2005): Microhabitats and Population Densities of California Legless Lizards, with Comments on Effectiveness of Various Techniques for Estimating Numbers of Fossorial Reptiles. J. Herpetol. **39**: 395-402.

Low, A.B., Rebelo, A.G. (1996): Vegetation of South Africa, Lesotho and Swaziland. Pretoria: Department of Environmental Affairs and Tourism.

Malone, J.H., Laurencio, D. (2004): The use of Polystyrene for Drift Fence Sampling in a Tropical Forest. Herpetol. Rev. **35**: 142-143.

Mao, J., Yen, K., Norval, G. (2004): A preliminary test and report on the efficiency of a new funnel trap for semi aquatic snakes. Herpetol. Rev. **35**: 350-351.

Nature Conservancy Council (1983): The Ecology and Conservation of Amphibian and Reptile Species Endangered in Britain. Wildlife Advisory Branch, Nature Conservancy Council. London.

Simmons, J.E. (2002): Herpetological Collecting and Collections Management, Revised edition. Society for the Study of Amphibians and Reptiles. Herpetological Circular, **31**. pp. 153.

Sørensen, T. (1978): A method of establishing groups of equal amplitude in plant sociology based on similarity of species content. In: Phytosociology: Benchmark Papers in Ecology, Vol. 6, p. 234-249. McIntosh, R., Ed., Dowden, Hutchinson and Ross, Stroudsburg, PA.

StatSoft, Inc. (2002): STATISTICA (data analysis software system), version 6. www.statsoft.com.

Sutton, P.E., Mushinsky, H.R., McCoy, E.D. (1999): Comparing the Use of Pitfall Drift Fences and Cover Boards for Sampling the Threatened Sand Skink (*Neoseps reynoldsi*). Herpetol. Rev. **30**: 149-151.

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