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Comparison of reptile sampling in Iran with pitfall versus double-ended funnel traps

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In north Khorasan province, Iran, we compared the effectiveness of two types of traps for collecting reptiles: funnel traps and pitfall traps. Three stations were monitored over three 10-day periods and in total 544 individuals (including 200 recaptures) belonging to 5 species and 4 families of lizards (Lacertidae) were collected. Funnel traps with 280 captures were more efficient than pitfall traps with 264 captures, but the differences between the two traps are not significant. Three species were captured most often in the three different stations respectively: station 1, *Bunopus crassicauda* (22% relative frequency); station 2, *Eremias fasciata* (29% relative frequency); and station 3, *Trapelus agilis* (32% relative frequency). Shannon species richness indices were higher for pitfall than funnel traps (i.e., 1.45 vs. 1.40), but the difference was not significant. Pitfall traps were better for capturing species that search widely for food, while the funnel traps preferentially captured species that climb plants, such as *Trapelus agilis*. We recommend using both types of trap to capture the various types of species in any one region.

Keywords: Lizards; Northern Khorasan province; species richness; trap effectiveness

Introduction

Pitfall and funnel traps as well as quadrate, transect, and time-constrained searches are widespread techniques that have been used in the past for herpetofaunal monitoring (Scott, 1982; Heyer, Donnelly, McDiarmid, Hayek, & Foster, 1994). Comparing sampling techniques is important to identify the relative effectiveness of each technique, which can have its own advantages, disadvantages, and sampling biases (Campbell & Christman, 1982; Fair & Henke, 1997). According to previous studies from non-Iranian countries, pitfall traps are good for collecting small lizards and snakes (Vogt & Hine, 1982). Drift fences and large diameter traps can enhance the efficiency of these traps (Corn & Bury, 1990; Brennan, Majer, & Moir, 2005; Todd, Winne, Willson, & Gibbons, 2007), while the efficiency greatly depends on the positioning of fences, their length and their height (Bury & Corn, 1987; Corn & Bury, 1990). The efficiency of pitfalls is usually higher than funnel traps but according to several previous studies in other countries, both trap types complement each other's effectiveness (Vogt & Hine, 1982; Bury & Corn, 1987; Greenberg, Neary, & Harris, 1994; Jorgensen, Vogel, & Demarais, 1998; Enge, 2001). Corn (1994) indicated that there is no trapping system that is known to capture all species in proportion to their actual abundance and diversity. However, different capturing methods can estimate species richness and relative abundance of the herpetofauna with different biases (Greenberg, Neary, & Harris, 1994).

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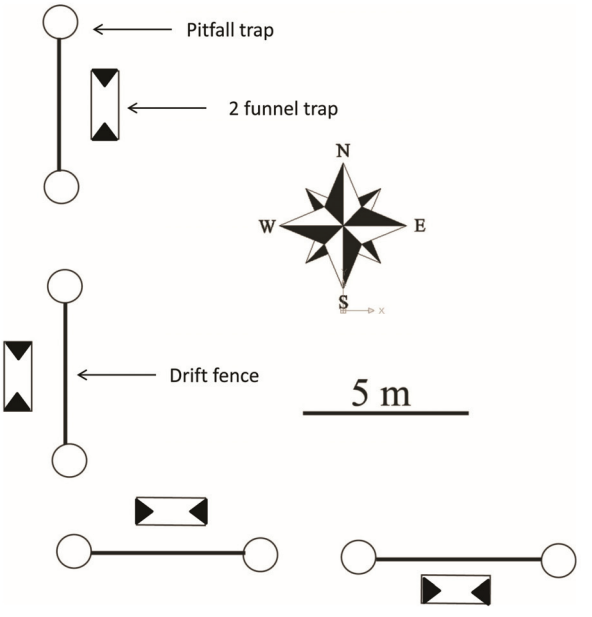

Figure 1. Array design used for comparing trapping efficiency of two-ended funnel traps with pitfall traps in the region of Jajarm, Iran.

In the present study, we compared two trapping methods – pitfalls used with drift fences and double-ended funnel traps – and their relative effectiveness with drift fences in North Khorasan province. We assumed that each trap type had its own effectiveness in sampling in terms of number of individuals captured and species richness. The results of the present study will help to select the best trap type in relation to target species.

Material and Methods

The study was conducted in Northern Khorasan province, in northeastern Iran. Jajarm city has warm and dry deserts. We limited our evaluation of the herpetofauna to an area with small shrubs and loose soil in southern Jajarm. The average rainfall in that region is about 125 mm annually, with most of the rain in winter, and the temperature oscillates between 1.4 and 24.4°C during the year. The study area has salty soils as shown by the Kal-e Shour River and *Haloxyon* and *Artiplex* trees.

Two sampling techniques for reptiles were employed in the present study: pitfall traps, used with drift fences, were prepared from pipe tubing which we divided into 30 cm lengths. The final traps were 10 cm in diameter and embedded vertically in the ground. Drift-fences linked them and have been situated 5 cm in the ground for more consistency. The height was about 15 cm. Funnel traps consist of a metal tube with either a single or double open end, but here we only used double opening traps.

Three stations were selected for this study and we established 8 pitfall and 4 funnel traps (Figure 1) with four 5-m long, erect fences arranged in an "L" pattern with a 5-m space between each length at each station. Traps at each station were used over 10 days and monitored daily in April 2015. All captured specimens were extracted, recorded, and marked by permanent red dye (Magic Marker), so they could be identified if recaptured. All captured specimens were released into their habitat.

Table 1. Overall percent and mean number of species and individuals that were captured per locality (±SE) in pitfall and two-ended funnel traps with a drift fence from April 2015 in Jajarm region. N = Number of captured individuals.

Species	N	Two-Funnel trap		Pitfall trap	
		Total study (%)	Mean per locality	Total study (%)	Mean per locality
Trapelus agilis	136	88.24	2.00	11.76	0.27
Bunopus crassicaudus	129	22.48	0.48	77.52	1.67
Eremias fasciata	116	60.34	1.17	39.66	0.77
Mesalina watsonana	102	36.27	0.62	63.73	1.08
Trachylepis septemtaeniata	61	39.34	0.40	60.66	0.62
Total	**544**	**51.47**	**4.66**	**48.53**	**4.40**

Table 2. Relatively abundance (P_i) of each species that was captured by each type of trap, and the Shannon Diversity Index calculated for each type of trap.

Species	Pitfall		Funnel trap	
	N	P_i	N	P_i
Trapelus agilis	16	0.06	120	0.42
Bunopus crassicaudus	100	0.37	29	0.10
Eremias fasciata	46	0.17	70	0.25
Mesalina watsonana	65	0.24	37	0.13
Trachylepis septemtaeniata	37	0.14	24	0.08
Shannon Index	**1.45**		**1.40**	

Trap success was evaluated by calculating the number of commonly trapped species, their relative abundance, and Shannon's diversity indices for each trap type at the three sites (Brower & Zar, 1977).

Results

In total we captured 544 lizards belonging to 5 species in four families in 240 array nights and days for pitfalls and 120 array nights and days for funnel traps, with an average of 1.51 individuals per night. Mean captures per array were higher for two-ended funnel traps (2.33±1.68) than for pitfalls (1.10±3.98). 48.5% of all individuals were trapped by pitfalls, while two-ended funnel traps captured 51.5%. This difference was statistically not significant (t-test; P=0.92). All five species were captured by both types of traps over the 30-day period (Table 1).

The difference in the number of individuals trapped per species between the two trap types is clear (Table 2): *Trapelus agilis* was the most frequently captured species (2.00±0.06) in the two-ended funnel traps. By contrast, *Bunopus crassicaudus* was captured in high numbers (1.67±1.08) in the pitfall traps.

Our results indicate that pitfall traps captured more terrestrial species like *Bunopus crassicaudus*, but the two-ended funnel traps captured more frequently the widely distributed species (*Trapelus agilis*). The relative abundance of both species was calculated

for each trap type separately. For *Trapelus agilis* in the two-ended funnel the Relative Abundance P_i was 0.42, and for *Bunopus crassicaudus* in the pitfalls, P_i was 0.37. The Shannon Diversity Index indicates that two-ended funnel traps have a higher chance of capturing a high diversity of species than pitfall traps (Table 2), but differences in the index were not significant between the two types of traps.

Discussion

Several studies on herpetofaunal sampling have shown that using more than one technique at a location can be complementary as each technique can catch a different group of animals (Bury & Corn, 1987). Campbell and Christman (1982) suggested that funnel traps are most effective in capturing large snakes, while pitfalls are more efficient at capturing terrestrial frogs, lizards, and small snakes. Greenberg, Neary, and Harris (1994) have studied the efficiency of three types of traps in Florida, USA. They employed concurrently pitfall, one-ended and two-ended funnel traps and confirmed previous studies showing that they had complementary efficiencies.

At our study site, all captured specimens were lizards. According to our results, two-ended funnel traps captured more lizards than pitfalls and the diversity index on the two-ended funnel trap was also higher than pitfall traps, but the differences were not significant. When the two types of traps were used together, arranged in the array shown in Figure 1, they worked in complement to each other.

The diameter of the pitfall has a direct influence on trap efficiency (Vogt & Hine, 1982). The ability of the traps to capture the full diversity of species in a region is an important criterion for selecting trap type and size. In general, techniques that can capture a high diversity of species are favoured by herpetologists (Bury & Raphael, 1983). Our study shows that both trap types captured the same number (N=5) of lizard species. However the number of captured individuals of each species differed, indicating that trap type can have an effect on the estimation of species diversity and abundance.

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Disclosure Statement

No potential conflict of interest was reported by the authors.

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