A Comparison of Herpetofauna Detection and Capture Techniques in Southern New Mexico

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ABSTRACT

We conducted systematic trials of four herpetofauna survey methods to assess their effectiveness in the Chihuahuan desert. Drift fences with pitfall and funnel traps, pitfall traps without fences, artificial habitats (with and without water added), and line transects were paired in arroyos and adjacent uplands. Times taken to set up, maintain, and remove survey materials were recorded. Twenty-seven captures or detections of six species were recorded. While the unwatered artificial habitats were most efficient in capture rate for all species pooled, the distribution of the species captured indicated that to give representative results, surveys should incorporate a combination of techniques. More extensive trials would be useful in confirming these results and assessing seasonal effects.

KEYWORDS: survey, inventory, monitoring, community

A number of techniques have been developed for surveying herpetofaunal communities (Campbell and Christman, 1982; Vogt and Hine, 1982; Jones, 1988; Szaro et al., 1988). These include pitfall traps with and without drift fences and funnel traps (Gibbons and Semlitsch, 1981; Bury and Corn, 1988), time-constrained transect or quadrat searches (Campbell and Christman, 1982; Bury and Corn, 1988; Jones, 1988; Raphael, 1988), artificial habitats (e.g. DeGraaf and Yamasaki, 1992; Fitch, 1992), glue traps (Bauer and Sadlier, 1992), road searches (Jones, 1988; Dodd et al., 1989), and incidental observations (Campbell and Christman, 1982). With the exception of pitfall and drift fence design (Gibbons and Semlitsch, 1981; Campbell and Christman, 1982; Vogt and Hine, 1982; Bury and Corn, 1987), comparisons of these techniques remain largely anecdotal (Jones, 1986). As part of an assessment of herpetofaunal community structure in the upper Chihuahuan desert ecotype, we investigated the effectiveness and efficiency of four capture/detection techniques.

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MATERIALS AND METHODS

We conducted four systematic trials of the four techniques in the McGregor Range section of Fort Bliss in southern New Mexico. The trials were run in scrub/shrub, montane desert ecotone at about 1,500 m elevation. The dominant shrubs were Apache plume (*Fallugia paradoxa*), salt bush (*Atriplex canescens*), and creosote (*Larrea tridentada*). For each trial, paired trap arrays and transects were placed in an arroyo and in an adjacent upland habitat. Upland sites were 50 m from the corresponding arroyo sites. Drift fence arrays were perpendicular to the arroyo (Szaro and Belfit, 1986) and consisted of two consecutive 7.5 m fences 40 cm high with 11-liter (22 cm diameter by 31 cm deep) pitfall buckets at the center and at each end. Funnel traps (Imler, 1945; Fitch, 1987) were placed on both sides midway along each fence. Two sets of artificial habitat arrays (Fitch, 1987) were placed at each site. These consisted of four 37 by 75 cm sheets of 1.3 cm thick plywood elevated by a 8 cm block under each corner and laid out at the corners of a 10 m square. For one of these arrays at each site, 0.5 liter of water was poured slowly on the ground under the center of each plywood sheet daily. Pitfall arrays consisted of four 11-liter buckets arranged in a 10 m square. The buckets were covered by square boards overhanging them by 10 cm and elevated by 8 cm blocks. Two 300 m line transects were established for each trial and habitat. These were walked at 10 m min^{-1} (Werschkul, 1982). Running down and along the arroyo, each set of capture/detection techniques was laid at 50 m intervals in the following order: first transect; drift fence; watered artificial habitat; unwatered artificial habitat; pitfall traps; and second transect. All surveys were performed by the same individual. During setup (construction), maintenance, processing, and removal for each array or transect, the time taken for the task was noted to the nearest 5 min. While surveying the traps and transects, herpetofauna that were observed incidentally were noted, as were those seen in the general area (within 30 km). The four trials were run from 19 September - 13 October 1992 for a total of 19 days (4, 4, 5, and 6 days, respectively).

RESULTS AND DISCUSSION

Six or 7 species (1 amphibian, 5-6 reptiles) were caught or detected. Some *Cnemidophorus* could be identified to genus only. These were discussed below as a distinct species. Capture/detections included 1 amphibian and 5 or 6 lizard species. All lizards were observed at the study sites or in nearby areas (Table 1). An additional 3 lizards, 3 snakes, and 2 turtle species were observed but not captured or detected.

The total of 27 herpetofauna captures (or detections) was insufficient for statistical comparisons (Table 2), but inspection of the results gives insight into the effectiveness of these techniques: (1) None of the 4 *Cophosaurus texanus* encountered were found under the artificial habitats; (2) *Sceloporus undulatus* was frequently found under unwatered artificial habitats; (3) Pitfall arrays (without drift fences) were ineffective for all species; (4) All of the *Phrynosoma cornutum* and most of the *S. undulatus* were detected by visual means (artificial habitats and line transects).

Generally speaking, the artificial habitats took the least time to set up and process, and line transects the most (Table 3). While the importance of differences in setup, processing, and removal times will vary for other trapping durations, the unwatered artificial habitats were most efficient in captures or detections per hour (Fig. 1); the watered artificial habitats, line transects, and drift fences were intermediate in efficiency, and the pitfall arrays were the least efficient.

Table 1. Herpetofauna captured and detected during the study, observed at the study sites, or observed in the general area during the study period.

Scientific name	English name	Captured and/or Detected	Observed at study sites	Observed in area
Bufo punctatus	Red-spotted toad	X		
Cnemidophorus sp.	Whiptail lizard	X	X	X
Cnemidophorus tesselatus	Checkered whiptail	X	X	X
Cophosaurus texanus	Greater earless lizard	X	X	X
Phrynosoma cornutum	Texas horned lizard	X	X	X
Sceloporus undulatus	Southern prairie lizard	X	X	X
Uta stansburiana	Side-blotched lizard	X		
Phrynosoma modestum	Round-tailed horned lizard		X	X
Sceloporus magister	Twin-spotted lizard		X	
Urosaurus ornatus	Tree lizard			X
Bogertophis subocularis	Trans-Pecos rat snake			X
Crotalus viridis	Prairie rattlesnake			X
Masticophis flagellum	Coachwhip snake			X
Terrapene carolina	Three-toed box turtle			X
Terrapene ornata	Desert box turtle			X

There was fairly close agreement between lizard species captured, observed at the sites, and observed in the area, indicating that lizards were inventoried reasonably well when all techniques were used. No single technique detected all species or

performed noticeably better in species richness (Table 2). Although no snakes or box turtles were observed at the sites themselves (Table 1), their presence in the area contrasts markedly with the trapping record. Snakes presumably could have been caught in the funnel traps of the drift fence arrays or detected during line transects. Possibly more intensive sampling would be required to record these species. Box turtles might successfully avoid pitfall traps (even when combined with drift fences) and very extensive sampling would probably be required to record these species in line transects.

Table 2. Number of captures or detections for each species of herpetofauna by technique, southern New Mexico, September and October 1992.

Species	Artificial Habitat			Line Transect	Drift Fence	Pitfall Array	Total
	Watered	Unwatered	Total				
Bufo punctatus	.	.	.	.	2	.	2
Cnemidophorus sp.	1	2	3	2	.	.	5
Cnemidophorus tesselatus	1	1	2	1	1	.	4
Cophosaurus texanus	.	.	.	3	1	.	4
Phrynosoma cornutum	1	1	2	.	.	.	2
Sceloporus undulatus	.	5	5	2	.	1	8
Uta stansburiana	1	.	1	.	1	.	2
Total	4	9	13	8	5	1	27

Because species responded differentially to the various techniques, both in terms of which species were caught and the number of individuals of the species, no single technique can be considered sufficient for assessing lizard communities in the Chihuahuan Desert, at least at these sampling intensities. Combining the data from the unwatered artificial habitat and drift fence arrays accounts for all of the species detected. Notably, three other combinations of two techniques accounted for 6 of the 7 species. A more extensive trial would be useful in determining which technique or combination of techniques would be sufficient for surveying lizards in these habitats.

Other investigations have also concluded that a variety of techniques should be employed in herpetofaunal community inventories. Storm and Pimentel (1954) and Dodd (1991) discussed biases in pitfall/drift fence sampling, while Gibbons and

Semlitsch (1981) indicated that this method is essential for detecting certain species. Campbell and Christman (1982) noted that the relative efficacy of pitfalls and searching varies between habitats. They also showed the importance of night road searches (18 additional species detected) and general collection (25 additional species detected) in compiling species lists. Fitch (1992) noted considerable differences among the susceptibility of various snake species relative to detection technique.

Table 3. Summary of time (in minutes) expended and capture efficiency for herpetofauna capture/detection techniques.

Activity	Artificial Habitat		Line Transect	Drift Fence	Pitfall Array
	Watered	Unwatered			
Setup	145	155	155	395	435
Maintenance	40	15	90	310	230
Processing	420	240	2145	425	345
Removal	80	110	5	130	75
Total	685	520	2395	1260	1085

We expected that in the desert environment, the watered artificial habitat arrays would be a more successful means of detecting herpetofauna than the unwatered arrays. Our data indicate that the opposite may have been true, at least for *S. undulatus*. Two possible reasons for this are that the surveys took place in the fall, rather than during a period of greater heat stress; and that the weather was unseasonably cold during part of the survey period.

When effort was considered, the unwatered artificial habitat array was several times more effective than the other techniques in terms of the number of animals captured or detected (Fig. 1). However, the artificial habitat array and line transect techniques have an important disadvantage in that animals are seldom actually captured. This makes species identification difficult in some cases. Since species identification is a crucial component of community assessment, more than one technique could be employed in a survey protocol. Our trials indicate that for surveying herpetofauna in Chihuahuan Desert habitats, unwatered artificial habitat and drift fence arrays should be combined. Techniques more suitable for snakes and box turtles should also be incorporated if information on these groups is desired.

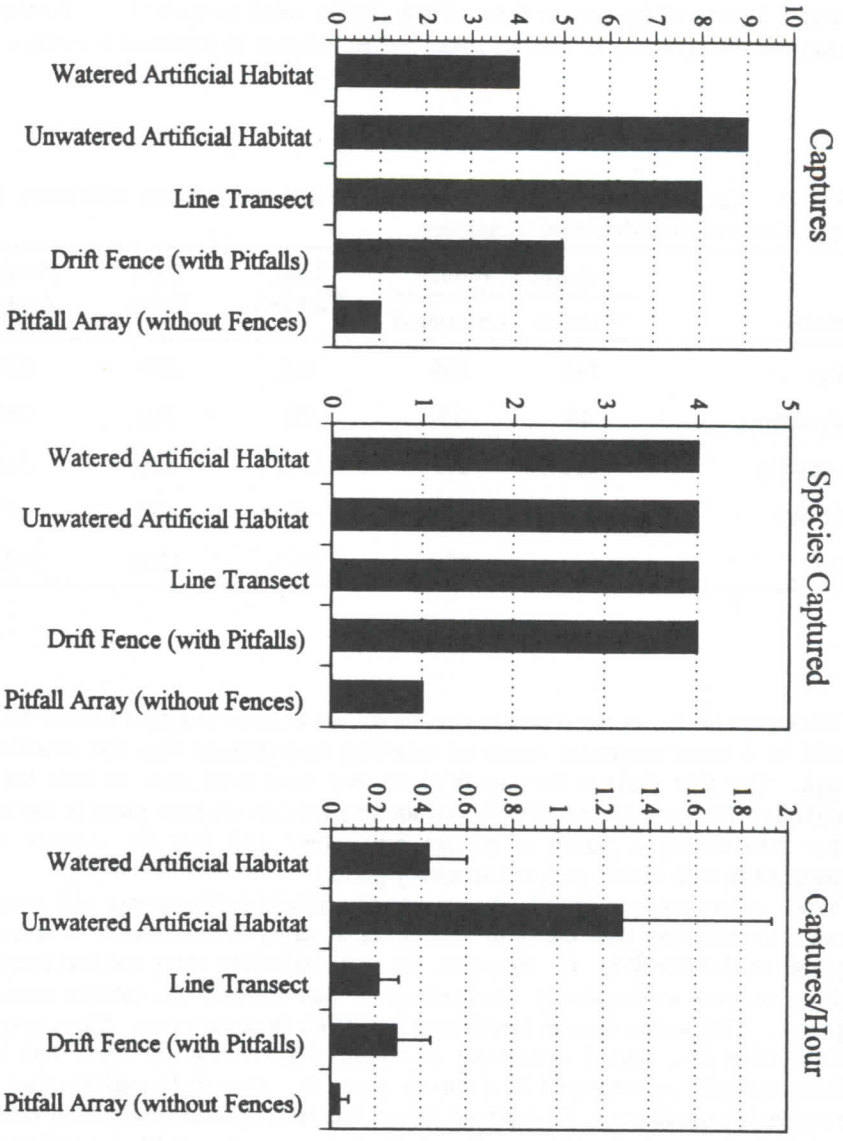

Figure 1. Number of captures or detections, number of species captured or detected, and mean capture or detection rate per hour of effort (± standard error of the mean), for five capture/detection techniques.

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