A New Application in the Pitfall Trapping of Insects

Burton J. Smith[1]
Department of Biology, Western Kentucky University,
Bowling Green, Kentucky 42101

Abstract

A previously untested technique in pitfall trapping utilized various drift fence designs to funnel insects into the trap. The use of these designs resulted in increased efficiency of catch severalfold over a similar unfenced trap. The use of these designs to investigate migratory patterns of ground insects appears to have considerable promise.

Introduction

The use of pitfall traps as a sampling device has been known for some time. There are numerous variations in the construction of such traps, from glass jars to gallon cans. Fichter (1941) described a design that incorporated a rain shield over a 2-story trap with partitions in the upper story to guide insects into the lower story that contained alcohol. Since then, most work with pitfall traps has been concentrated on using different kinds of baits, ways of positioning traps (Greenslade 1964), and various time-sorting techniques (Williams 1958, Holthaus and Riechert 1966).

The concept of using a funnel-shaped device for concentrating and leading animals into traps is common practice in the sciences and on many western ranches (wing corrals, drift fences, etc.). However, the application to ground insects appears unique. During the summer of 1975, I combined the pitfall trap with a winged V drift fence specifically for the purpose of collecting insects.

Materials and Methods

The study area was an abandoned tobacco field, 10 miles (16.1 km) south of Bowling Green, Kentucky. The field was last cultivated in 1974 and had been undisturbed since then. The predominant vegetation was ragweed with scatterings of Bermuda grass, goldenrod, and various other forbs. There was some ground litter, but bare ground was evident in many places. The field was about 2 acres (0.8 ha) in size, with the long axis in an east–west direction.

The traps were gallon (3.8-liter) cans, 15.5 cm in diameter, buried slightly below ground level and filled with water to a depth of 5 cm. Fences were constructed of strips of plastic trash bags about 10 cm high and about 1 m long (Fig. 1A). Small sticks were used to hold the plastic in place.

The experiment was initiated on 21 August 1975 and terminated on 7 October 1975, and was divided into 5 phases based on design of wing fences and layout of traps. Thirty-three collections, each of 24-hour duration, were made during the study. The experiment was interrupted several times by heavy rains. However, all but Phase IV were run on consecutive days.

Phase I involved 12 traps, 6 open and 6 with cross fence design (Fig. 1B, 1C, 1D). The traps with a cross fence design had plastic across the top of the can at the point of intersection. Each arm of the cross was 0.5 m long. Those traps were laid out in a line in an east–west direction, about 10 m from the north side of the field. The fenced and unfenced traps were spaced 2.5 m apart. This phase continued for 5 days.

Phase II consisted of 12 traps, 4 with no fence and 8 with a V design. Four V traps had the opening to the north and 4 to the south. Each arm of the V was 1 m long with an angle of about 60° between them. Those traps were laid in a straight line

[1] Present address: Route 2, Box 176, Interlachen, Florida 32048.

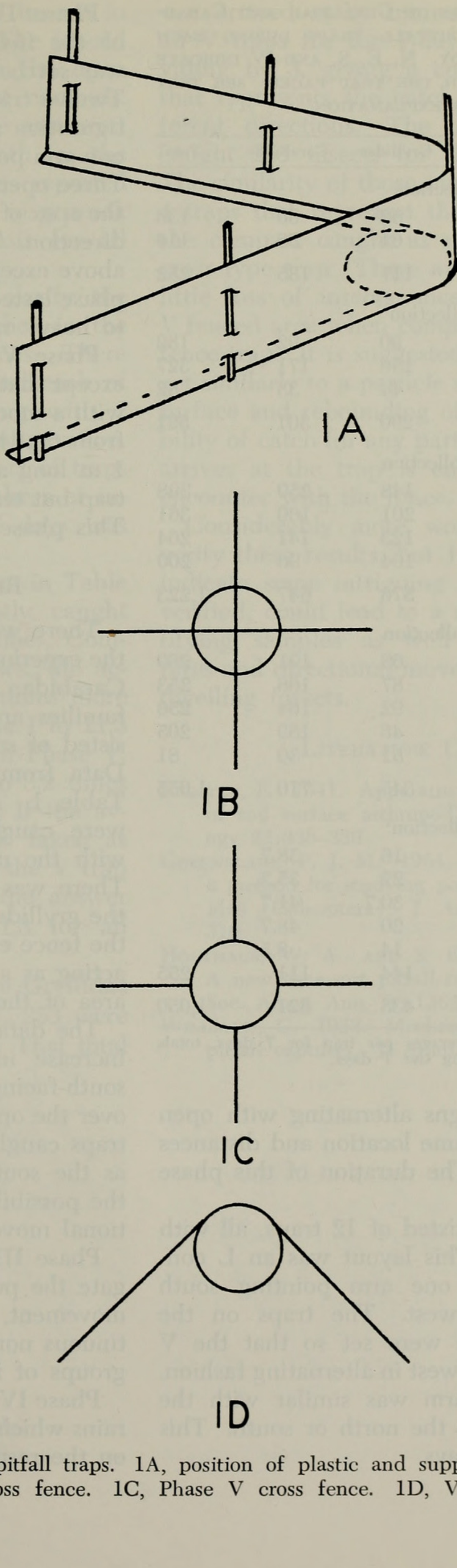

Fig. 1. Various fence designs for pitfall traps. 1A, position of plastic and supporting sticks on V wing fence. 1B, Phase I cross fence. 1C, Phase V cross fence. 1D, V wing fence.

TABLE 1.—NUMBERS OF GRYLLIDAE AND CARABIDAE CAUGHT IN PITFALL TRAPS DURING EACH PHASE OF THE STUDY. N, E, S, AND W INDICATE DIRECTION IN WHICH THE TRAP FACED. SEE TEXT FOR EXPLANATION

	Gryllidae	Carabidae	Total
Phase I, 5-day collection			
Fence	56	80	136
Open	61	55	116
Total	117	135	252
Phase II, 6-day collection			
S	90	92	182
N	156	171	327
Open	44	38	82
Total	290	301	591
Phase III, 9-day collection			
N	148	250	398
E	201	160	361
W	123	141	264
S	104	96	200
Total	576	647	1,223
Phase IV, 6-day collection			
N	69	191	260
E	87	166	253
W	92	164	256
S	46	159	205
Open	51	30	81
Total	345	710	1,055
Phase V, 7-day collection[1]			
N	16	38.7	
E	22	35.3	
W	30.7	41.7	
S	20	48.7	
Open	14	8.5	
Cross	144	111	255
Total	438	621	1,059

[1] These data are averages per trap for 7 days, totals are for all traps during the 7 days.

with the V designs alternating with open traps with the same location and distances as in Phase I. The duration of this phase was 6 days.

Phase III consisted of 12 traps, all with the V design. This layout was an L configuration with one arm pointing south and the other west. The traps on the north–south arm were set so that the V opened east and west in alternating fashion. The east–west arm was similar with the traps opening to the north or south. This phase lasted 7 days.

Phase IV was conducted on the side of the field opposite from Phase I and was set back from the edge about 10 m. Twelve traps were arranged in an L configuration similar to Phase III except that one arm pointed north and the other south. Three open traps (no fences) were set off the apex of the L and ran in a southeasterly direction. The V traps were similar to the above except that the angle was 90°. This phase lasted for 6 nonconsecutive days due to heavy rains.

Phase V was identical with Phase IV except that the center open trap was fitted with a modified cross. That cross differed from that in Phase I in that each arm was 1 m long and the fence did not cross the trap but terminated at the edge of the can. This phase continued for 7 days.

RESULTS AND DISCUSSION

There were 6,259 insects caught during the experiment. Of those, 4,180 were either Carabidae or Gryllidae, and only those families are discussed. The balance consisted of small numbers of many families. Data from each phase are presented in Table 1. A greater number of carabids were caught with the cross fence than with the unfenced traps during Phase I. There was a slightly opposite trend with the gryllids, thought to have resulted from the fence extending across the pit, thereby acting as a bridge and reducing the open area of the trap.

The data from Phase II show a definite increase in the numbers caught in the south-facing and north-facing fenced traps over the open traps. Also, the north-facing traps caught almost twice as many insects as the south-facing ones. This suggested the possibility of some sort of mass directional movement.

Phase III was set up to further investigate the possibility of detecting any mass movement, and the data indicated a continuous north to south movement for both groups of insects.

Phase IV was interrupted twice by heavy rains which might have had some influence on the results, e.g., the average catch per trap per day dropped from 5.3 insects in Phase III to 4.6 in Phase IV. The fenced cans were more efficient than the open cans, notably in the capture of carabids. Again, movement patterns were east–west for the gryllids and to the south for the carabids. The increased catches reported for the various directions were, in general, consistent on a day-to-day basis for all phases of the experiment.

Phase V was an effort to clarify the reasons for the increased catches in the fenced traps over the open ones. There were 3 traps that opened toward each of the 4 cardinal directions, along with 2 open traps and 1 with a cross configuration. Because of the different numbers of traps for each unit, the average numbers of insects caught per trap every 7 days was used for comparison.

As can be noted from the data in Table 1, the fenced traps consistently caught more insects than the unfenced ones. Combining the data for both families, the actual increase ranged from 1.2 times more than the unfenced trap in Phase I to 11.3 times for the cross fence trap in Phase V. The V traps caught from 2.4 to 3.2 times more than the unfenced traps. If the average value for the V traps is taken as 2.8 and multiplied by 4 (since the V trap is open only to 1 quadrant), the answer is 11.2, quite close to the 11.3 for all 4 quadrants.

Combining the results for the Gryllidae and the Carabidae in Phase V, 253 were caught per trap for the 7 days. That total was arrived at by summing the catch of all V traps for the 7-day period and dividing by 3, giving a composite number that represents the catch from the 4 different directions. The cross fence trap caught 255 insects for the same period. The similarity of those numbers imply that 4 traps that represent the 4 quadrants of the compass caught as much as a single cross type trap. There appears to be very little loss of insects once they enter the V fenced area when compared to the cross fence trap. It is suggested that the insects act similarly to a particle striking a smooth surface and rebounding off it. The probability of catch for any particular insect that arrives at the trap is enhanced by each encounter with the fence.

Considerably more work is needed to verify these results, but I believe they do indicate some intriguing trends which, if verified, could lead to a method of quantifying samples as well as determining rates and directional movements of ground dwelling insects.

Literature Cited

Fichter, E. 1941. Apparatus for the comparison of soil surface arthropod populations. Ecology 22:338–339.

Greenslade, P. J. M. 1964. Pitfall trapping as a method for studying populations of Carabidae (Coleoptera). J. Anim. Ecol. 33:301–310.

Holthaus, W. A., and S. E. Riechert. 1966. A new time-sort pitfall trap. Bibl. Entomol. Soc. Amer. Ann. 66:1362–1364.

Williams, G. 1958. Mechanical time-sorting of pitfall captures. J. Anim. Ecol. 27:26–35.