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Comparative sampling methods for grassland spiders

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Introduction

Ecological studies on ground-living spider populations often require quantitative sampling methods when the faunas of similar sites are being compared. Pitfall traps are seldom suitable for this purpose because local environmental conditions influence the catching efficiency and the traps are selective for the most mobile species. Heat extraction methods using sample turves in a Tullgren Funnel or 'platform type' apparatus (Duffey 1972) produce reliable and consistent results but are very time-consuming. Hand-searching, either over a unit area or for a fixed time period, is the most commonly used method and has many advantages although it is often slow and demands a high level of concentration. The examination of ½ m^2 of calcicolous grassland, for example, with a vegetation height of 15 cm, may take between 1 and 1½ hours to search thoroughly for spiders. Rapid survey of several sites therefore requires the help of many collectors or else the use of a mechanical method for sampling.

This need has drawn the attention of arachnologists to commercially made suction samplers, which although not yet widely used, have given encouraging results in preliminary trials (Morris 1971, P. Merrett pers. com.). Two types are available known as the D-vac and Burkhard (figs. 1 & 2). Both are powered by a portable 2-stroke engine operating on a petrol/oil mixture and carried on the back of the operator by means of a harness and frame. The engine rotates a fan which draws air through a cylinder attached to the end of a concertina tube. The D-vac cylinder is made of glass fibre and the opening has an area of 909 cm^2 (approx. 1/11 m^2). The Burkhard has a much smaller, metal mouth-piece, 19.6 cm^2, in area. Animals caught by the D-vac are trapped in a fine mesh nylon bag situated just inside the opening of the cylinder while in the Burkhard the trapping chamber is situated at the distal end of the much narrower concertina tube. This means that animals sucked in by the latter must pass the whole length of the tube before being caught with the result that a high proportion of the specimens may be damaged. On the other hand the small nozzle of the Burkhard makes it easier to use within a sampling frame in contrast to the D-vac which is too large to reach into the corners.

Fig. 1. The D. Vac suction-sampler in use.

Fig. 2. The Burkhard suction-sampler being used within a ½ m^2 frame.

Sampling by hand collection and suction apparatus

For 2 days in mid-May 1972 the efficiency of hand-collecting was compared with the D-vac and Burkhard suction samplers, using ½ m^2 quadrats. The areas chosen were four different sites on chalk grassland at Leckford, Hampshire, known as A1, A3, B and J. The dominant grass was *Festuca ovina* and there were many species of calcicolous herbs although the density and height of the vegetation varied according to management. Details of the numbers of spiders and species taken by hand-collecting are shown in table 1. A total of 62 species was recorded from the 40 ½ m^2 samples.

The vegetation heights for each sampling locality are plotted against number of species and number of individuals in fig. 3 and in both cases there is a direct relationship. Nevertheless one should bear in mind that the shortest vegetation (area B) was also trampled by cattle and this type of disturbance, on its own, would have a significant effect on the numbers of spiders present.

There was insufficient time to take more than 3 or 4 samples using the suction equipment and this was done in area B with additional samples in area J using the Burkhard (table 2). In spite of the difficulties of using the D-vac machine efficiently within the confines of a ½ m^2 quadrat frame the results compare very favourably with hand-collecting. On the other hand the Burkhard, even with the smaller nozzle which was able to reach into all parts of each sample area, produced poor results compared with

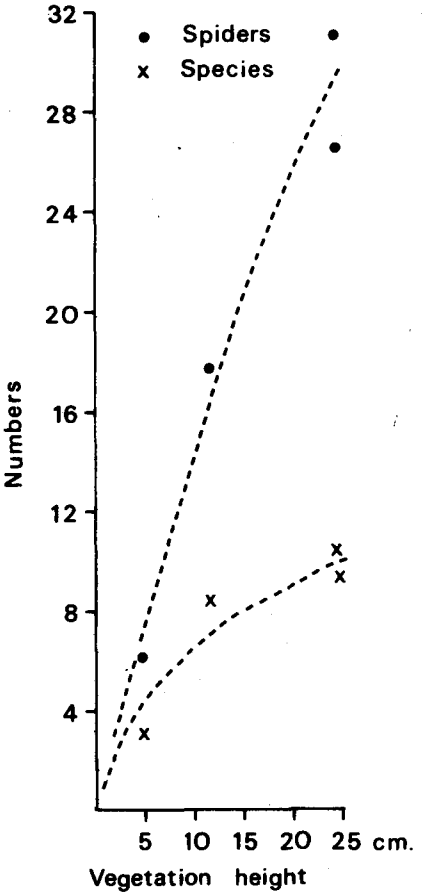

Fig. 3. The relationship between vegetation height on chalk grassland at Leckford, Hampshire and the numbers of spiders and species collected by hand. A total of 40 samples (each of ½ m^2) taken on 4 sites.

	Spiders mean/½ m^2	Species mean/½ m^2	Total species per site
A1 (11 x ½ m^2) Veg. ht. 12 cm, mown once each winter	17.7 ± 3.7	8.1 ± 0.9	29
A3 (11 x ½ m^2) Veg. ht. 25 cm, undisturbed	31.0 ± 4.1	9.5 ± 0.7	39
B (9 x ½ m^2) Veg. ht. 5 cm, cattle-grazed	6.2 ± 1.0	3.1 ± 0.4	11
J (9 x ½ m^2) Veg. ht. 25 cm, undisturbed	26.4 ± 4.3	10.4 ± 1.5	31

Table 1. Mean numbers of spiders and species taken by hand-collecting per ½ m^2

hand-collecting in areas B and J.

	Spiders	*Species*
Burkhard (4 x ½ m^2 in B)	2.5 ± 0.8	1.5 ± 0.4
D-vac (3 x ½ m^2 in B)	9.0 ± 2.4	4.3 ± 0.5
Burkhard (3 x ½ m^2 in J)	5.6 ± 3.8	1.6 ± 0.5

Table 2. Mean numbers of spiders and species per ½ m^2 quadrat by vacuum sampling

The normal method of operating the D-vac for survey or sampling work in the field is to take 11 random "sucks" or subsamples, the total area sampled then being approximately 1 m^2 (actual area = 9999 cm^2). A frame was used in the work reported here so that a comparison could be made of the efficiency of different methods. However 2 sets of 11 random subsamples taken in A3 gave considerably higher totals of spiders (40 and 108 per ½ m^2 respectively) than by hand-collecting within a ½ m^2 quadrat. This suggested the possibility that the 2 methods of using a D-vac may produce different results although an equal area of vegetation was sampled. On 9 May 1973 a systematic comparison was made on the chalk grassland of A1 to test this hypothesis. Within this area 9 random 1 m^2 samples were taken with the D-vac using a quadrat frame and 9 sq. metre samples were also taken with the same apparatus each consisting of 11 subsamples spaced at 3 m intervals along a series of transects running up and down a south-facing slope. The results are presented in table 3 together with mean numbers for other invertebrate groups. Significance values were calculated using the Mann-Whitney U-test.

The difference between the total invertebrate catch taken by each method is significant ($p < 0.02$) suggesting that different results are likely to be obtained. Not all the invertebrate groups responded in the same way however, the differences between the spiders, beetle larvae and Heteroptera were not significant while for adult beetles, Homoptera, Hymenoptera (Parasitica) and Diptera, values of 0.02 and 0.002 were recorded. The causes of the differences between the two sampling methods are not clear. It is unlikely to be due to the more extensive cover achieved by 99 subsamples of 1/11th m^2 compared with 9 samples of 1 m^2. The latter could be expected to include the range of variation in the distribution of spiders and species in a fairly uniform vegetation cover such as chalk grassland. On the other hand the distance around the edges of the 9 x 1 m^2 quadrat frames is only 36 metres compared with the 108.9 metres around the circumferences of the 99 subsamples. It is possible, although there is no

	9 x 1 m^2 (each of 11 subsamples)	9 x 1 m^2 quadrats	Significance values Mann-Whitney U-test
Araneae	48.7	43.4	N.S.
Opiliones	1.6	1.6	–
Coleoptera	9.5	4.7	$p < 0.002$
Coleoptera larvae	14.4	7.6	N.S.
Heteroptera	19.0	23.7	N.S.
Homoptera	237.2	187.2	$p < 0.02$
Hymenoptera (Parasitica)	39.2	20.1	$p < 0.002$
Formicoidea	3.2	3.3	N.S.
Diptera	25.6	12.6	$p < 0.02$
Isopoda	3.4	1.2	–
Means of Total Invertebrate Catch	402.2	305.8	

Table 3. Mean numbers of different invertebrate groups from 9 x 1 m^2 of chalk grassland using the D-vac suction-sampler in 2 different ways

proof, that as the D-vac inlet cylinder is lowered to the ground and again as it is raised invertebrates peripheral to the sampling unit are drawn in. If this happens then the larger number of subsamples taken per unit area will result in over-recording due to the edge-effect. Further experimentation is clearly needed with suction samplers before we understand their limitations and working efficiency under different conditions. Nevertheless in spite of the inadequacy of available information the D-vac sampler is proving to be a valuable tool for obtaining quick results in comparative invertebrate survey.

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