A Comparison of Line Intercepts and Random Point Frames for Sampling Desert Shrub Vegetation[1]

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Although much work has been done in recent years on sampling vegetation, the accuracy of many sampling techniques has not been adequately tested in desert shrub types. Far too often visual or ocular methods have been relied upon for describing the vegetation of low producing deserts. With the coming of more intensive management, more efficient and accurate methods of studying desert shrub vegetation must be found. The purpose of this study was to evaluate the relative merits of the line intercept and randomly located point frames in the study of desert shrubs.

During the summer of 1961, data were collected to determine the efficiency of estimating percentage ground cover and botanical composition of vegetation with randomly located line intercepts and point frames a Sagebrush-grass community and a Sagebrush-shadscale community. The Sagebrush-grass type was dominated by big sagebrush *(Artimisia tridentata)* with an understory of bunchgrasses such as beardless wheatgrass *(Agropyrom inerme)* and forbs (Table 1). It is typical of much of the foothill range in the Intermountain region. The Sagebrush-shadscale range selected is typical of much of the winter ranges in the same area. The dominant species were big sagebrush, shadscale saltbrush *(Atriplex confertifolia)* and spiny hopsage *(Grayia spinosa)*. Little herbaceous vegetation was present (Table 3).

In each vegetation type a one-half acre plot was selected for testing the methods. The position and starting point of each transect and point frame was located at random.

The line intercept method was a modification of that used by Canfield (1941). Measurements of all plants that intercepted the 50 foot lines were recorded and the estimates of vegetation attributes calculated from these measurements. In shrubby vegetation, the measurements were made in the crown spread intercepted by the line (Figure 1). Grasses and forbs were measured at ground level. Each line intercept was considered as a single sampling unit (Brown, 1954) and 15 transects each 50

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[1] *Portions of this study were presented in an M.S. Thesis at Utah State University.*

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FIGURE 1. Line intercept in the typical Sagebrush-shadscale vegetation used to test the sampling methods.

feet long were used in each vegetation type.

The point frame used was similar to that used by Cook and Box (1961). It is essentially a modification for use in shrubs of the early frames used in sampling sward vegetation (Tinney, et. al., 1937). The frame is approximately five feet long and has ten pins one-eighth inch in diameter, each separated by a space of six inches (Figure 2). Each frame was considered a sampling unit, and 15 frames were randomly located throughout each study area. The first hit on each plant was recorded. The percentage of hits on vegetation represented percent cover. Species composition was calculated from the percent of hits on each species.

Time consumed by each method was recorded, and used as one of the measures of efficiency. For each of the attributes measured by the methods, the mean, the variance, the standard deviation, and the coefficient of variation were computed by standard statistical procedures. The differences between means were tested by the "t" test. The theoretical number of samples required to sample each attribute within ten percent of the true mean with a five percent probability of error were calculated using the procedure suggested by Snedecor (1956).

Results And Discussion

The percent botanical composition, as estimated by the point and line intercept, did not differ greatly for the Sagebrush-grass type. The line intercept estimated slightly higher percentages of shrubs and forbs and somewhat lower percentages of grasses than did the point frame. Only small differences in individual species were noted (Table 1). The differences were not statistically significant (Table 2).

Differences in botanical composition estimates were somewhat greater between sampling methods in the Sagebrush-shadscale community. In the sparse desert type, the line method estimated a higher percentage of shrubs than did the point. Likewise, grass and forb percentages were lower when estimated with the line intercept. However, the differences noted were not significant (Table 2).

From the standpoint of time required to adequately sample the stands by the two methods, the point frame required fewer man-hours work than the line intercept method. In the Sagebrush-grass type the average time used by one man to establish, read, and record the information for each transect was 1.45 man-hours. Using the calculated figure of 16.83 transects needed to sample the major species within ten percent of the mean the total time required to sample a similar area would be 29.27 man-hours. With the point frame an average of 19 minutes was required to establish, read, and record information from each sampling unit. The time required to sample the 136.28 frames needed to reach the same accuracy as the intercept method was about 20.26 man-hours.

In the Sagebrush-shadscale type the time used in each sampling unit was less than in the Sagebrush-grass type, but the variance was higher and resulted in a greater number of sampling units being needed to reach the desired accuracy. An average time of 55 minutes per transect was used in the Sagebrush-shadscale vegetation. A total of 50.68 transects was required representing 46.27 man-hours work. The point frame took an average of nine minutes per sampling unit and required

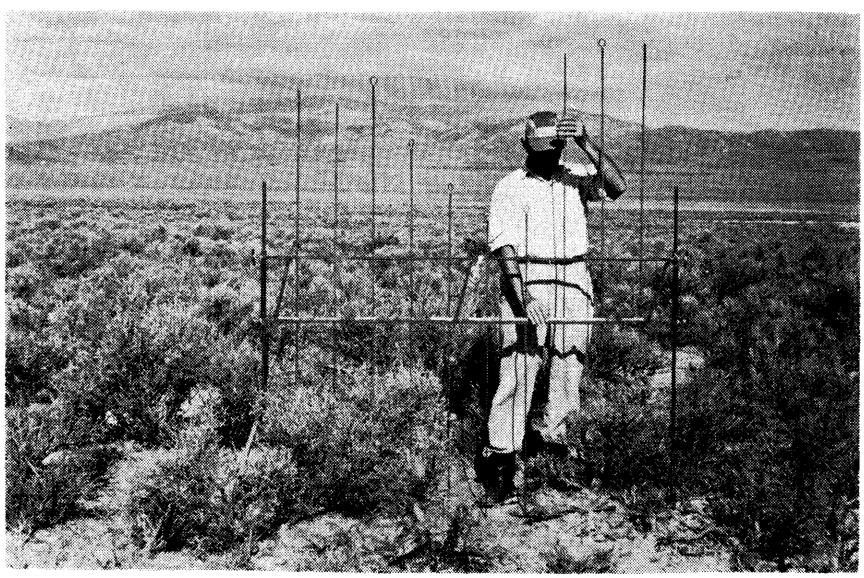

FIGURE 2. Large point frame being used to estimate percent composition and cover in desert shrub vegetation.

Table 1. Botanical composition in the Sagebrush-grass type based upon two methods.

Species	Line intercept	Point frame
Shrubs	— — — (Percent)	— — —
Artemisia tridentata	47.29	45.12
Chrysothamnus viscidiflorus	9.45	9.03
Average	56.74	54.15
Forbs		
Achillea lanulosa	2.86	2.90
Aster sp.	0.94	0.83
Balsamorhiza sagitatta	1.86	1.78
Eriogonum umbellatum	1.99	1.11
Geranium fremonti	0.85	—
Gutierrezia sarothrae	4.44	4.61
Lupinus spp.	3.05	3.17
Average	15.99	14.40
Grasses		
Aprogyron inerme	5.40	5.55
Agropyron spicatum	2.39	2.06
Bromus tectorum	3.64	4.66
Elymus cinereus	2.80	3.28
Koeleria cristata	6.90	8.86
Melica bulbosa	1.61	1.78
Poa pratensis	3.27	3.55
Stipa lettermani	1.25	1.66
Average	27.26	31.40
Total	99.99	99.95

a total of 166.71 frames. The time consumed was 25 hours.

The precision of sampling can be measured by the coefficient of variation (ratio of the standard deviation to the mean) or by the number of samples needed to estimate the mean with equal precision and probability if equal sized sampling units are used (Cook and Box, 1961). However, in this study, sampling units of unequal size (lines 50 feet long vs. frames five feet long) were used. Consequently the coefficient of variation cannot be used as a measure of precision.

The time needed to reach a pre-determined accuracy can be used as a measure of efficiency for the two methods. From the standpoint of time the point frame required considerably less man-hours of work than did the line intercept to reach the same accuracy. In the Sagebrush-grass type, the point frame was 1.44 times more efficient in time than the line intercept. The point method was 1.85 times faster than the intercept in the Sagebrush-shadscale type. The relative speed of the point frame indicates that it could be used for sampling species composition of desert vegetation with a considerable saving in time and money.

Ground cover is one of the most common measurements made in vegetation studies. Percentage ground cover as used in this study is "The proportion of ground occupied by perpendicular projection onto it of the aerial parts of individuals of the species under consideration" (Greig-Smith, 1947). Only living material was measured in the study.

Estimates of ground cover by the two methods showed considerable differences. In the Sagebrush-grass type the point frame estimated higher cover for all species—shrubs, forbs, and grass. These estimates were significantly higher at the .05 level than estimates made with the

Table 2. Means, standard deviations, coefficients of variations and number of sample observations required to measure percentage of ground cover and percentage composition of major species in two types by the line-interception and point frame methods.

Attributes measured	Line interception				Point frame			
	$\bar{x}$	S	C.V.	n[1]	$\bar{x}$	S	C.V.	n[1]
Percentage composition of major species (Sagebrush-grass)	47.29	9.10	19.24	16.83	45.12	24.71	44.76	136.28
Percentage composition of major species (Sagebrush-shadscale)	61.00	20.38	33.40	50.68	53.72	32.55	60.59	166.71
Percentage ground cover (Sagebrush-grass)	54.82*	9.51	17.34	13.66	65.33*	11.25	17.22	13.47
Percentage ground cover (Sagebrush-shadscale	19.58**	9.22	47.08	100.85	41.33**	23.86	57.73	151.38

[1] Number of sample observations based upon estimating the mean within ten percent of the true mean with a five percent probability.

* Denotes significance of the difference of the mean at 0.05 level.

** Denotes significance of the difference of the mean at 0.01 level.

Table 3. Botanical composition in the Sagebrush-shadscale type based upon two methods.

Species	Line intercept	Point frame
Shrubs	——— (Percent)	———
Artemisia tridentata	61.00	53.72
Chrysothamnus viscidiflorus	17.65	18.33
Atriplex confertifolia	6.40	6.39
Grayia spinosa	9.78	9.33
Sarcobatus vermiculatus	—	1.11
Average	94.83	88.88
Forbs		
Halogeton glomeratus	4.94	10.27
Grasses		
Sitanion hystrix	0.23	0.83
Total	100.00	99.98

lines. Estimates from both methods were within 10 percent of the true mean, therefore, some explanation other than chance must be made for the differences. The higher estimation of cover by the point method when compared to other methods has been noted by several investigators working in many vegetation types (Goodall, 1952; Whitman and Siggeirson, 1954; Johnston, 1957; Cook and Box, 1961).

Goodall (1952) suggested that one of the major reasons for the higher estimation of cover by the point method was due to the diameter of the pins. Theoretically, the point should be infinitely small and any increase in size may lead to a higher estimation of ground cover. Since a frame that can be used for sampling shrub vegetation, out of necessity, must be relatively large, and the pins must be sufficiently large to remain rigid in the frame, there could be some error due to pin size alone when sampling shrub cover with a large point frame. Although the one-eighth inch pins used in this study were ground to a fine point, some bias could have resulted in their use.

Although cover estimates were significantly higher with the point than with the line in the Sagebrush-shadscale type, cover was under-sampled on both areas. Therefore, the differences were not meaningful and could be due to chance alone. Only enough samples were taken to estimate the variance of this attribute in the community and no attempt was made to estimate absolute cover during the study.

The time required to sample the percentage ground cover within ten percent of the mean on the Sagebrush-grass type was 23.54 man-hours for the line intercept. A total of 13.66 lines were needed. The same accuracy could be obtained with 13.47 point frames or 4.15 man-hours. Therefore, the point frame is 5.67 times faster than the line intercept for estimating cover in Sagebrush-grass vegetation.

On the Sagebrush-shadscale type, 100.85 intercepts were needed. A total of 92.26 man-hours was needed to sample ground cover within ten percent of the mean with the line. The point method required 166.71 frames to reach the same accuracy. The time used was 22.42 man-hours work. The point frame was 4.11 times more efficient in time for sampling ground cover in the shrub stand.

On the basis of time required per sampling unit, the point frame is from four to thirteen times more efficient than the line intercept for sampling percentage composition and ground cover in desert shrub vegetation.

Several investigators have studied the use of line intercepts in shrub vegetation (Baur, 1943; Kinsinger, et al., 1960) and have reported varying degrees of success with it. It is generally accepted as one of the more rapid and accurate methods of estimating attributes of desert shrubs. The point frame method has not received wide use in sparse, desert shrub vegetation. Results presented here indicate that the point frame can be modified for use in sparse shrub types. Percentage composition of the major species can be found much faster by the point method than by the more common line intercept, and there are no differences in the estimates of the population mean. Further modifications, such as establishing a production value for each hit on a particular species, would make range surveys much more rapid and accurate in the arid regions. In vegetation similar to the typical Sagebrush-shadscale range used in this study, one worker could sample the range to within ten percent of the mean in three days using randomly located point frames.

Summary

Data were collected from randomly located 50 foot line intercepts and point frames for comparison of the two methods in sampling Sagebrush-grass and Sagebrush-shadscale vegetation. The point frame was 1.44 times faster for estimating the same accuracy in major species than the line intercept in the Sagebrush-grass type and 1.85 times more efficient in the Sagebrush-shadscale type. Ground cover was estimated 5.67 times faster with point frame than with the line intercept in the Sagebrush-grass vegetation. The point frame method was 4.11 times more efficient in time for sampling ground cover in the Sagebrush-shadscale type.

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