STUDIES ON THE USE OF THE POINT-QUADRAT METHOD OF BOTANICAL ANALYSIS OF MIXED PASTURE VEGETATION [1]

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INTRODUCTION

Since the development of the point-quadrat method for the analysis of pasture vegetation originated by Levy and Madden [3] in New Zealand, there have appeared in the United States a number of studies on its use and applications. Following an intensive comparative investigation in Wisconsin of several methods of botanical analysis, Tinney, Aamodt, and Ahlgren [4] concluded that the point-quadrat method gave the greatest promise of yielding reliable data consistent with rapidity and ease of operation. Hanson [5] had earlier found that the method was reliable when employed in analytical work on the native prairies of western North Dakota. More recently, Arny and Schmid,[6] working with various pasture mixtures in Minnesota, have investigated critically the use of the inclined point-quadrat method. These investigators showed that in mixtures of tall legumes and fine-leaved grasses correction factors must be computed in order precisely to evaluate the data, since the broad-leaved legumes tended to be hit less per gram of dry weight than the narrow-leaved grasses.

The present study was undertaken in order to determine (1) the relative merits of the point-quadrat method as compared with the count-list method for sampling small areas of a low-growing, grass-lespedeza pasture; and (2) the relative efficiency of four different point-quadrat methods for the quantitative analysis of such vegetation.

The investigation was carried out during July and August 1942 on a lespedeza-small grain rotation pasture in the vicinity of Columbia, Mo. Because of unfavorable planting conditions in the fall of 1941, it was impossible to sow the small grain successfully. Hence, the next spring and summer the pasture had an astonishingly uniform cover of the palatable fall panicum, (*Panicum dichotomiflorum*), which had replaced the grain, in addition to an excellent stand of lespedeza (*Lespedeza stipulacea*). While the fall panicum is hardly in the usual

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[3] Levy, E. B., and Madden, E. A. The point method of pasture analysis. New Zeal. Jour. Agr. 46: 267-279, illus. 1933.

[4] Tinney, F. W., Aamodt, O. S., and Ahlgren, H. L. Preliminary report of a study on methods used in botanical analyses of pasture swards. Amer. Soc. Agron. Jour. 29: 835-840. illus. 1937.

[5] Hanson, H. C. A comparison of methods of botanical analysis of the native prairie in western North Dakota. Jour. Agr. Res. 49: 815-842, illus. 1934.

[6] Arny, A. C. and Schmid, A. R. A study of the inclined point-quadrat method of botanical analysis of pasture mixtures. Amer. Soc. Agron. Jour. 34: 238-247. 1942.

category of forage crops, in its growth form under pasture conditions it closely resembles several domesticated grasses. Thus the results reported herein are thought to be reasonably applicable to lespedeza—grass mixtures in which the grass component is broader-leaved than Kentucky bluegrass.

PRELIMINARY COMPARISON OF THE POINT-QUADRAT, COUNT-LIST, AND WEIGHT-LIST METHODS OF ANALYSIS

PROCEDURE

An area supporting a relatively uniform mixed stand of grass and lespedeza, and having practically uniform soil and topographic conditions, was selected, and a plot of 100 m.[2] (10×10 m.) was staked off. Ten one-half-square-meter quadrats were then selected at random. In all cases, the order of study was as follows: (1) Count-list; (2) inclined point-quadrat; (3) straight point-quadrat; (4) weight-list. After careful counting of stems of individual plants [7] with a minimum of disturbance of their natural positions of growth, the point-quadrat apparatus was set up parallel to the long axis and across the half-square-meter sample area. Readings were first taken with the apparatus set up in the inclined (45°) position; and, then, without moving the two front supports, the apparatus was so placed that the needles were vertical. In each position, two types of data were recorded as follows: (1) The first species hit per needle (method A); and (2) the total number of hits obtained by pushing each needle to the ground, irrespective of whether the same plant or different ones were hit once or more than once (method B). Second and third sets of readings of 10 needles each were next obtained by resetting the apparatus in the quadrat, diagonally to the right, and then diagonally to the left. Afterwards, the entire one-half-square-meter area was clipped by hand at the soil surface, and, later, the species were hand-separated in the laboratory, the vegetation was oven-dried, and dry weights were obtained. For convenience, three components of the vegetation were separated, as follows: (1) Lespedeza; (2) grasses; (3) forbs.[8] Since other legumes were very rare, and since 98 percent of all grasses was fall panicum, no further separation appeared necessary. This part of the study was carried on only in early July.

RESULTS

The data in table 1 summarize the results of the count-list determinations. Although variation from quadrat to quadrat is evident, standard deviations and standard errors were not computed because the comparative magnitude of differences between methods is such as to indicate quite clearly these essential differences.

Comparing the percentage composition figures of table 1 with those of table 2, it is obvious that the use of the count-list method results in a decided underestimate of the amount of vegetation furnished by lespedeza, and vice versa, a noticeable overestimate of the grass

[7] In the case of grasses, culms were taken as the unit for counting.

[8] The forbs included all broad-leaved herbs that were samples. The following species were the principal ones sampled: Bracted plantain (*Plantago aristata*), bullnettle (*Solanum carolinense*), cocklebur (*Xanthium* sp.), common ragweed (*Ambrosia artemisiifolia* var. *elatior*), curly dock (*Rumex crispus*), field dodder (*Cuscuta pentagona*), knotweed (*Polygonum aviculare*), lanceleaf ragweed (*Ambrosia bidentata*), milk purslane (*Euphorbia supina*), Pennsylvania smartweed (*Polygonum pensylvanicum*), peppergrass (*Lepidium virginicum*), red sorrel (*Rumex acetosella*), spiny sida (*Sida spinosa*), yarrow (*Achillea millefolium*).

element. Forbs were relatively scarce, and are not important enough to be worth further consideration at this time. So far as lespedeza is concerned, an undercount was certainly to be expected because of the widely branching nature of the plant. Similarly, the overcount of grasses further emphasizes the difficulties inherent in any direct counting of stems of individuals of such plants. The unit used for direct counting was the culm; but the point-quadrat data for grasses include hits on any aerial part of the plant.

TABLE 1.—*Summary of results of count-list determinations*

Quadrat No.	Lespedeza		Grasses		Forbs	
	Plants	Composition	Plants	Composition	Plants	Composition
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*
1	564	38.6	886	60.6	11	0.8
2	313	20.7	1,115	73.6	87	5.7
3	388	31.7	821	67.0	16	1.3
4	283	22.9	920	74.3	35	2.8
5	364	30.8	748	63.2	71	6.0
6	287	29.3	670	68.4	23	2.3
7	367	42.9	461	53.9	27	3.2
8	294	26.4	771	72.3	15	1.3
9	269	27.2	645	70.3	25	2.5
10	291	28.8	625	69.9	13	1.3
Total	3,420	299.3	7,662	673.5	323	27.2
Mean	342	29.9	766.2	67.4	32.3	2.7

TABLE 2.—*Summary of results of weight-list determinations*

Quadrat No.	Lespedeza		Grasses		Forbs	
	Weight	Composition	Weight	Composition	Weight	Composition
	Grams	*Percent*	*Grams*	*Percent*	*Grams*	*Percent*
1	28.05	57.3	20.05	41.0	0.85	1.7
2	20.25	39.2	28.05	54.4	3.3	6.4
3	24.2	48.6	24.15	48.5	1.45	2.9
4	18.7	36.5	29.9	58.3	2.7	5.2
5	29.3	54.3	22.9	42.4	1.8	3.3
6	20.5	48.6	20.3	48.1	1.4	3.3
7	24.3	60.5	14.0	34.8	1.9	4.7
8	24.3	37.1	39.4	60.2	1.8	2.7
9	17.1	35.7	28.7	59.9	2.1	4.4
10	17.0	43.6	20.7	53.1	1.3	3.3
Total	223.7	461.4	248.15	500.07	18.6	37.9
Mean	22.37	46.1	24.815	50.01	1.86	3.79

An examination of the data obtained by using the point-quadrat methods (table 3) discloses that, even when a minimum of 10 needles per half-square-meter quadrat is used, the percentage composition of the elements of the vegetation quite closely approaches that obtained from dry weights. So far as the four methods of employing the apparatus are concerned, the data are not sufficiently extensive, nor have they been sufficiently tested, to permit the drawing of inferences. Yet it is fairly clear that somewhat greater accuracy—assuming that the data obtained from dry weights provide a satisfactory basis for comparison—is obtained by the inclined method, where the needles are pushed to the ground and all hits tabulated (method B). Moreover, from these preliminary trials, it is also evident that the fore-

going statement holds, though with some variation, for all the elements of the vegetation. No well-marked tendencies toward underhitting of legumes or overhitting of grasses are ascertainable. The addition of further readings from a second and third set within the half-square-meter area merely resulted in slight percentage changes, the net result of the total hits of 30 needles per quadrat being nearly the same as that from 10 needles. From these preliminary studies, and under the conditions described, it would appear that for sampling small areas a large number of readings is not necessary.

TABLE 3.—*Summary of data obtained by point-quadrat methods* [1]

HITS ON LESPEDEZA

Quadrat No.	Needles straight				Needles inclined 45°			
	A		B		A		B	
	Hits	Composition	Hits	Composition	Hits	Composition	Hits	Composition
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
1	4	40	21	45.7	[2] 4	40	[2] 17	40.5
2	5	50	[2] 25	59.5	[2] 6	60	[2] 13	44.8
3	2	22.2	6	18.8	4	40	12	33.3
4	4	40	22	61.1	[2] 4	44.4	[2] 21	51.2
5	4	44.4	15	57.7	6	60	24	70.6
6	5	50	13	38.2	2	20	12	35.3
7	0	0	5	21.7	[2] 2	22.2	[2] 22	48.9
8	[2] 4	44.4	[2] 12	63.2	[2] 1	10	[2] 15	40.5
9	[2] 2	20	[2] 8	25	[2] 4	40	[2] 12	26.7
10	5	55.6	14	46.7	[2] 4	44.4	[2] 17	45.9
Total	35		141		37		165	
Mean of 10 quadrats	3.5	36.7	14.1	43.7	3.7	38.1	16.5	43.8
Mean of 20 quadrats	3.8	41.0	13.8	46.5	3.6	37.0	15.4	48.0
Mean of 30 quadrats	3.9	39.1	14.4	45.7	3.6	36.4	15.5	41.3

HITS ON GRASSES

1	6	60	25	54.4	[2] 5	50	[2] 23	54.8
2	5	50	[2] 15	35.7	[2] 3	30	[2] 15	51.7
3	7	77.8	26	81.3	6	60	24	66.6
4	6	60	14	38.9	[2] 4	44.4	[2] 19	46.3
5	5	55.6	11	42.3	4	40	10	29.4
6	5	50	21	61.8	8	80	22	64.7
7	9	100	18	78.3	[2] 5	55.6	[2] 18	40
8	[2] 4	44.4	[2] 6	31.6	[2] 8	80	[2] 20	54.1
9	[2] 7	70	[2] 23	71.9	[2] 6	60	[2] 32	71.1
10	4	44.4	16	53.3	[2] 4	44.4	[2] 18	48.6
Total	58		175		53		201	
Mean of 10 quadrats	5.8	61.2	17.5	54.9	5.3	54.4	20.1	52.7
Mean of 20 quadrats	5.2	57.4	15.2	52.1	5.5	57.3	19.1	53.5
Mean of 30 quadrats	5.3	57.0	16.6	53.3	5.6	57.8	20.5	55.0

HITS ON ALL FORBS

Mean of 10 quadrats	0.2	2.1	0.4	1.3	0.7	7.2	1.4	3.7
Mean of 20 quadrats	.1		.4		.4		1.1	
Mean of 30 quadrats	.1		.3		.6		1.4	

[1] In this and subsequent tables A is used to indicate only the first hit on vegetation tabulated; B to indicate all hits on vegetation tabulated, as needle is pushed to the ground, irrespective of whether a given plant is hit once or oftener.

[2] One or more hits on forbs were obtained in this quadrat. Although not listed separately in a table because of their relative unimportance to the study as a whole, the hits on forbs were included in calculating percentage composition of lespedeza and grasses. These small percentages of forbs therefore account for the apparent discrepancies in the composition figures for lespedeza and grasses.

COMPARISON OF DIFFERENT METHODS OF USING THE POINT-QUADRAT APPARATUS FOR BOTANICAL ANALYSIS

PROCEDURE

In larger areas of the same pasture that was described in the first section of this report, a more extensive investigation was directed at comparing the 4 different applications of the point-quadrat method to which reference has already been made. Ten sample areas had been selected previously and covered with wire cages (approximately 4×4 feet) to exclude grazing animals. During early July, and again in August, the point-quadrat apparatus was set up at random in 2 separate places within the sample area. Readings were first taken with the needles inclined at an angle of 45°, and 2 sets of data, as before, were recorded. Without moving the front supports, the needles were then set vertically, and a second set of data was obtained. Following the completion of such readings, a rectangular area (6×19 inches), equivalent to that covered by vegetation through which the inclined needles passed, was carefully clipped, and the species later separated by hand. This procedure was repeated for the other set on the same plot, and then for each of the remaining 9 similar plots. A total of 200 needles for each of the 4 methods was thus obtained.

In August after the vegetation had had a month of undisturbed growth, the foregoing procedure was repeated for each sample area, except that the parts previously harvested were avoided in making the tests. By August the vegetation had attained a fairly uniform height of 6 inches, whereas in July the general level had been 4 inches. Since the vegetation was 2 inches taller in August, a slightly larger rectangular area (8 × 19 inches) was harvested for dry-weight determinations. By using such small harvested areas it was hoped that the correlation of percentage composition between the oven-dry weight, for a given element of the vegetation, and that determined by point-quadrat methods would be more precise, a relationship well demonstrated by the work of Arny and Schmid.[9] Furthermore, if greater precision were thus attained, the relative merits of the four methods tested would be thrown into sharper contrast and be of proportionately greater significance.

RESULTS

The data given in tables 4 and 5 summarize for lespedeza the results for July and August obtained by using the 4 techniques available with the point-quadrat method. Number of hits and percentage composition per quadrat (set of 10 needles) for lespedeza are here indicated. While the mean percentage composition contributed by lespedeza in July varies considerably with the method used, the standard deviation and standard errors clearly indicate that a more reliable result is obtained by recording all hits (method B), irrespective of whether the needles are vertical or inclined at an angle of 45°. Moreover, by comparing with these results the figures for July on percentage composition of lespedeza on a dry-weight basis (table 4) the greater reliability of this method (B) of counting all hits is further substantiated. The data for July appear to indicate that somewhat more satisfactory results can be obtained with the inclined method

[9] See footnote 6.

than with the vertical one, but the August data fail to confirm this finding. It should be recalled, however, that the vegetation in August was a good 2 inches taller, suggesting the possibility that in a vertical position the taller, flat-bladed lespedeza might have been hit more often than if the needles had been inclined.

TABLE 4.—*Summary of data obtained in point-quadrat determinations for lespedeza in July*

Quadrat No.	Needles straight				Needles inclined 45°				Lespedeza composition (dry-weight basis)	
	A		B		A		B			
	Hits	Composition	Hits	Composition	Hits	Composition	Hits	Composition		
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Grams*	*Precent*
1	[1] 3	33.3	[1] 11	31.4	4	40	[1] 18	51.4	8.2	46.1
2	[1] 6	60	[1] 22	62.8	4	40	[1] 27	56.2	11.5	63.8
3	[1] 3	30	[1] 21	52	4	40	[1] 27	60	5.3	43.3
4	5	50	16	57.1	5	50	20	57.1	6.6	59.9
5	5	50	15	46.9	4	40	27	56.2	6.8	51.9
6	[1] 5	55.6	[1] 13	44.8	[1] 6	54.5	[1] 24	55.8	6.5	55.56
7	7	70	[1] 25	73.5	7	70	22	53.6	7.5	63.8
8	5	50	22	61.1	7	70	22	59.4	9.3	76.3
9	6	60	23	69.7	8	80	33	70.2	7.4	72.3
10	6	60	27	65.8	6	60	21	55.2	6.9	62.8
11	7	77.8	15	55.6	8	80	33	78.6	7.0	71.6
12	6	60	29	69.05	8	80	33	73.3	9.4	82.3
13	[1] 5	50	[1] 21	60.0	[1] 5	50	[1] 20	54	6.8	56.7
14	8	80	23	62.2	8	80	30	71.4	9.0	73.6
15	6	60	18	54.5	4	40	35	72.9	4.0	68.4
16	7	70	[1] 36	85.7	[1] 7	70	[1] 38	80.8	9.3	71.7
17	[1] 3	30	[1] 18	47.4	[1] 4	40	[1] 21	48.8	7.7	60.6
18	3	30	21	47.7	[1] 4	40	[1] 34	68	9.8	64.6
19	6	60	27	69.2	5	50	28	70	11.8	75.4
20	7	70	[1] 24	60	[1] 3	36	[1] 22	59	5.0	51.9
Total	109		427		111		535		158.8	
Mean	5.5	58.6	21.4	58.9	5.6	55.5	26.8	62.1	7.9	64.1
Standard deviation		15.24		12.19		16.55		9.96		9.77
Standard error		3.41		2.70		3.70		2.23		2.18

[1] 1 or more hits on forbs were obtained in this quadrat. See footnote 2 of table 3.

The data for the grasses are given in tables 6 and 7. As in the case of lespedeza, these results indicate that for the grasses involved the counting of the total number of hits (method B) is more accurate than merely listing the first species hit per needle (method A). Standard deviations and standard errors both bear out this assertion. Moreover, the inclined method, under the conditions prevailing in July appeared to give slightly better estimates for the percentage composition furnished by grasses, as judged from the data for dry weight of grasses, given in table 6. The figures for August parallel those for lespedeza in showing that the most reliable results were obtained by counting the total hits when the needles were in a vertical position, but the differences obtained by this method and that in which the needles are inclined were slight. Both methods, as compared with dry-weight percentage figures, gave reliable results.

TABLE 5.—*Summary of data obtained in point-quadrat determinations for lespedeza in August*

Quadrat No.	Needles straight				Needles inclined 45°				Lespedeza composition (dry-weight basis)	
	A		B		A		B			
	Hits	Composition	Hits	Composition	Hits	Composition	Hits	Composition		
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Grams*	*Percent*
1	4	40	15	40.5	[1] 2	20	[1] 14	31.8	5.6	34.8
2	2	20	29	49.2	2	20	22	37.9	6.0	38.6
3	3	30	32	61.5	5	50	34	52.3	8.6	50.4
4	6	60	32	53.3	2	20	22	35.5	8.8	47.8
5	4	40	38	64.4	5	50	43	55.1	15.4	67.5
6	6	60	38	58.5	6	60	[1] 44	61.1	12.4	59.9
7	7	70	55	76.4	8	80	45	73.8	15.9	69.7
8	6	60	49	70	3	30	37	62.7	12.5	62.2
9	4	40	32	64	4	40	48	68.6	14.3	67.8
10	6	60	28	73.1	6	60	46	61.3	12.5	63.4
11	8	80	48	81.4	7	70	56	81.2	18.2	84.2
12	7	70	39	65	1	10	45	57.7	11.2	54.3
13	5	50	31	58.5	6	60	40	72.7	11.7	64.8
14	4	40	30	50	3	30	31	50	9.7	47.8
15	4	40	39	63.9	3	30	33	60	11.0	56.4
16	6	60	37	67.3	2	20	38	52.0	14.6	58.6
17	5	50	43	68.3	5	50	40	72.7	11.5	65.3
18	5	50	60	77.9	7	70	60	73.2	14.7	68.1
19	5	50	47	70.1	3	30	38	57.6	11.4	57.9
20	4	40	45	70.3	5	50	51	73.9	10.5	61.4
Total	101		777		85		787		236.5	
Mean	5.1	50.5	35.9	64.2	4.3	42.5	39.4	60.2	11.8	59.0
Standard deviation		14.68		10.32		20.23		13.64		11.35
Standard error		3.28		2.31		4.52		3.05		2.53

[1] 1 or more hits on forbs were obtained in this quadrat. See footnote 2 of table 3.

TABLE 6.—*Summary of data obtained in point-quadrat determinations for grasses in July*

Quadrat No.	Needles, straight				Needles, inclined 45°				Grass composition (dry-weight basis)	
	A		B		A		B			
	Hits	Composition	Hits	Composition	Hits	Composition	Hits	Composition		
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Grams*	*Percent*
1	[1] 5	55.5	[1] 23	65.7	6	60	[1] 15	42.8	8.7	48.8
2	[1] 3	30	[1] 12	34.2	6	60	[1] 20	41.7	6.5	36.0
3	[1] 5	50	[1] 17	42	6	60	[1] 16	35.5	4.4	44.2
4	5	50	12	42.8	5	50	15	42.8	4.4	39.9
5	5	50	17	53.1	6	60	21	43.8	6.2	47.3
6	[1] 2	22.2	[1] 13	44.8	[1] 4	36.4	[1] 18	41.8	4.9	41.9
7	3	30	[1] 8	23.5	3	30	19	46.3	4.1	34.9
8	5	50	14	38.9	3	30	15	40.6	2.8	23.0
9	4	40	10	30.3	2	20	14	29.8	2.8	27.3
10	4	40	14	34.1	4	40	17	34.7	3.9	36.1
11	2	22.2	12	44.4	2	20	9	21.4	2.7	27.6
12	4	40	13	30.95	2	20	12	26.7	2.0	17.5
13	[1] 3	30	[1] 7	20.0	[1] 2	20	[1] 7	18.9	2.1	17.5
14	2	20	14	37.8	2	20	12	28.6	3.1	25.3
15	4	40	15	45.5	6	60	13	27 1	3.1	30.3
16	3	30	[1] 5	11.9	[1] 2	20	[1] 7	14.9	3.2	24.7
17	[1] 6	60	[1] 17	44.7	[1] 5	50	[1] 21	48.8	4.9	38.6
18	7	70	23	52.3	[1] 5	50	[1] 15	30	5.2	34.2
19	4	40	12	30.8	5	50	12	30	3.8	24.3
20	3	30	[1] 15	37.5	[1] 6	60	[1] 21	47.7	4.6	47.8
Total	79		273		82		299		83.4	
Mean	3.95	40.0	13.7	38.3	4.1	40.3	14.95	34.7	4.2	33.4
Standard deviation		13.52		12.21		16.86		9.99		9.82
Standard error		3.02		2.73		3.77		2.23		2.19

[1] 1 or more hits on forbs were obtained in this quadrat. See footnote 2 of table 8.

TABLE 7.—*Summary of data obtained in point-quadrat determinations for grasses in August*

Quadrat No.	Needles, straight				Needles, inclined 45°				Grass composition (dry-weight basis)	
	A		B		A		B			
	Hits	Composition	Hits	Composition	Hits	Composition	Hits	Composition		
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Grams*	*Percent*
1	6	60	22	59.5	[1] 7	70	[1] 27	61.4	10.3	64.0
2	8	80	30	50.8	8	80	36	62.1	9.5	61.1
3	7	70	20	38.5	5	50	31	47.7	8.4	49.2
4	4	40	28	46.7	8	80	40	64.5	9.6	52.1
5	6	60	21	35.6	5	50	35	44.9	6.6	28.9
6	4	40	27	41.5	4	40	[1] 27	37.5	7.0	33.8
7	3	30	17	23.6	2	20	16	26.2	6.9	30.2
8	4	40	21	30	7	70	22	37.3	7.6	37.8
9	6	60	18	36	6	60	22	31.4	6.8	32.2
10	4	40	14	26.9	4	40	29	38.7	7.2	36.5
11	2	20	11	18.6	3	30	13	18.8	3.4	15.8
12	3	30	21	35	9	90	33	42.3	9.4	45.6
13	5	50	22	41.5	4	40	15	27.3	6.2	34.3
14	6	60	30	50	7	70	31	50	10.5	51.8
15	6	60	22	36.1	7	70	22	40	8.5	43.6
16	4	40	18	32.7	8	80	35	48.0	10.3	41.4
17	5	50	20	31.7	5	50	15	27.3	6.1	34.7
18	5	50	17	22.1	3	30	22	26.8	6.9	31.9
19	5	50	20	29.9	7	70	28	42.4	8.3	42.1
20	6	60	19	29.7	5	50	18	26.1	6.6	38.6
Total	95	-------	418	-------	114	-------	517	-------	156.1	-------
Mean	4.8	50.0	20.9	35.8	5.7	57.0	25.9	40.0	7.8	40.3
Standard deviation	-------	14.68	-------	10.32	-------	19.76	-------	13.03	-------	11.45
Standard error	-------	3.28	-------	2.31	-------	4.42	-------	2.91	-------	2.56

[1] 1 or more hits on forbs were obtained in this quadrat. See footnotes of table 3.

From the data given in tables 4, 5, 6, and 7, it is clear that, at least for the heights of vegetation considered, there is no necessity for the computation of correction factors. These might be required, however, for a finer-leaved grass element.

Although some forbs were sampled and their percentage composition calculated as for lespedeza and the grasses, the mean percentage, as determined on a dry-weight basis, was 2.4 for July and 0.67 for August. Therefore it does not seem necessary to consider them in detail. In general, it might be remarked that the percentage composition of the vegetation furnished by forbs was more accurately sampled by the inclined-point method wherein all hits were tabulated.

A consideration of the factors of time and ease of operation of the various methods was outside the immediate objective of this study. Yet, as shown by other investigators, including Tinney, Aamodt, and Ahlgren,[10] the use of the point-quadrat method, regardless of what special application may be made of the apparatus for a particular investigation, is definitely time- and labor-saving as compared with most other methods of botanical analysis. So far as counting all hits versus counting only the first plant hit per needle is concerned, the latter method is undoubtedly the more rapid; but, as indicated by the general results of this study, greater accuracy is obtained by counting all hits per needle as the latter is pushed into the soil. The

[10] See footnote 4.

particular method to be employed will depend to a considerable extent on the degree of accuracy required in a given investigation.

SUMMARY

During July and August 1942 a study of the uses of the point-quadrat method of botanical analysis of a lespedeza-grass pasture mixture was undertaken (1) to determine the relative merits of this general method as compared with those of the count-list method, and (2) to ascertain the relative efficiency of four different applications of the point-quadrat method, for the same vegetation.

In a study made on one-half-square-meter quadrats, the results, though not subjected to statistical analysis, indicate that, for the vegetation analyzed, all four applications of the point-quadrat method yield more satisfactory results than the count-list method, assuming that weight-list data furnish a satisfactory basis of comparison. Moreover, no tendencies toward underhitting of the legume or overhitting of the grass were indicated in the results so that evaluation of correction factors do not appear necessary.

Results obtained from studies carried out in July and August, suggest that on the low-growing vegetation of the tests, the counting of all hits as the needles of the point-quadrat apparatus are pushed through the plants to the ground yields more reliable results than merely recording the first plant hit by each of the 10 needles. For the lower-growing (about 4 inches tall) vegetation in July, the inclined-point method gave more satisfactory results, as judged from calculated standard errors, than the straight method. Yet, in August, with the vegetation some 2 inches taller, the reverse appeared to be true. Height of the vegetation, as well as the morphology of the species involved, thus appeared to influence the manner of the use and the evaluation of results obtained by means of the point-quadrat method. Thus, it is likely that the most satisfactory method of botanical analysis will vary with the type of vegetation, and that this method should be evaluated on the basis of repeated trials.