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Comparing Different Methods of Measuring the Coverage of *Salsola Laricina* in the Steppe Region of Rudshur Saveh

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ABSTRACT ─ In this study, the coverage of *Salsola laricina* was investigated with three methods of estimation quadrat, point-contact and linear contact to compare the efficacy of these methods in terms of accuracy, precision and time in the steppe region of Rudshur Saveh. Based on the index of Morisata, *Salsola laricina* has uniform dispersion pattern in the study area. To compare the coverage estimation method with control, the student t-test was used. All three used methods with control quadrat method in high-density and low-density are as follows: In the case of high-density, all methods of point-contact and linear contact and estimation in quadrat respectively show the closest estimation compared to the control that in fact there is a significant difference in the level of 0.1 percent and there is not a significant difference in low density of point-contact method compared to the control (Quadrat method) and there is a significant difference in linear contact method in the level of 0.1 percent compared to the control and there is a significant difference in the level of 1 percent in estimation method in quadrat. Therefore, in the case of high-density, the estimation method in quadrat in terms of accuracy of coverage has been estimated and time is the best approach and in low density, linear contact method in terms of accuracy of estimated coverage is suggested as the best method. But in terms of time, estimation method in quadrat in both cases of high-density and low-density is the recommended method. This method is the easiest way to identify the vegetation, but the level of estimation is dependent on the skill and experience of the people.
KEYWORDS: coverage, measurement methods, *Salsola laricina*, Rudshur Saveh

Introduction

Coverage often used as an important trait in vegetation studies and its measuring as a non-destructive method is the basis of comparison between vegetative forms of different plants (Cook and Estabandyk, 1986). Measuring coverage level in range habitat is very important and inevitable, because coverage level is used to determine the status of production and soil conservation and watershed. Covering a species is occupied level by its vegetative components. There are other definitions. For example Duben Mayer said that coverage is an estimation of the surface that a plant exerts its effect on other components of the ecosystem and it is not an estimate of the level of shading. In other words, the plant may be present but only surface to be measured. In other words, plants may be presented but just their effect is measured. Inflorescence of plants often excluded from this definition because they are relatively unstable. Seedlings of perennial plants sometimes excluded because they may be lead to overestimation of coverage after growth in dry areas (Asri, 2005). Hoda et al (1959) compared two methods of point-contact on the line of transect and linear transect about a variety of plant species in California and found that both of these methods are suitable for measuring the degree of coverage and vegetation composition and there isn't observed a significant difference in statistical analysis in the mean of coverage level. Payn (1974) showed that determination of the coverage level is a good indicator for estimating production of grass and broad-leaved. He found a significant relationship about 0.9 between canopy coverage and weight of grasses of 16 species. Janbaglu (1085) compared quadrat methods, visual estimation, the contact of spot on the line, linear contact, sampling point, estimate, ruler of meter diameter, use of ring and rod and loop method in three regions of Rudshur, Hamand Absard and Polur and concluded that in the enclosure of Rudshur that is an example of plant communities of steppe rangelands with dry and cold weather of region of Iran - Turani, the suitable and recommended method is quadrat 1*1 meters. In enclosure of Hamand Absard that is the semi steppe rangelands of region of Iran - Turani, the method of counting using quadrats of the point-contact on the line of transect of 50 meters and frame of ten-point in terms of desired result in terms of the percentage of coverage and ease of use is recommended. In addition, in the enclosure of Polur with weather of dry forests with cold winters of Iran- Turani region, quadrats of 60 * 25 cm and 1 * 1 meter due to the low of coefficient of variation and error of criteria and range of trust and approximate equality of obtained figures in the statistical calculations is the suitable and

recommended method for measuring level of coverage. Arzani (1989) and Saeedfar (1994) obtained the relationship between canopy coverage, foliage coverage and basal area with the production in a number of perennial species in arid and semi-arid region of Iran. Erfanzadeh (1998) compared four measurement method of coverage involves wheel spot, ten-spot frame in inside and outside of quadrat, spotted transect and spotted step in two meadow communities in the park of Golestan and shrubbery of Bajestan of Khorasan province. Rabie (2008) in the steppe region of Khojir National Park compared three methods of mapping, linear contact and point-contact for coverage estimation and concluded that linear contact shows the closest estimate of coverage to control. Kaviani (2009) in a study investigated the coverage of sagebrush in steppe region of Rudshur Saveh and concluded that estimation methods in quadrat, point-contact and linear contact showed a significant difference in the level of 0.1% with control. Hashemi (2010) investigated estimation methods in quadrat, point-contact and linear contact in three districts of Hassan Abad, Akram Abad Kiyanpour and Yousef Abad Ghaffari that in all three areas quadrat method showed the nearest coverage to the control and estimation method has a little difference in quadrat with control, linear contact in this area showed a lot of differences with control and not considered a proper method for the coverage in these areas therefore for measuring coverage, quadrat method is recommended in all three regions.

In this study, the coverage of Salsola laricina with three methods of estimation in quadrat, linear contact and point-contact to quadrat (control) method to compare the efficacy of these methods in terms of accuracy, precision and time in steppe region of Rudshur Saveh was studied.

Materials and methods

The position of the study area

Rudshur enclosure is located in south of Robat Karim in 60 kilometers of Tehran-Saveh road with an area of 30 hectares and the position 53' 50˚ east longitude and 26' 35˚ north latitude. Height of enclosure is about 1120 meters above sea level. In the steppe region the average annual rainfall is about 204.6 mm. Absolute maximum and minimum of temperature, is -18 and 44.5 ° C, respectively and the average number of frost days per year is about 62 days. Almost dry season begins in early April and will continue until mid-October (figure 1). The soil of Rudshur enclosure in terms of classification is of brown eroded soils and their primary ingredients are old alluvial. The soils in terms of appearance are among the plateaus. Surface soil with loamy clay texture is placed on the soil with heavy texture of gravel. Soil depth is relatively high and does not exceed one meter. Soil pH of this region is 7.7. The enclosure is constructed from 1965 and is prevented from the arrival of the animals inside the enclosure. Outside the enclosure cattle is grazing continuously during winter and spring. The predominant species are *Artemisia sieberi* and in inside are *Artemisia sieberi*, *Salsola laricinia* and *Stipa hohenackeriana* (Akbarzadeh, 2005).

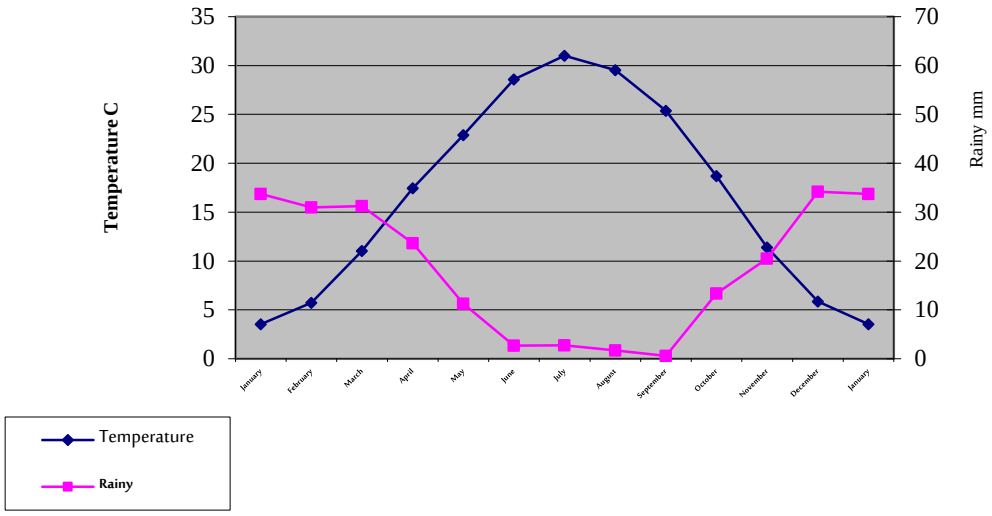

Figure 1. Curve of Ambrotik of weather station of Amin Abad according to 40-year static (2005-1965)

Sampling Method

First, to determine the size of optimum quadrat to sampling Salsola laricina, Vigret method was used (Asri, 2005). According to Vigret, optimum quadrat size or shape is related to quadrat that the multiplication of relative cost (the minimum time required to take a sample / the required time to take a sample) and relative variance [(the minimum standard deviation)^2 / (SD) ^{2}] is minimum. Then to determine the dispersion pattern of sagebrush, Morisita indicator was used in the study area (Asri 2005). This index is one of the best criteria for the distribution of plants because it is independent of population density and the number of quadrat. For this purpose, 30 quadrates in the size of 3 × 3 m (obtained size from Vigret method) were randomly deployed in the area. In each of the quadrates, the number of Salsola laricina plants was counted. Using a set of measured values on plants (x_i) in the set of quadrates was obtained two ranges for Morisita index by the following equations:

$$M_u = \frac{X^2_{0.975} - n + \Sigma x_i}{(\Sigma x_i) - 1}$$: Dispersion index

$X^2_{0.975}$ = Chi-square value of the table with degree of freedom (1-n) that is with 97.5% area on the right.
X_i= The number of plants in quadrat i (, n ...., 3,2,1 = i)
n= The number of quadrats

$$M_c = \frac{X^2_{0.025} - n + \Sigma x_i}{(\Sigma x_i) - 1}$$: Clumped index (cumulative)

X^2_{0025}= Chi-square value of the table with degrees of freedom (1-n) that is with 2.5 percent area on the right.

After determining the distribution pattern of sagebrush bushes in the area, appropriate methods with this model was used to determine the coverage level. First, four ranges were selected with the area of one hectare and border of each area was determined by the rope. In each of the ranges, for all Salsola laricina plants by measuring two perpendicular diameters, canopy of coverage was calculated. The obtained coverage from this way was considered as the control and the estimated coverage using other methods were compared with the control. Coverage measurements in this study were: the linear contact, the point-contact and estimate in the quadrat. In the linear contact, 25 baselines to a distance of 100 meters from each other and to the length of 50 meters with four transect of 15 meters perpendicular to the baseline were considered. Then a rope above the canopy of plants coverage was tight strongly and length of a part of Salsola laricina plants that had contacted with the rope was measured. In the spotted contact, 30 quadrats with 3 × 3 m randomly were deployed in the enclosure. Inside each of the quadrates, three-spot frames of one meter for measuring coverage level were in the proximity of each other and the contact of rods with Salsola laricina plants was recorded. In the estimation method, first 30 quadrats with the size of 3 × 3 meters accidentally were placed in the enclosure and then inside them, occupied level by Salsola laricina plants was estimated to quadrat.In order to investigate the obtained coverage level, the relative difference of estimated coverage in any way with control means the coverage estimation error in each method was calculated. The more relative difference of estimated coverage level with control (coverage estimated with considered methods minus the obtained actual coverage of the control method on the actual coverage) in any way is less, the considered method has higher accuracy (Mousaee, 2004).

Results

Optimal quadrat size for sampling Salsola laricina in this region was obtained 3 × 3 m (Table 1).

Table 1. Determine the size of optimal quadrat in Vigret method

Quadrat size (meter)	The number of required quadrats for sampling level of 80 sqm	Standard deviation	Time spent for a sample (min)	Relative variance	Relative cost	Multiplication
1×1	80	6.71	0.45	4.21	1.02	4.29
2×2	20	4.62	0.88	2.78	1.98	5.50
3×3	9	4.46	1.13	1.22	3.27	3.98
4×4	5	7.62	1.82	1.38	4.35	6.00

By counting the number of Salsola laricina plants in established quadrats, Morisita dispersion index was calculated as follows:

$$I_d = n\left[\frac{\Sigma x^2 - \Sigma x}{(\Sigma x)^2 - \Sigma x}\right] = 0.019$$

Calculating two values of range using relationship related to evenness and accumulation index:

$$M_u = \frac{x^2_{0.975} - n + \Sigma x_i}{(\Sigma x_i) - 1} =$$

= 0.953 Evenness index

$$M_c = \frac{x^2_{0.025} - n + \Sigma x_i}{(\Sigma x_i) - 1} =$$

=1.062 Accumulation Index

Regard that $1>M_u>l_d$, so:

$$I_p = -0.5\left[\frac{I_d - M_u}{M_u}\right] = 0.490$$

Because the value of standard index of Morisita is less than 5.0, can have 95 percent confidence that the studied Salsola laricina in sampling quadrates has uniform distribution. The mean of actual coverage level of Salsola laricina using measuring small and large diameter of all plants in four macro quadrat ten in ten square meters was estimated in both high-density and low-density that the basis of coverage was control. Accordingly, the scope of coverage in high density state is 24.15 percent and in the high-density and low-density is 185.6 percent. Estimated coverage in different ways by Student t- test with software (version 14) SAS were compared with control (Table 2 and Table 3). The results show that among methods the maximum estimated coverage is related to estimation method in quadrat (8.42 percent). In high density state, the estimation methods in quadrate, linear contact and point-contact showed a significant difference in the level of 0.1 percent to control and in low-density, the difference isn't significant in point-contact compared to control, in the linear contact, the difference is significant in the level of 0.1% compared to control and in estimation method in quadrat, the difference is significant in the level of 1 percent.

Table 2. Estimated coverage Salsola laricina based on different methods in high-density

Estimation methods of coverage	The values estimated coverage	**p-value**	Test result
Quadrat control method in high-density	24.15		
Linear contact	8773.4	0	***
Spotted contact	593.4	0	***
Estimation in the quadrat	42.8	0	***

ns= The difference is not significant *= significant difference at the 5% level, ** = significant difference at 1%, *** = significant differences in the level of 0.1%

Table 3. Estimated coverage Salsola laricina based on different methods in low-density

Estimation methods of coverage	The values estimated coverage	**p-value**	Test result
Quadrat control method in low-density	185.6		
Linear contact	8773.4	0	***
Spotted contact	593.4	096.0	NS
Estimation in the quadrat	42.8	003.0	***

ns= The difference is not significant *= significant difference at the 5% level, ** = significant difference at 1%, *** = significant differences in the level of 0.1%Comparing the accuracy of coverage among the used methods shows that in high-density state, the most accurate method of estimation of coverage is estimation method in quadrat and point-contact has the most relative

difference with control (Table 4) In the low density, linear contact is the most accurate method to estimate the coverage among methods and estimation method in quadrat has the highest relative difference to control (Table 5).

Table 4. Comparing the accuracy of estimation methods of coverage of Salsola laricina in high-density

Methods	Accuracy
Spotted contact	-67.0
Linear contact	-69.0
Estimation in quadrat	-0.44

The negative number indicates lower density of considered method compared to the control and the positive number indicates higher density of used method compared to the control.

Table 5. Comparing the accuracy of estimation methods of coverage of Salsola laricina in low-density

Methods	Accuracy
Spotted contact	-0.21
Linear contact	-25.0
Estimation in quadrat	-36.0

The negative number indicates lower density of considered method compared to the control and the positive number indicates higher density of used method compared to the control.
The least spent time among the coverage estimation methods of estimation method in quadrate with the time of 2.52 minutes and the highest time is related to point-contact with the time of 4.07 (Table 6).

Table 6: Comparing time in different methods of estimating coverage of Salsola laricina

Methods	Maximum (min)	Mean(min)	Minimum(min)
Estimation in quadrat	3.41	2.52	2.17
Spotted contact	4.59	4.07	3.29
Linear contact	4.50	3.28	3

Discussion and conclusion

Various factors causes to make difference in responding of different methods of coverage estimation that the following can be cited: the important factor is distribution patterns of plants, so that steady rise reduces the number of required samples and effects in the spent time. The next factor is the nature of method. Janbaglu (1985) has proved the methods of linear contact and point-contact from the standpoint of calculating the coverage percent and ease. Borhani et al (2001) offered wheel-spot method for estimating the level of coverage in Mute and Alavijeh regions.

In the present study the obtained Salsola laricina coverage on the basis of estimation methods of Salsola laricina coverage in high-density and low-density mode is as follows: In the case of high-density, all methods of linear contact and point-contact and estimation in quadrat show the closest estimate, respectively, compared to control in fact, they have a significant difference in the level of 0.1 percent and in low density of point-contact compared to the control (quadrat method), the difference is not significant, linear contact at the level of 0.1% as compared to the control, the difference is significant and in the estimation method in quadrat, difference is significant at 1 percent, in high-density mode, estimating method of quadrat in terms of accuracy of coverage has been estimated and time is the best method and in low density, linear contact method in terms of accuracy of estimated coverage is suggested as the best method. But in terms of time, estimation method in quadrat in both high-density and low-density is a recommended method. Judgment in the effectiveness of used methods depends on the considered criteria by researcher. This criterion may be less spent time, more accuracy or a combination of these two criteria. Pearson and Sternitzak (1974) stated that methods used to study the coverage should provide in the less time the considered accuracy. If the criterion is time in the plant of Salsola laricina, estimation in quadrat is suggested for coverage estimation, but if the criterion is precision, the control method is more accurate than other methods, though that the method is time-consuming. This study shows that the priority of each method can be determined for each species separately.

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