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Study of distribution pattern and density of vegetative cover in steppe and forest areas of Isfahan University of Technology

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ABSTRACT

Since density is considered as one of the most important numerical indices to explain quantitative values of a plant community by affecting on many aspects and activity of ecosystem, on the other hand, awareness about plants distribution pattern in environment is an essential preparation for measurement and study of vegetative cover, therefore, in this research determination of density and distribution pattern of vegetative cover were carried out in two forest and steppe areas of Isfahan Industrial University using plots and distance methods. The results explained that, distribution pattern of vegetative cover of forest area had a uniform distribution so that, Point quarter, Ordered distance and T-square methods had a smaller standard error respectively. In the steppe area with bulk distribution pattern, standard error was less in Point quarter, Ordered distance, T-square and plot respectively. On the other hand in forest area, density resulted from Ordered distance, T-square, plot and Point quarter methods were respectively close to the real density. While in the steppe area, density resulted from Point quarter, Ordered distance, T-square and plot methods were respectively close to the real density.

Key words: Density, Distribution pattern, plot, forest, steppe, Isfahan Industrial University

INTRODUCTION

Human ability to protect or management of plant species is limited due to lack of adequate information about their different reactions to environment disruptive factors. So, more studies are needed to quantify distractive factors of plan communities (Bratton, 1985) Protective management needs understanding plant community status (in nature condition) in both community situations of being destructed or growing (Pavlik and Barbour, 1988). Density measurement and determination of distribution pattern of vegetative cover back to antiquity. In 20th century BC, Teofrust observed that, there are some certain relationships

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between plants and their environment so, he was the first person who considered plants ecology of quantitative approach (Bonham1989). In order to compare estimation methods of distribution pattern of vegetative cover and density, two factors including accuracy and time are required. Density is one of the most important characteristics of a population so that this measure is an important numerical index to explain quantitative values of a plant community. This characteristic is important since affects many aspect and activities of the ecosystem (Ardekani, 2004). Density is important to evaluate tree and shrub communities while it is less important for grasses and herbaceous broadleaf, in other words, counting is more common in sparse and distant vegetative cover (Bonham,1989) On the other hand, knowledge of plants distribution pattern in environment is an essential preparation to measure and studying vegetative cover. In general, these patterns are divided to two categories including random and non-random (uniform and bulk). Uniform or regular distribution is achieved when the scopes are certain and conditions of distribution ranges are equal and same. Therefore, it can be said that, uniform pattern of distribution of a species in the same conditions. Bulk or disordered distribution is observed when there is a general tendency to accumulate in a plant community, it means when the presence of a person in a place depends on the presence of others in the same place (Pearson and Sternitzke, 1974). The objective of this research was to compare sampling methods using plot and without plot to estimate density and to determine distribution pattern of vegetative cover in the forest area of Isfahan Industrial University in 1389.

MATERIALS AND METHODS

Study area

The forest of Isfahan Industrial University with an area about 160 hectares was established in 1348 and trees planting was started in 1351. The number of trees was estimated about 160000 and the dominant tree species include pine, acacia, cedar barreled, berries and maple. This ecosystem is considered as a suitable habitat for all kinds of animals due to abundance of food sources and safety. Steppe vegetative cover in the area mostly includes anemone, soil, old wigs, Sheng, wheat flower, sorrel, etc.

Methodology

Considering distribution pattern in forest as uniform and in steppe was very low, so in this research by applying sampling methods using plot and without plot (distance) we evaluated the results of each methods that which method is close to the actual density in the studied ecosystem. For this purpose, the work was started by three times counting the shrubs as sweep in the steppe and in an area with length of 200 m so that each two persons with a distance of one meter and in a same direction by moving along the area counted the correspondent shrubs and each meter was considered as a Transect with a width of 18 m. Therefore, the width of considered Transect was 54 m. In the forest area also, five points were randomly chosen in an area about 0.79 ha of the forest, and the trees were counted using 10*10 plots (100 m2) and their total number was achieved. Measurement in forest was same as steppe but with this difference that, for T-Square method in addition to angles more than 90˚, the trees placed at 90˚ or right point and the distance between them was considered (Afshar,2004). In this research, to determine plants distribution patternin two areas of steppe and forest, goodness of fitting test and to compare achieved actual density through direct counting of trees or shrubs, statistical t-test and equation 1 were used. Finally, by SPSS

software edition 16, One Sample T-Test was used to compare actual density with achieved densities by plot and without plot methods.

$$t = \frac{\bar{x} - \mu}{S_{\bar{x}}} \quad \mu = \frac{NumberofTrees}{Area} \qquad (1)$$

Where:

$S_{\bar{x}}$: Standard error, $\overline{X}$: Mean achieved density, μ : Actual mean

RESULTS

The results of determination of plant distribution pattern by goodness of fitting test explained that, considering value of the index is less than 1, distribution of the species in the area is uniform (Table 1) (Mesdaghi, 1998).

Table 1. Results of determination of plants distribution pattern by goodness of fitting-Test method

Plot- Sampling

$(xi - \bar{x})^2$	$(xi - \bar{x})$	Number of shrubs	Sampling plot
0.04	-0.2	0.7	1
0.64	0.8	0.08	2
0.64	0.8	0.08	3
0.04	-0.2	0.07	4
1.44	-1.2	0.06	5
2.76		Mean= 0.072	

Forest tree density calculation results by T-square, Variable Area Transect, ordered distance and linear Transect methods have been shown in tables 2 to 10.

Table 2. Calculation of trees density in the section 1 of the forest by T-Square method

T-square

xz	T-square distance tree to neighbarzi(m)	Point- to- tree distance xi(m)	Sampling unit
6.71	3.05	2.2	1
3.55	2.15	1.4	2
3.786	2.28	1.36	3
7.42	2.65	2.8	4
8.265	2.85	2.9	5
29.821	13.55	10.66	Summation
	37.192	24.89	Squares summation
	2.71	2.132	Mean

Table 3. Calculation of trees density in the section 2 of the forest by T-Square method

T-square (>90)

xz	T-square distance tree to neighbarzi(m)	Point- to- tree distance xi(m)	Sampling unit
14.99	6.45	2.2	1
9.1	6.5	1.4	2
8.92	6.56	1.36	3
18.48	6.6	2.8	4
19.14	6.6	2.9	5
69.83	32.71	10.66	Summation
	214.006	24.89	Squares summation
	6.542	2.132	Mean

Table 4. Calculation of trees density in the section 3 of the forest by T-Square method

T-square

xz	T-square distance tree to neighbarzi(m)	Point- to- tree distance xi(m)	Sampling unit
6.71	3.05	2.2	1
3.01	2.15	1.4	2
3.876	2.85	1.36	3
7.42	2.65	2.8	4
8.205	2.85	2.9	5
6.84	2.83	2.42	6
5.38	3.8	1.41	7
2.55	3	0.85	8
3.39	2.67	1.27	9
47.42	25.85	16.61	Summation
	75.77	35.07	Squares summation
	2.87	1.84	Mean

Table 5. Calculation of trees density in 0.33 ha of the forest area by Variable Area Trasect method

W(m)	Li (m)	Sampling unit
3	14.8	1
	15.85	2
	13.8	3
	14.5	4
	11.2	5
	70.15	Total

Table 6. Calculation of trees density in 0.33 ha of the forest area by Variable Ordered Distance method

Ri2	Distance to the third measured shrub Ri (m)	Sampling unit
13.69	3.7	1
23.04	4.8	2
17.64	4.2	3
21.16	4.6	4
12.96	3.6	5
88.49	20.9	Total
	4.18	Mean

Table 7. Calculation of trees density in 0.78 ha of the forest area by Variable Ordered Distance method

Ri2	Distance to the third measured shrub Ri (m)	Sampling unit
13.69	3.7	1
23.04	4.8	2
17.64	4.2	3
21.16	4.6	4
12.96	3.6	5
15.21	3.9	6
11.83	3.44	7
15.36	3.92	8
21.25	4.61	9
152.15	36.77	Total
	4.08	Mean

Table 8. Calculation of trees density in 0.33 ha of the forest area by Line Intercept method

$\frac{1}{Wi}(m)$	Wi (m)	Number
3.33	0.3	1
2.27	0.44	2
3.33	0.3	3
3.84	0.26	4
12.77		Total

Table 9. Calculation of trees density in 0.33 ha of the forest area by Point-Quarter method

44	43	42	41	Sampling unit
3.7	4.33	2.97	2.2	1
4.9	4.7	2.1	1.4	2
5.4	0.05	2.2	1.26	3
4.05	3.17	3.35	2.85	4
4.75	3.6	3.02	2.9	5
105.82	63.85	38.413	25.18	$\text{Sum}(rij^2)$

Table 10. Calculation of trees density in 0.78 ha of the forest area by Point-Quarter method

44	43	42	41	Sampling unit
3.7	4.33	2.97	2.2	1
4.9	4.7	2.1	1.4	2
5.4	0.05	2.2	1.36	3
4.05	3.17	3.35	2.85	4
4.75	3.6	3.02	2.9	5
4.1	3.9	2.92	2.31	6
3.44	4.74	2.83	1.2	7
3.2	4	3.92	2.3	8
4.61	4.7	2.83	2	9
165.96	164.52	78.32	41.24	$\text{Sum}(rij^2)$

In order to calculate actual density in steppe and forest, density, variance and standard error were achieved by related equations after collecting data by plot and without plot methods. Therefore, single sample T-Test was used to test this assumption that there is no difference between actual density and calculated density (Tables 11, 12).

Table 11. Comparison of steppe plant density calculation methods by single sample T-Test

p	t	DtorNt	$S_{\overline{X}}$	Method
0.0176	2.68	1.04	0.21	T-square
0.0366	2.31	0.71	0.1	Ordered distance
		1.35		Variable area trasect
0.0000<0.0001	-37.39	0.288	0.0048	Point quarter
		1.1		Line Intercept

Table 12. Comparison of forest plant density calculation methods by single sample T-Test

p	t	Dt یا Nt	$S_{\overline{X}}$	Method
0.9981	0.0026	0.061	3.008	T-square
0.8439	-0.21	0.05	0.138	Ordered distance
		0.066		Variable area trasect
0.0007	9.4	0.103	0.0053	Point quarter
		0.193		Line Intercept

Table 13. Results of determining bulk distribution pattern in steppe area through plot sampling by T-Student test

p	t	Se	$\overline{X}$
0.7448	0.332	1.99	1.1416

Table 14. Results of determining uniform distribution pattern in forest area through plot sampling by T-Student test

p	t	Se	$\overline{X}$
0.9665	0.0459	0.37	0.07

Table 15. Results of determining cover bulk distribution pattern in steppe area through Transect method by T-Student test

t	Se
1.62	0.20

Table 16. Results of determining cover bulk distribution pattern in steppe area through Transect method by T-Student test

t	Se
0.56	0.6318

DISCUSSION AND CONCLUSION

According to the study results, it was found that the main factor affecting on the accuracy of density estimation methods is the sample size. Sample size also varies by various factors such as distribution pattern and sampling unit size. In the used distance methods, the main effective factor on the sample size was distribution pattern while in quadrates counting; distribution factor was minor and affected by density measure. Therefore, in this case an effective factor on sample size variations which is the sample unit size can be mentioned. Distance methods are fast methods compared with quadrates. But, this principle is not common in various communities and depends on needed size in each method. Quadrates method is a slow method considering desert time, and is a fast method considering staff time and totally, has a low time efficiency which is affected by community density. Totally a certain method to measure density for all plant communities cannot be chosen but, superiority of each method in each community can be determined. Hence, standard error is an important index of methods accuracy and if it has a lower value, its accuracy would be greater. The results of this research explained that, distribution pattern of vegetative cover in the forest area had a uniform distribution so that, Point quarter, Ordered distance, Plot and T-Square methods had smaller errors respectively. In the steppe area with bulk pattern of vegetative cover distribution, standard error was lower in Point quarter, Ordered distance, T-Square and plot methods respectively. On the other hand, in the forest area the density resulted from Ordered distance, T-Square, Plot and Point quarter methods was respectively closer to actual density. While, in the steppe area the density resulted from Point quarter, Ordered distance, T-Square and Plot was respectively closer to actual density.

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