Range Condition Classification Based on Quantitative Characteristics of Vegetation

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Abstract

Change in range condition classes over time are usually the basis for monitoring management effectiveness. Several approaches have been proposed to monitor the range condition classes in relation to a bench mark usually called climax stage. There are some types of range condition classification often included in a range inventory. In this paper, six factors of canopy cover, litter frequency, plant vigour, soil protection percentage, plant composition, and present production as a percentage of indicative state were described for determination range conditions. We have determined range condition classes by using R software. This method was developed by FAO projects in Iran. The relationships between different factors and their scores were determined by linear equations. The vegetation data in field were collected in 20 plots of 25x60 cm by established *F*-shaped layouts. In each plot, species cover percentages, litters, rocks, and bare soils were estimated. Based on our total scores, we got the fair state of range condition. It is possible to create a package in R software to determine condition classes which will be used by range managers and experts.

Key words rangeland monitoring; condition classification; canopy cover.

Introduction

Range condition as an important concept of management was defined as a present status of vegetation of a range site in relation to the climax (Dyksterhuis, 1949). Change in range condition scores over time are usually the basis for monitoring management effectiveness. Several approaches have been proposed to monitor the effects of livestock on the condition of rangelands in relation to a bench mark situation usually called climax stage (National Research council, 1994). Holechek et al. (2011) revised this definition to the state of health and mentioned that there were controversies on bench mark situation selected by different authors as the end point of range conditions. Although selection of climax for assessing range condition is ideal, but in many situation achievement to the climax condition is almost intangible. Perhaps comparing the present status of a rangeland of a key area is more reasonable than the concept of reference area of climax. A key area is a portion of rangeland that serves as an indicative sample of range conditions, or degree of seasonal use (Society for Range management 1989; Holechek et al., 2011). The vegetation of key area plays the role of climax condition in our range condition evaluation. Our methodology of quantifying the range condition classification mostly depends on present situation of vegetation in relation to quantitative measure of key area status. But our bench mark can be easily converted to other actual situations (e.g., climax stage).

In this paper, six factors were described for determination of range conditions, a method that was developed by FAO projects in Iran (FAO, 1971). These factors included: (1) canopy cover, (2) litter frequency**,** (3) plant vigor, (4) soil protection percentage, (5) plant composition, and (6) production percent in relation to indicative key area sample**.** The relationship between different factors and their scores were determined by linear functions (Mesdaghi, 2015). The advantage of our method is the possibility of creating a R package to determine condition classes for range managers and experts.

Methods and Study Site

To describe the range condition of a steppe vegetation of arid region in Iran, vegetation data were collected in 20 plots of 25x60 cm by permanently established *F*-shaped transects fixed by means of pages and metallic tapes (fig. 1). Estimations were made for total aerial cover of all species in quadrate, separate cover and seedling number of each species, litter, rock, and bare soils percentages. All six measured vegetation factors were rated by Table 1. The ratings of range condition classes are shown in Table 2.

Linear functions of X, as percentages and Y, as the scores of each factor were calculated and the score of factors were obtained by interpolation of mean estimated measures into the linear equation extracted from Table 1. All calculations were made by R software.

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Results

The collected data of six factors are shown in Table 3 and by interpolation of estimated mean of each factor in linear equations, scores were obtained (Table 4). The total score of 49.54 was within the class of 50 to 69 and rated as fair condition.

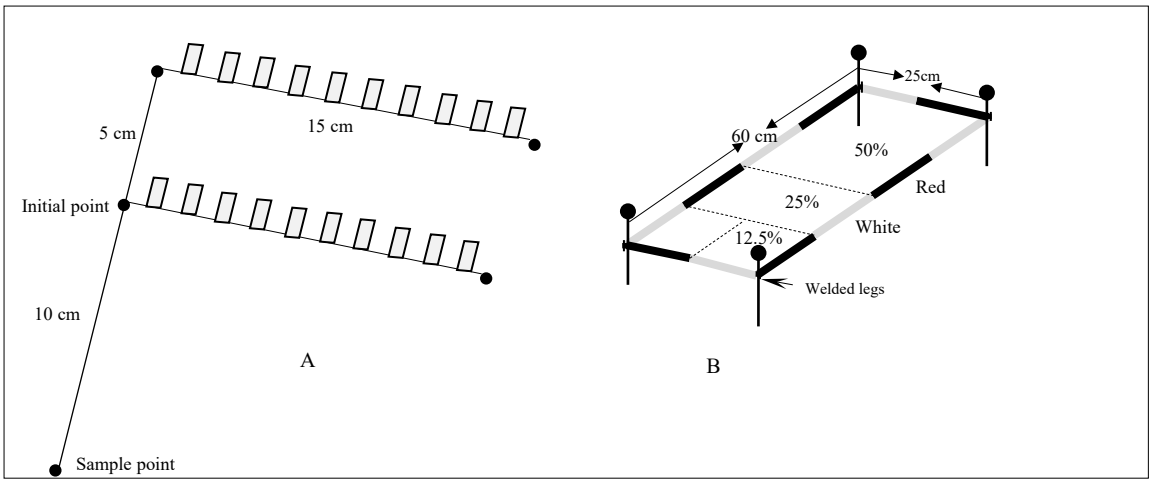

Fig.1. Layout of permanent transect (A) and plot shape and size (B).

Table 1. Ratings of six factors for determination of range condition.

a. Canopy Cover		b. Bare Soil		c. Litter Frequency		d. Plant Composition		e. Plant Vigor		f. Production Percentage of KA	
Xc (%)	**Yc (Score)**	**Xb (%)**	**Yb (Score)**	**Xl (%)**	**Yl (Score)**	**Xo (%)**	**Yo (Score)**	**Xv (%)**	**Yv (Score)**	**Xp (%)**	**Yp (Score)**
0-25	0-5	100	0	0-10	0-1	100-125	0-2.5	100-140	0-3	< 10	0
25-50	5-10	100-90	0-2	10-20	1-2	125-150	2.5-5	140-180	3-6	10-34	1-5
50-75	10-15	90-80	2-4	20-30	2-3	150-175	5-7.5	180-220	6-9	35-64	6-10
75-100	15-20	80-70	4-6	30-40	3-4	175-200	7.5-10	220-260	9-12	65-79	11-14
100	20	70-60	6-8	40-50	4-5	200-225	10-12.5	260-300	12-15	90-100	15
		60-50	8-10	50-60	5-6	225-250	12.5-15				
		50-40	10-12	60-70	6-7	250-275	15-17.5				
		40-30	12-14	70-80	7-8	275-300	17.5-20				
		30-20	14-16	80-90	8-9						
		20-10	16-18	90-100	9-10						
		10-0	18-20	100	10						

Table 2. Ratings of range condition classes.

Range Condition	Score (Percent of Key Area)
Excellent	80-100
Good	70-79
Fair	50-69
Poor	30-49
Very poor	11-29
Non-usable	0-10

Table 3. Data collected for different plant species and soil characteristics in 20 plots.

SP	PC	C	S1	C2	S2	C3	S3	C4	S4	C5	S5	C6	S6	C7	S7	C8	S8	C9	S9	C10	S10
Agcr	1	5	0	10	2	0	0	0	0	0	0	0	0	3	1	2	0	0	0	0	0
Agin	1	0	0	3	0	5	0	0	0	0	0	0	0	2	0	2	0	4	1	3	0
Brto	1	15	2	0	0	20	4	5	0	10	0	0	0	0	0	0	4	0	0	1	0
Brpe	2	2	0	2	0	1	0	1	0	5	0	3	0	1	0	1	0	2	0	1	0
Feov	1	0	0	0	0	1	0	10	5	5	0	2	0	0	0	1	0	0	0	0	0
Kopr	2	0	0	5	1	0	0	5	0	10	0	10	0	3	0	30	4	0	0	0	0
Laor	2	10	0	0	0	30	3	5	2	3	0	15	0	30	0	60	5	0	0	20	0
Arau	3	1	0	2	0	0	0	0	0	2	0	0	0	2	0	1	0	0	0	2	0
TCS		33		22		57		26		35		30		41		97		6		27	
LIP		1		3		1		0		1		0		1		3		0		1	
SGP		1		2		0		0		1		0		1		0		3		0	
TCP		30		20		55		25		33		28		38		95		6		25	
BSP		68		75		44		75		65		72		60		2		91		74	
SP	**PC**	**C11**	**S11**	**C12**	**S12**	**C13**	**S13**	**C14**	**S14**	**C15**	**S15**	**C16**	**S16**	**C17**	**S17**	**C18**	**S18**	**C19**	**S19**	**C20**	**S20**
Popr	1	5	0	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0
Agcr	1	2	0	6	0	6	0	6	0	0	0	0	1	0	0	1	0	0	0	0	0
Laor	2	10	0	8	2	0	0	0	0	15	1	0	0	5	1	10	0	0	0	0	0
Assi	3	0	0	0	0	7	0	0	1	0	0	0	0	5	0	1	0	0	0	27	0
Arau	3	0	0	1	0	15	2	0	0	3	1	0	0	0	0	42	3	14	3	0	0
Brto	1	2	1	0	0	0	0	0	0	1	0	10	1	0	0	0	0	0	0	0	0
Kopr	2	0	0	0	0	5	0	15	1	0	0	0	0	30	2	0	0	2	0	0	0
Agin	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feov	1	0	0	0	0	5	0	1	0	0	0	11	0	0	0	14	0	0	0	0	0
Brpe	2	12	1	0	0	0	1	0	0	0	1	0	1	0	0	2	0	0	0	0	0
Brte	3	1	0	2	0	5	0	1	0	0	0	5	0	1	0	4	0	0	0	4	0
TCS		32		17		44		23		19		29		41		75		16		31	
LIP		3		2		2		1		1		2		2		4		1		2	
SGP		1		1		4		1		0		0		1		1		1		0	
TCP		20		17		44		22		19		28		41		73		16		31	
BSP		66		80		50		76		80		70		66		22		82		67	

SP=Species (abbreviated by 2 letters of genus and species), PC= Palatability Class, C=Cover Percentages (1-20 plots), S = Seedling Number (1-20 plots), TCS= Total Canopy Cover Percentages of Species, LIP= Litter Percentages, SGP= Sand/Gravel Percentages, TCP= Total Cover Percentages, BSP=Bare Soil Percentages. *Agcr=Agropyron cristatun , Agin= Agropyron intemedium ,Brto=Bromus tomentellus, Brpe=Bromus persicus, Feov=Festuca ovina, Kopr=Kochia prostrata, ,Laor=Lactuca orientalis. Arau=Artemisia aucheri, Popr=poa pratense, Assi= Astragalus silicuses , Arau=Artemisia aucheri, Brte=Bromus tectorum.*

Table 4. Linear equations, mean estimated measures, and scores of factors after extrapolation.

Factor	Linear equation of factors (Extracted from Table 1)	Mean of estimated measures (calculated for Table 2)	Score of each factors after extrapolation in corresponding equation
TCP	Yc = 0.20*Xc	33.30	6.66
BSP	Yb = -0.20*Xb+20	64.25	7.15
FLIP	Yl = 0.10*Xl	85.00	8.50
WSPC	Yo =0.10*Xo-10	194.86	9.49
WSCC	Yv=0.075*Xv-7.5	187.00	6.53
PPK	Yp=0.125*Xp+2.875	66.67	11.21
Total			49.54

FLIP= frequency of LIP, WSPC= weighted SPC, WSCC=weighted SCC, PPK= Production as a percent of key area

Discussion and Conclusions

The original scores of the factors devised by FAO project (FAO, 1971) were not equally rated causing non-linearity functions and not reasonable scores, so our ratings were revised (Table 1) to make linear relationships between cover, litter, etc. and scores (Table 4).

The scale of our *F*-shaped transect is fitted to monitor steppe vegetation pattern. However, for desert regions with scattered vegetation, a large scale transect is needed as Wilson, et al. (1984) described it.

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