An Assessment of Biennial Enclosure Effects on Range Production, Condition and Trend (Case Study: Taftazan Rangeland, Shirvan)

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Abstract
Grazing Survey is one of the most important measures that are required to identify and assess the impact on the management of these areas. Some of these measures are assessment of biennial enclosure on production, condition and trend of rangelands. In this investigation, the effects of enclosure, on the production rate, condition and trend of rangelands were studied. The study was conducted at the range plan area of 2273 ha of Taftazan rangeland in Shirvan and has been implemented since1376 and study area has been enclosure for 2 years with area of 200 hectares since 1388. In this study, using a 4-factor method, into 10 plots (1×1m2), range condition was studied in a randomized complete. Using attitude scale, range trend was found and ultimately clipping and weighing method, range productivity was estimated and then compared with the initial assessment. The data were analyzed using Duncan test in completely randomized block design. As the results showed, the production and vegetation cover percentage, condition and trend of rangelands in enclosure area, had significant differences ($p<0.01$). Also, results and field measurements indicate that the dominant type of region is (Ar.au-Po.bo), canopy cover is 37%, range condition, is mean (almost good), range trend is positive and forage production is 280 kg /ha indicating a positive effect of enclosure on production, condition and trend of rangelands in the study area.

Key Words
Plot, attitude scale, 4-factor method, Taftazan range plan, enclosure

Introduction

Natural ecosystems are considered as part of the renewable natural resources, including key indicators of sustainable development of each country. Ranges are defined as ecology of natural systems characterized by their original vegetation and having a natural potential, is considered as an important source of animal and plant production. Unfortunately, lack of proper management of natural resources in the natural areas, particularly pastures caused some changes in the composition of the vegetation so that valuable natural species are placed by palatability and toxic species. Hence, some measures should be done in this case and present the proper management to sustain and make this great source stable (Mirjalali, 2011). Several researches done in this field indicate that some management practices such as short and long term prevention of livestock grazing in the pasture (enclosure) lead to the improvement of plant composition, increased production, vigor reinforcement and vitality of plants, increased seeds, increased food storage in the aerial and underground organs and establishment of seedlings (Trlica and Cook 1971). Enclosure is one of the easiest ways to range improvement and under all conditions is due of vegetation renovation (Moghadam, 1379). One of the purposes of enclosure is investigation of vegetation variation in the long-term and also Effect of grazing. Another purpose is expected of the enclosure exercise to range is vegetation renovation and Compensation of livestock grazing that has been entered on pasture (Azarnivand and Zare chahuki, 1387). James (2001) Performing a study on the grazing systems concluded that if the grazing systems are properly designed, there won't be any problems for feeding the livestock and the rangeland will have a permanent forage source. Through a research, Larry (2010) stated that the grazing system will be successful if the segmentation, grazing season, utilization rate and water resources are carefully designed in the region. Given that more than half of Iran is arid and semi-arid and the rainfall scarcity always had the greatest effect on plant growth and development in these areas and Ranges can be changed in effect, Therefore, it seems necessary the estimation of vegetation in range and ultimately yield information about the production rate in the range after the range plan execution. It never been considered a census of all plants in a range due to the high diversity of grassland vegetation extent and cannot be studied by fractionation. If possible, it involves high costs that are not reasonable and economical. In such circumstances, it should be attempted vegetation sampling and the results be extrapolated to the entire population. Manage any resource; it is not possible without deep understanding and knowledge (Arzani, 1382). Increased ground litter in the enclosures zone as compared with the grazed areas is can be the reason for the decline in soil organic matter in this zone since they would not be trampled on, broken down and incorporated with the top soil by grazing animals (Sanjari et al., 2007). In recent years, researchers have become increasingly interested in assessing the impact of grazing or enclosure systems on soil physical characteristics (Bauer *et al*., 1987; Dormaar *et al*., 1990; Mueller and Green 1995; Su et al., 2003). Grazing practices are recognized as the key drivers to manage and control soil quality in grazing lands. Sustainable utilization of grazing lands requires management strategies that do not compromise the

capacity of soil to function over the long-term (Liebig et al. 2006). Depending on the ecosystem resilience and disturbance feedback, grazing causes either positive or negative effects on soil properties (Franzluebbers and Stuedemann, 2003). Due to the dynamic changes ranges and occurrence of short-term and long-term changes, recognition of these resources should be done with more details to contain information about the change. Recognize the changes that are required for range management is needs to assess to be possible to analyzed and different factors can be identified. There are different methods for evaluation of the ranges, including the effect of enclosure on range production changes, condition and trend. Among these methods, some are faster, some are more accurate and some of them are easier. Moreover, the choice of methods while depends on the purpose and application of methods, also depends on the characteristics of habitats and plant communities. Rangeland assessment is discussed as a matter of principle for the management of such factors. General to determine the sampling time to assess and measure different parameters in different ecological zones of vegetation in plant communities, knowing the stage of plant phonology and composition of the plant community is mandatory. Important factor in determining the virtual size and the plot appropriate form is characteristics of the vegetation (Growth form, density, diversity and distribution pattern) (Alizade, 1387). The concept of range condition is used to denote the changes in vegetation composition, productivity, and land stability that occur when rangelands are grazed by domestic livestock (Wilson AND Tupper 1982). In Iran, to determining of range condition, four-factor and six-factor methods are used. Range condition is a health condition or current range situation compared with climax stage (Moghadam, 1379). Range condition or range health is the present state of the vegetation, compared to the kind and amount of native vegetation the range site is capable of producing (Lacey and Taylor, 2005). To determine the range condition, soil condition and vegetation is essential. To determine range condition, Lower bound on the assessment of soil and vegetation is considered. Although range condition is evaluated on a continuous scale from 0% to 100%, arbitrary classes are generally reported to illustrate range condition (Global Rangelands Knowledge System, 2010). Using the four-factor method on terms of the range condition, ranges are divided into four categories. Purpose of determining the degree of range condition, is to clarify the extent of vegetation changes along with soil changes in the study areas (Moghadam, 1379). Range condition is the most important indicator needs in assessing rangeland management (Pieper & Beck, 1990). Range condition illustrated history of alive and non-lived factors on grassland vegetation and soil in the past and present and its classification is an attempt to separate the changes occurs in time in a habitat type or range site (Pamo et al., 1991). Range trend actually reflects any change in range condition. If the change is to regress, retrograde tendencies will be and if the changes to the climax tend to be progressive. Factors such as plant power, revitalization of desirable plants, abundance of litter and soil erosion condition, indicate the range trend (Moghadam, 1379). Using attitude scales, ranges tend to be determined (Alizade, 1387). The plant cutting to determining of production may be based on growth form or by species. Production is annual growth of range plants and includes all green organs, stems, flowers agents, flower clusters, seeds and fruit (Mesdaghi, 1382). The purpose of range condition classification is to provide an estimate of the vegetation that is present on a given site compared to climax vegetation. This provides a basis for estimating trend, productivity, feasibility of range improvements and suggested stocking rates (David *et al*., 1982). Lewis et al. (1977) conducted an 8-year study to compare the effect of range condition on steer gains when pastures were grazed to a comparable degree of utilization. They found that excellent condition ranges produced the most gain per ha (13.17 kg) but were intermediate in average daily gain (.77 kg). The aims of the proposed application are firstly, using of four-factor method to determining and comparing of range condition, secondly, using of attitude scale method to determining and comparing of range trend and finally, using of clipping and weighing method to determining and comparing of range production. Four factor methods for the first time in 1952 introduced by the K .W Parker and used in the U.S. forestry.

The study area

The study area located within the range plan area of 2273 ha of Taftazan rangeland in Shirvan and has been implemented since1376 and study area has been enclosure for 2 years with area of 200 hectares since 1388. The section under study is delimited by 57°44' 48'' to 57°46' 3'' E longitude and 37°47' 10''N to 37°48' 14''N latitude. Annual precipitation averages 300 mm. Most of the precipitation falls in the cloudy seasons. Annual average evaporation is about 245 mm. The area's climate is semi-arid, with an annual average temperature of 5 ◌̊C. The height of the study area is 1950m. Soils are predominately sandy-clay. Organic matter content was low; averaging about 0.3% and soil pH averaged approximately 7.5-7.8. The grazing trial was from June 1, 2009, through September 22, 2011. Rainfall from June through September was 19.6 mm. This was 5.84 mm below the average amount normally received during

that time of year. Dominant erosions are water and wind erosions, respectively. Figure 1 shows the study area situation.

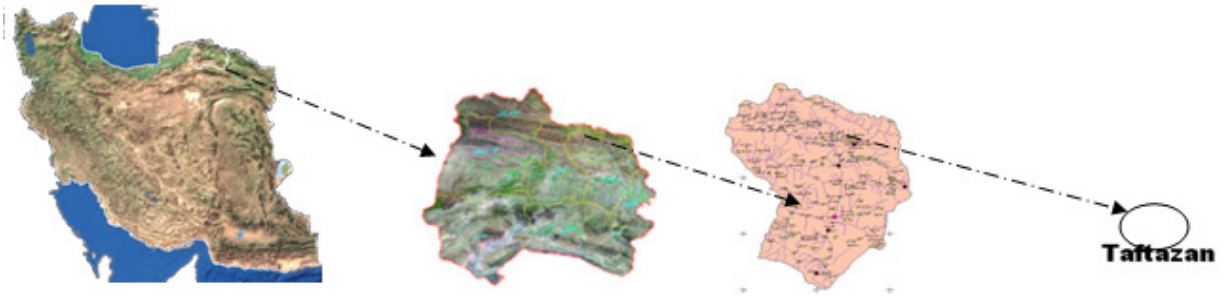

Figure1. The study area situation

Methods and Materials

The study area with area of 200 ha in 2009 was enclosure for 2 years and it provides an opportunity to investigate the effects of enclosure on changes in range production, range condition and range trend in the study area. The survey started in 2009 and ended in 2011. The enclosure area has predominant vegetation types include poa bolbosa and Artemisia aucheri, also its predominant type is (Ar.si-Po.bo) and our study is focused on is type. The floristic list of studying area has been shown in Table1. Sampling condition before and after enclosure operation is completely uniform from the standpoint of elevation, aspect, soils, geology and type of geological formation. Firstly, all available data relating to the location and condition of the study are, were collected from the range plan handbook for the area and the local queries. Secondly, field operations and assessing of vegetation map was done. After sufficient justification based on topographic maps and aerial photographs taken during the field survey, withdrawals were made using a randomized plot when the plants start to grow and the seeds have been reported. In this study, the plots of one square meter have been used to range assessment and By cutting and weighing the forage in each plot, canopy cover, species composition and production and other requirements have been assessed (Figure 2). Production rate, after cutting and weighing the Hays, has been calculated based on the plant species. Determination of range condition (which is one of the indicators needed to assessing of range management) and initial stocking rates were based on procedures used by four-factor method and also range trend was distinguished by orientation scale. Figure 3 shows relationship between decreasers, increasers and invaders. Utilization was determined by placing wire enclosures in each pasture so that ocular judgments could be made on the differences in the amount of forage inside and outside enclosures (David et al., 1982).

Figure2. Plot establishment to estimation of vegetation

Table1. The floristic list of studying area

Row	Species Name	Family Name
١	Agropyron trichophorum	Poaceae
2	Poa.bulbosa	Poaceae
3	Stipa.barbata	Poaceae
4	Artemisia.aucheri	Asteraceae
5	Artemisia.diffusa	Asteraceae
6	Artemisia.scoparia	Asteraceae
7	Artemisia.khorassanica	Asteraceae
8	Cousinia.sp	Asteraceae
9	Cirsium.congestum	Asteraceae
10	Cirsium. turkestanicum	Asteraceae
11	Gundelia.sp	Asteraceae
12	Taraxacum. iranicum	Asteraceae
13	Astragalus.brevidens	Fabaceae
14	Astragalus.gammiferous	Fabaceae
15	Medicago.sativa	Fabaceae
16	Onobrychis.cornuta	Fabaceae
17	Onobrychis.verae	Fabaceae
18	Eryngium.sp	Apiaceae
19	Acantholimon.glandulosum	Caryophyllaceae
20	Acantholimon.microcephalum	Caryophyllaceae
21	Berberis. integerrima	Berberidaceae
22	Rosa.begerriana	Rosaceae
23	Rosa.persica	Rosaceae
24	Euphorbia.sp	Euphorbiaceae
25	Juniperus. excelsa	Cupressaceae
26	Juniperus. polycarpus	Cupressaceae
27	Phlomis.concellata	Lamiaceae
28	Lactuca.orientalis	Asteraceae
29	Verbascum. Songaricum	Scrophulariaceae
30	Verbascum.speciosum	Scrophulariaceae

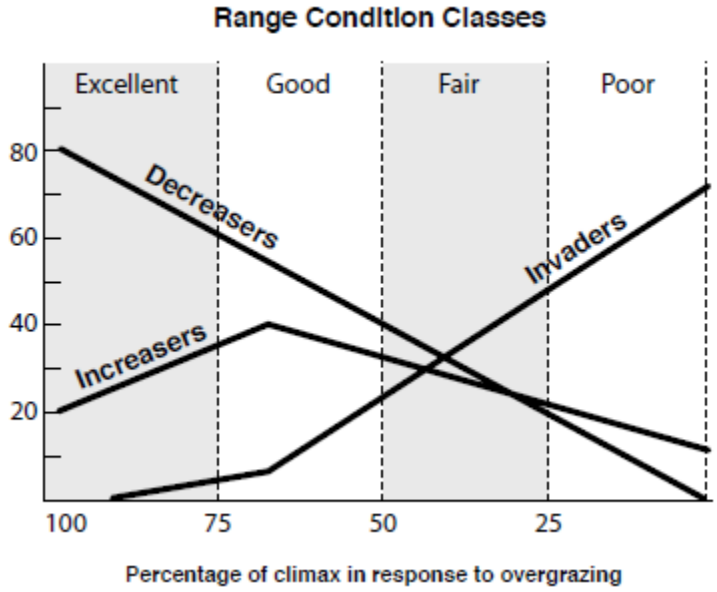

Figure3. Relationship between decreasers, increasers and invaders (Lacey and Taylor, 2005)

Results

Study and proper understanding of the interrelationships of the components of the ecosystem, is one of the main secrets of rangeland management measures. The score of evaluation of the rangeland condition was 38.5 which were earned using field sampling and summation of points related to considered factors which replacing it in the table of rangeland condition assessment, rangeland condition determined as fair (Tables 3 and 4). Note that although the rangeland condition was evaluated fair, but this point is closer to good condition to the poor condition. Then using trend scale, range trend evaluated positive earning 6 positive and 2 negative scores, with regard to the fact that preferable and ice cream species have good regeneration and erection and also brushes that have been damaged during grazing years ago, are improving. Hay exist in sampling plots was desiccated and its weight was estimated and results showed that production rate in each m^2 was 28 gram and total production in study area was 280 kilogram.

In this method score of range condition is result of sum of scores of the following four factor method:

a- Soil erosion and conservation 20 score
b- Species composition 10 score
c- Canopy cover percentage 10 score
d- Plant vigor 10 score

A- Soil factor (based on soil conditions and crop residue): This factor was evaluated in four classes and eventually earned 17.2 score. Physical erosion, or more frequently, a decline in the physical characteristics of the soil surface, is the most serious manifestation of a decline in range condition because of its long-lasting and progressive impact on production attributes. Ellison et al. (1951) considered that condition is always unsatisfactory unless the soil is stable and that forage value is only considered when the stability is assured.

B- Species composition: This factor was evaluated in four classes and eventually earned 7.3 score.

C- Canopy cover percentage: Score of this factor was determined based on canopy cover percentage evaluated in plots as table 1 and eventually earned 7 score. For most species, canopy cover will be closely related to biomass and may offer a substitute, provided some information is obtained about the biomass-cover relationship of the species to guard against unwanted distortion of the importance of those species.

Table 2: The score of the canopy cover percentage in the study area

	Plot Number										Average
The total plants in classes I, II, III	1	2	3	4	5	6	7	8	9	10	
	51	35	49	51	58	25	14	13	4	70	37
The score of canopy cover	10	7	9	10	10	5	2	2	1	10	7

D- Plant vigor factor: This factor considered based on plant health, vigor and age class in four class and eventually earned 7.3 score (Table 3).

Table 3: Sum of scores related to range condition used in the four factors Method

Condition degree	Sum of scores	Plant vigor		Species composition		canopy cover		Soil		Considered factors / Predominant Type
		Score	Class	Score	Class	Score	Class	Score	Class	
Fair	38.5	7	-	7	-	7.3	-	17.2	-	Ar. si -Po. bo

Tables 4 and 5 show the effects of biennial enclosure on production, condition and trend of Taftazan range. Results of this evaluation showed a positive variation in range production, condition and trend (Figures 4, 5 and 6).

Table4. Range condition classes used in the four factors Method

Range Condition Class	Details	Score
Good	Soil stable, productivity diminished	>40
Fair	Soil unstable, productivity good	30-40
Poor	Soil unstable, productivity diminished.	15-29
Very Poor	Soil unstable, unproductive	<15

Table 5. Evaluation of production rate in the study area

Parameters	Plot Number										Sum
	1	2	3	4	5	6	7	8	9	10	
Plot production (gr)	40	24	32	40	43	19	10	9	1	62	280

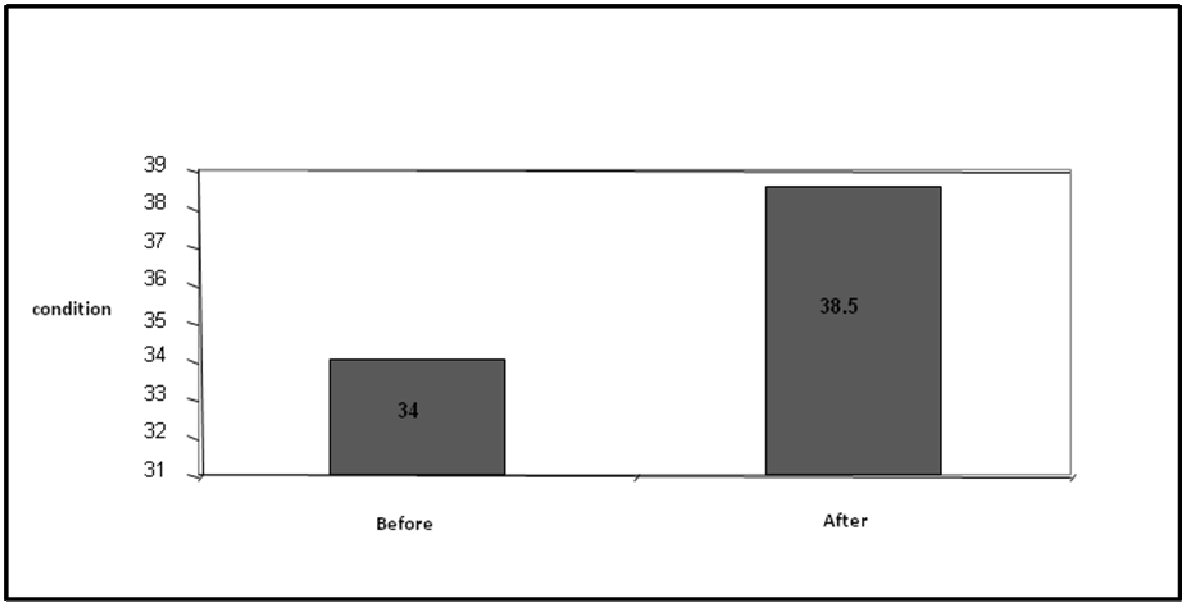

Figure4. The variation of the range condition in effect of biennial enclosure in the study area

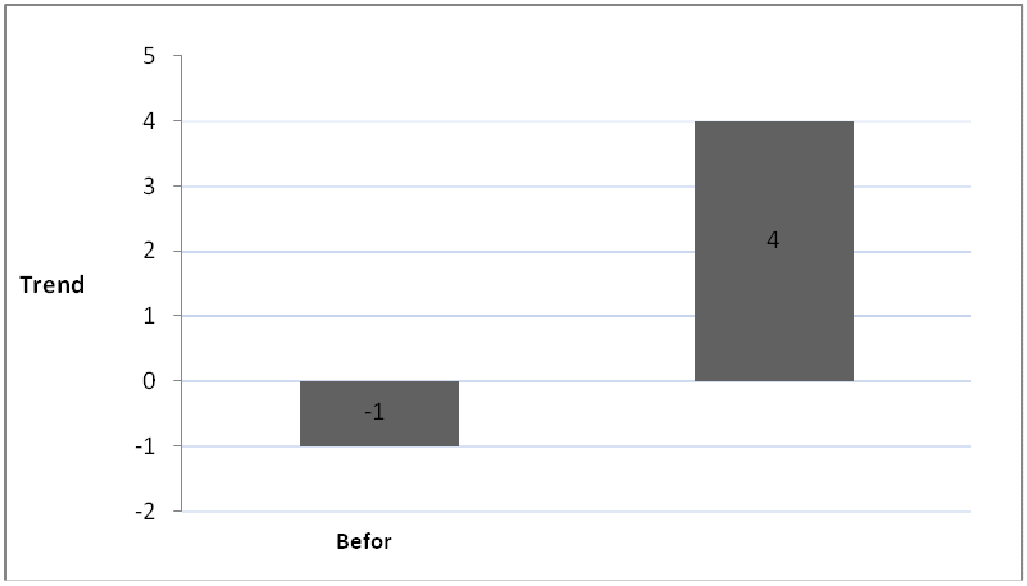

Figure5. The variation of the range trend in effect of biennial enclosure in the study area

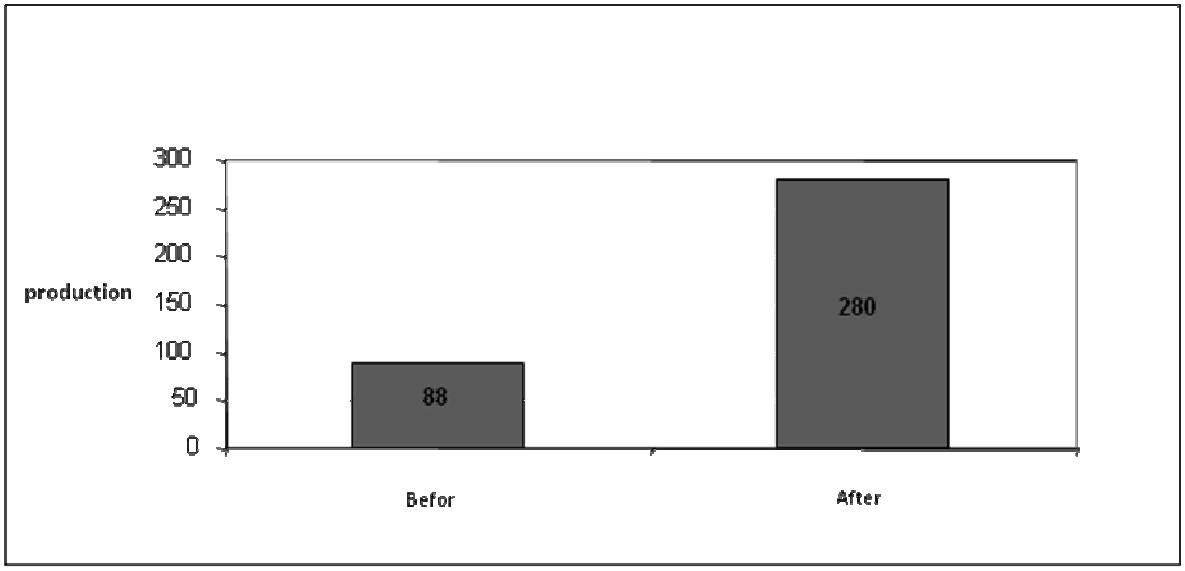

Figure6. The variation of the range production in effect of biennial enclosure in the study area

Discussion and Conclusion

Before enclosure execution in 2009, the forage production rate was 88 kg/hec and range condition was fair (with a score of 34) and rage trend was negative (with a score of -1). After execution of biennial enclosure and an evaluation that was done in spring of 1390, the results showed that the forage production rate was 280 kg/hec and range condition was close to good (with a score of 38.5) and rage trend was positive (with a score of +4). In addition to the opportunities for the vegetation growth and revivification of pasture plants, providing conditions to revive vegetation and the quality and quantity improvement, the excludes treatment can create conditions to increase the production of pastures, prevent further soil erosion and protect the areas in which the soil erosion is accelerated because of poor vegetation. To reach the equilibrium of rangelands, we should move in a direction that the current

operation units change into the optimal exploitation units to be able to provide their family necessities and reduce the pressure on the pasture vegetation.

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References

Bauer A., et al., Soil property comparisons in virgin grasslands between grazed and non-grazed management systems. Soil Science Society of America Journal, 51: 176 – 182, 1987. doi:10.2136/sssaj1987.03615995005100010037x

Dormaar J.F., et al., Distribution of nitrogen fractions in grazed and un-grazed fescue grassland Ah horizons Journal of Range Management 43, 6 – 9, 1990. Doi: 10.2307/3899110

Ellison, L., et al., Indicators of condition and trend on high range-watersheds of the Intermountain range, USDA Agriculture handbook, 19, 66 p, 1951.

Franzluebbers A.J., and Stuedemann J.A. Impact of cattle and forage management on soil surface properties in the southern Piedmont, USA, In 'Sod-Based Cropping Systems', Quincy, Florida (Ed. FM Rhoads), 71–80, 2003. (University of Florida)

Global Rangelands Knowledge System, A Resource about Rangelands in the Western U.S, 2010.

Lacey, J., and Taylor, J., Montana Guide to Range Site, Condition and Initial Stocking Rates, 2005.

Gerrish, G.R. Grazing System Layout and Design, Research Assistant Professor, University of Missouri - Forage Systems Research Center, Idaho Press. 2001.

Lacey J., and Taylor J.E. Montana Guide to Range Site, Condition and Initial Stocking Rates, 2005. http://www.montana.edu/wwwpb/pubs/mt8515.html

Keenan, L., Grazing Systems, The Noble Foundation as a forage management intern while attending, Oklahoma State University, 2010.

Lewis, J.K., et al., Effect of range condition on steer gains. South Dakota, Agr. Exp. Sta. Bull., 77-184, 1977.

Liebig M.A., et al., Soil response to long-term grazing in the northern Great Plains of North America. Agriculture Ecosystems & Environment, 115: 270-276, 2006.

Mirjalili, A. Effects of Enclosure, Rest-delayed and Continuous Grazing Treatments on Production Rate and Vegetation Cover of Sadr Abad Nodoushan of Yazd Pastures, Journal of Rangeland Science, 1(3): 167-174, 2011.

Mueller J.P., and Green J.T., Controlled grazing, Forage-Livestock Systems, West Virginia University Extension Service, 1995. Accessed at ww.caf.wvu.edu/~forage/controlgrazenc/fctrl.htm on Nov 2007.

Pamo E.T., et al., Range condition analysis: comparison of two methods in South New Mexico desert grasslands. J. Range Manage. 44:374-378, 1991.

Pieper, R., and Beck F. Range condition from an ecological perspective: Modification to recognize multiple use objectives. J. Range Manage, 43:550-552, 1990.

POWELL D.J., et al., Effect of Range Condition on the Diet and Performance of Steers Grazing Native sand-hills hills Range in Nebraska, JOURNAL OF RANGE MANAGEMENT, 35(1): 96-99, 1982.

Sanjari, G., et al., comparing the effects of continuous and time-controlled grazing systems on soil characteristics in Southeast Queensland, Australian Journal of Soil Research, 46: 348-358, 2007. http://dx.doi.org/10.1071/SR07220

Su Y.Z., et al., Influences of grazing and exclosure on carbon sequestration in degraded sandy grassland, Inner Mongolia, north China. New Zealand, Journal of Agricultural Research 46: 321-328, 2003. DOI: 10.1080/00288233.2003.9513560

Trlica M.J. and Cook C.W., Defoliation effects on Carbohydrate reserves of desert species. J. of range management, 24: 418-425, 1971. http://www.fao.org/wairdocs/ilri/x5543b/x5543b00.htm#Contents

WILSON, A.D., and TUPPER G.J. Concepts and Factors Applicable to the measurement of Range Condition, JOURNAL OF RANGE MANAGEMENT, 35(6): 684-689, 1982.