Annals of Arid Zone 37(2): 147-152, 1998

Effect of Overgrazing on the Phytosociology of Grassland Ecosystem of Aravalli Hills, Rajasthan

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Abstract: Overgrazing in the plain and hillock areas of grasslands of Aravallis results in slow but inexorable deleterious change in botanical composition. It triggers off succession, and invariably the degenerated stage consists of inferior, less palatable annual and perennial grasses such as *Tragus biflorus, Eragrostiella bifaria, Eragrostis tenella, Aristida funiculata, Melanocenchris jacquemontii, Tripogon roxburghii* and *Bothriochloa pertusa*. The Frequency Index Community Coefficient and Similarity Index is comparatively higher on hillocks rather than on plains of both protected and grazed sites. Protected site of grassland is less vulnerable to environmental vagaries due to higher value of Species Diversity Index. In plain and hillock areas of protected sites, maximum IVI was shown by *Aristida funiculata* and *Sehima nervosum*, respectively, whereas, in plain and hillock areas of grazed sites, maximum IVI was shown by *Brachiaria ramosa* and *Aristida funiculata*, respectively.

Kew words: Grassland, Aravalli hills, phytosociology, IVI, overgrazing

Grasslands and fodder crops play a key role in intensive system of land utilization. The increasing livestock population, industrialization and utilization of resources result in increasing pressure on grasslands. Hence, efficient and sustained utilization of grasslands may be very stable (pre-climax) under the influence of fire and grazing in forest climate, except in alpine regions (Champion, 1936). Grassland communities change their composition due to their seral nature, when grazing or burning pressure is relaxed and long-term protection often moves the grassland towards forest climate (Whyte, 1974). Deterioration of pastures and encouragement of wind and water erosion by migratory grazing was noticed in western Rajasthan (Prajapati, 1970). Livestock grazing reduces the regenerating capacity of grasslands and keep them at low level of productivity (Srivastava *et al.*, 1988). Under excessive grazing pressure, there is a shift in the species composition of grassland, i.e., less nutritive and unpalatable vegetation appears as observed by Gupta and Saxena (1971) in western Rajasthan.

Phytosociological studies are of great significance to range researchers in understanding the structure, function and dynamics of grassland ecosystem. These studies also help in proper management and utilization of grasslands. Such type of studies have been carried out by Sant (1964), Cherian and Bole (1964). Ahuja *et al.* (1968), Gupta and Saxena (1971) and Kumar and Joshi (1972) in Rajasthan. Phytosociological studies of grassland communities of Udaipur district and ecological studies on the grazing lands of Aravalli

hills has been carried out by Katewa (1990, 1996). Grazing has marked influence on the phytosociology of grasslands and therefore, the present investigation was carried out to present the effect of overgrazing on the phytosociology of grassland ecosystem of Aravalli hills.

Materials and Methods

The study was conducted in a protected and grazed sites of natural grassland ecosystem of Aravalli hills between 23°10′ North latitude and 69°30′ and 78°27′ East longitudes. The study area has a tropical monsoon type of climate, with an average annual rainfall of 595 mm and 30-42°C temperature range. Observations were recorded on plain and hillock areas of the study during July to November 1996. Phytosociological studies were carried out in accordance with standard quadrat method (Misra, 1968). Ten quadrats of one metre square were laid down on both plain and hillock areas of study sites to determine percentage frequency, density, abundance and importance value index for all the species. In perennial grasses, each tiller was considered as an individual plant because it is capable to give rise to a separate plant (Brown, 1954). Frequency Index Community Coefficient, Similarity Index, Index of Dominance and Index of General Species Diversity were calculated after Misra (1968), Sorensen (1948), Simpson (1949) and Marglef (1968), respectively.

Results and Discussion

Botanical composition, density and IVI of each species of plain and hillock areas of protected and grazed sites of grassland are given in Table 1. At protected site, herbage is harvested at maturity for hay making. Planted trees of *Tectona grandis*, *Albizia lebbek*, *Leucaena leucocephala*, *Dendrocalamus strictus*, *Eucalyptus citriodora*, *Dalbergia sisso* and *Wrightia tinctoria* are scattered at protected site, while at grazed site, only trees of *Prosopis juliflora* grow naturally. Important fodder grasses like *Sehima nervosum*, *Apluda mutica*, *Heteropogon contortus*, *Themeda triandra*, *Themeda quadrivalvis* and *Eremopogon foveolatus* were found more frequently at protected site, as compared to those in grazed site. Less palatable grasses like *Aristida funiculata*, *Eragrostiella bifaria*, *Alloteropsis cimicina*, *Melanocenchrus jacquemontii* and *Tripogon roxburghii* were found more frequently in grazed site, as compared to those in protected one. Among legumes, *Indigofera cordifolia*, *Tephrosia purpurea*, *Phaseolus trilobus* and *Cassia pumila* were found to be more frequent in protected site, while *Cassia obtusifolia*, *Crotolaria medicaginea* and *Zornia gibbosa* were found more frequent in grazed site. As a result of overgrazing in plain and hillock areas of grazed sites, certain species increase in density, while others decrease.

A comparative study of species composition in both sites shows that six species of grasses, i.e., *Cymbopogon martinii*, *Themeda triandra*, *Themeda quadrivalvis*, *Apluda mutica*, *Chrysopogon fulvus* and *Acrachne racemosa* have been found to occur only in protected site, while in grazed site, eight species of grasses, i.e., *Paspalidium flavidum*, *Urochloa panicoides*, *Setaria pallidifusa*, *Cenchrus setigerus*,

Table 1. Influence of overgrazing on the density and IVI of grasses, legumes and forbs of grassland ecosystem

Species group/species	Protected plain area		Protected hillock area		Grazed plain area		Grazed hillock area	
	Density (cm^2)	IVI	Density (cm^2)	IVI	Density (cm^2)	IVI	Density (cm^2)	IVI
Annual grasses								
Aristida funiculata	272.9	32.1	29.8	7.2	44.7	8.8	465.0	52.5
Alloteropsis cimicina	145.6	17.6	13.5	3.8	110.6	18.8	-	-
Apluda mutica	16.6	12.8	96.7	21.9	-	-	-	-
Brachiaria ramosa	72.5	11.0	40.6	8.5	101.5	21.2	49.0	7.4
Heteropogon contortus	63.8	10.9	112.3	20.0	23.4	8.6	182.7	24.3
Themeda triandra	18.7	9.1	-	-	-	-	-	-
Dactyloctenium aegyptium	18.0	4.6	-	-	60.5	13.9	2.5	3.8
Digitaria adescendens	15.2	4.3	4.5	3.1	12.2	6.2	13.6	6.6
Hackelochloa granularis	2.2	3.2	7.2	4.6	-	-	5.6	2.4
Sporobolus diander	9.5	2.5	-	-	24.5	5.5	-	-
Acrachne racemosa	1.0	2.5	-	-	-	-	-	-
Eleusine indica	4.4	1.9	4.1	2.3	2.7	1.3	9.5	2.0
Digitaria granularis	2.8	1.8	0.2	0.1	18.8	4.5	-	-
Aristida adescensionis	0.4	0.8	-	-	-	-	1.2	1.1
Melanocenchrus jacquemontii	0.08	0.8	-	-	-	-	12.2	5.6
Themeda quadrivalvis	-	-	0.5	14.2	-	-	-	-
Panicum miliaceum	-	-	18.0	3.3	2.6	1.9	-	-
Paspalidium flavidum	-	-	-	-	49.0	8.8	-	-
Chloris virgata	-	-	-	-	6.9	5.3	0.2	3.2
Setaria pallidifusca	-	-	-	-	14.4	5.3	20.9	6.9
Tragus biflorus	-	-	-	-	0.4	3.3	0.5	2.7
Tetrapogon tenellus	-	-	-	-	1.9	2.5	1.8	2.5
Eragrostiella bifaria	-	-	-	-	1.4	2.3	15.7	5.0
Eragrostis tenella	-	-	-	-	5.3	2.3	-	-
Rottboellia compressa	-	-	-	-	0.5	3.9	-	-
Urochloa panicoides	-	-	-	-	35.2	8.6	-	-
Perennial grasses								
Sehima nervosum	77.1	12.8	134.8	25.2	-	-	30.0	4.6
Cymbopogon martinii	53.0	11.2	5.9	3.3	-	-	-	-
Cymbopogon schoenanthus	3.0	7.7	-	-	-	-	0.2	5.0
Eremopogon foveolatus	40.3	7.3	9.8	5.8	8.8	3.8	6.8	2.4
Tripogon roxburghii	12.6	2.7	2.4	2.0	-	-	20.0	2.9
Cynodon dactylon	2.6	1.7	5.0	1.6	1.6	1.2	0.9	1.1
Chrysopogon fulvus	-	-	100.0	17.2	-	-	-	-

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Species group/species	Protected plain area		Protected hillock area		Grazed plain area		Grazed hillock area	
	Density (cm^2)	IVI	Density (cm^2)	IVI	Density (cm^2)	IVI	Density (cm^2)	IVI
Cenchrus ciliaris	-	-	0.5	0.5	1.8	3.2	-	-
Cenchrus setigerus	-	-	-	-	10.7	7.2	-	-
Bothriochloa pertusa	-	-	-	-	3.6	4.6	1.7	3.3
Legumes								
Cassia pumila	9.7	11.8	13.2	11.0	7.3	9.8	8.5	8.9
Tephrosia purpurea	6.2	11.2	4.3	8.1	-	-	-	-
Indigofera cordifolia	38.4	10.1	90.8	19.9	0.5	2.3	103.5	17.9
Cassia obtusifolia	0.2	5.8	-	-	15.7	13.6	-	-
Crotolaria juncea	1.2	5.5	2.1	5.3	-	-	-	-
Tephrosia tenuis	7.0	4.9	10.1	5.2	-	-	8.6	6.4
Crotolaria medicaginea	0.0	3.5	-	-	50.3	16.2	1.3	4.8
Phaseolus trilobus	1.7	2.8	0.1	0.6	-	-	0.2	1.8
Zornia gibbosa	3.9	2.4	0.1	1.6	16.9	6.8	0.8	19.5
Indigofera inifolia	0.0	1.3	0.2	2.3	-	-	0.2	1.8
Alysicarpus monilifer	1.0	1.0	0.1	0.2	2.1	1.8	-	-
Cassia tora	-	-	1.1	6.0	2.4	4.9	-	-
Indigofera linnaei	-	-	-	-	0.2	2.6	-	-
Desmodium trifolium	-	-	-	-	0.5	3.9	-	-
Forbs								
Urginia indica	0.1	18.5	0.3	19.1	0.3	20.4	1.3	27.8
Sesamum indicum	0.2	12.1	-	-	-	-	-	-
Ipomoea nil	26.1	11.1	13.6	7.0	8.1	7.2	35.9	9.1
Borreria stricta	14.0	6.3	27.3	11.1	5.2	4.5	25.7	8.7
Peristrophe bicalyculata	0.0	5.5	-	-	-	-	-	-
Bidens biternata	0.3	4.6	-	-	-	-	-	-
Parthenium hysterophorus	3.0	3.6	-	-	-	-	-	-
Lepidagathis trinervis	1.6	2.8	7.3	5.8	2.6	2.6	9.5	7.0
Boerhavia diffusa	0.05	2.5	-	-	0.4	3.3	0.7	3.3
Leucas aspera	1.0	2.1	0.1	1.6	0.1	1.4	1.0	1.8
Evolvulus alsinoides	0.5	2.1	-	-	6.8	5.3	-	-
Malvastrum sp.	0.5	2.0	0.2	1.6	-	-	0.1	1.8
Rhynchosia minima	0.08	2.0	0.8	3.1	-	-	-	-
Ipomoea pestigridis	0.4	1.7	15.4	3.4	3.4	2.9	1.0	2.2
Tribulus terrestris	0.08	0.9	-	-	0.2	4.1	0.3	5.5
Trichodesma indicum	-	-	1.5	8.1	-	-	-	-
Justicia simplex	-	-	0.7	7.1	0.1	7.8	5.7	14.4
Calotropis procera	-	-	0.1	7.1	-	-	-	-

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Species group/species	Protected plain area		Protected hillock area		Grazed plain area		Grazed hillock area	
	Density (cm^2)	IVI	Density (cm^2)	IVI	Density (cm^2)	IVI	Density (cm^2)	IVI
Enicostema verticillata	-	-	4.3	4.3	-	-	0.7	4.8
Sigesbeckia orientalis	-	-	1.2	3.7	-	-	-	-
Vicoa indica	-	-	0.3	3.6	-	-	-	-
Salvia plebia	-	-	0.5	3.2	-	-	-	-
Azadirachta indica	-	-	0.2	1.6	-	-	-	-
Polygalla chinensis	-	-	0.1	1.6	-	-	2.6	4.6
Triumfetta neglecta	-	-	-	-	9.5	11.3	-	-
Achyranthes aspara	-	-	-	-	0.7	3.9	-	-
Corchorus sp.	-	-	-	-	0.6	3.9	-	-
Trifolium sp.	-	-	-	-	0.4	1.6	-	-
Cyperus rotundus	-	-	-	-	0.8	1.8	-	-
Index of General Diversity	1.51		1.48		1.55		1.37	
Index of Dominance	0.038		0.037		0.033		0.061	

Chloris virgata, *Eragrostiella bifaria*, *Bothriochloa pertusa* and *Tetrapogon tenellus* occur. Both sites show very slow process of invasion.

Species Similarity Index was found to be 0.61, which is nearly equal to two third of hillock area of protected and grazed sites due to their higher value of Frequency Index Community Coefficient (57.14%), whereas, in plain area of protected and grazed site, Species Similarity Index was 0.54, which was slightly higher to its counterpart due to their lower value of Frequency Index Community Coefficient (49.90%). General species diversity index is comparatively higher in protected site (1.49) as compared to grazed site (1.46). Data clearly indicate that species composition does not exhibit any remarkable change under the influence of overgrazing. Grassland ecosystem of Aravalli hills are in seral stage of succession, which are considerably stable (pre-climax) under the influence of fire and grazing, although these factors are maintained by anthropogenic bodies. These findings show co-alliance with those of Champion (1936).

In the plain area of protected site, the highest IVI among grasses, legumes and forbs was shown by *Aristida funiculata*, *Cassia pumila* and *Urginia indica*, respectively, while in the hillock area of same site, the highest IVI among grasses, legumes, and forbs was shown by *Sehima nervosum*, *Indigofera cordiolia* and *Urginia indica*, respectively. In the plain area of grazed site the highest IVI among grasses, legumes and forbs was shown by *Brachiaria ramosa*, *Crotolaria medicaginea* and *Urginia indica*, respectively, while in the hillock area of same site, highest IVI among grasses, legumes and forbs was shown by *Aristida*

funiculata, *Zornia gibbosa* and *Urginia indica*, respectively.

Acknowledgement

Authors are thankful to the Directorate of Watershed Management and Soil Conservation, Government of Rajasthan for financial assistance.

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