Pak J Sci Ind Res 1998 **41** *(5) 251-255*

ECOLOGICAL ASSESSMENT OF RANGELAND VEGETATION IN SOUTHERN ATTOCK *PART I.* PHYTOSOCIOLOGY

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(Received 14 January 1996; accepted 10 June 1998)

Phytosociological study was carried out over an area of 73780 ha rangelands in southern Attock. The objective of this study was to delineate the existing vegetation into dominant plant communities so as to monitor and maintain the health of these rangelands over time based on floral, edaphic and climatic requirements. Four ecological units were identified and vegetation and landuse map was prepared. Vegetation inventory of Summed Dominance Ratio (SDR) showed a total of 17 plant species in protected unit(sub-unit 1.1) and 18 plant species in unprotected unit (sub-unit 1.2) which were distributed among plant communities of *Chrysopogon montanus* and *Heteropogon contortus* respectively. Similarly, 11 plant species in protected unit(sub-unit 2.1) and 12 plant species in unprotected (sub-unit 2.2) were found among plant communities of *Acacia modesta, Acacia nilotica, Adhatoda vesica* and *Ochthochloa compressa,* respectivly. Overall the invader plant species, which were high in unprotected area were being replaced with desirable forage tree and grass species in protected areas.

Key words: Rangeland, Phytosociology, Summed Dominance Ratio (SDR).

Introduction

Rangelands are the areas which are not fit for cultivation due to low and erratic precipitation, steep topography and low quality soils. These areas are typically used for livestock grazing instead. According to National Commission on Agriculture (Anon 1988), 51% of the total area of Pakistan is classified as rangeland. It is, therefore, necessary to manage this vast resource along scientific lines so that rangelands can be grazed by livestock on a sustained basis without causing a downward trend in the natural resources.

Productivity and livestock grazing capacity of a rangeland can be determined from its species composition (USDA 1970). Stodart *et al* (1975) stated that climate and soils are the environmental factors which determine the kind of vegetation that can grow in that area. In Pakistan, rangeland resources exist to a large extent under arid and semi-arid conditions and most of them have already been exhausted due to centuries of overuse resulting in complete vegetation shifts to mostly shrubs of low palatability (FAO 1985). The aim of the present investigation was to study the phytosociology and degree of dominance among species in a rangeland area of southern Attock, Pothwar. For this purpose, Importance Value and Summed Dominance Ratio (SDR) were used as criteria for determining the importance of the species for controlling the naturally occurring plant communities under subtropical semi-arid climate.

Study Area. The study area was located between latitude 33° 30' and 34° north and longitude 72° 45' east in Attock district, about 100 Km north-west of Islamabad (Fig 1). The survey area, comprising 73780 ha rangelands and 45500 ha cultivated lands lay between the roads from Hasanabadal to Attock, Pindigheb, Fatehjang and Hasanabdal.

Climate. The area lies between an elevation of 300-600 m and has a mean annual rainfall of 350-650 mm. The climate is semi-arid warm, sub-tropical winter/monsoon and falls under climax vegetation of dry sub-tropical broad-leaved-thorn mixed forest, agro-ecological region IV (Beg *et al* 1987). The mean maximum temperature ranges up to 40° C in May-June, while the mean minimum temperature of 2.2° to 4.7°C occurs during December and January.

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The Soils. The area has complex geological history of orogenic disturbances, erosion and depositional cycles. This has resulted in the formation of mountain and rough broken lands, interpreted separately into two physiographic soils (mapping units 1 and 2). The soils in mapping unit 1 (sub-unit 1.1 and 1.2, vegetation and landuse map, (Fig 1) included coarse loamy to sandy clay loams, brown to reddish brown and excessively drained (Zeb *et al* 1977). These soils have been developed *in situ* from the underlying rocks which consist mainly of limestone, cretaceous slates,

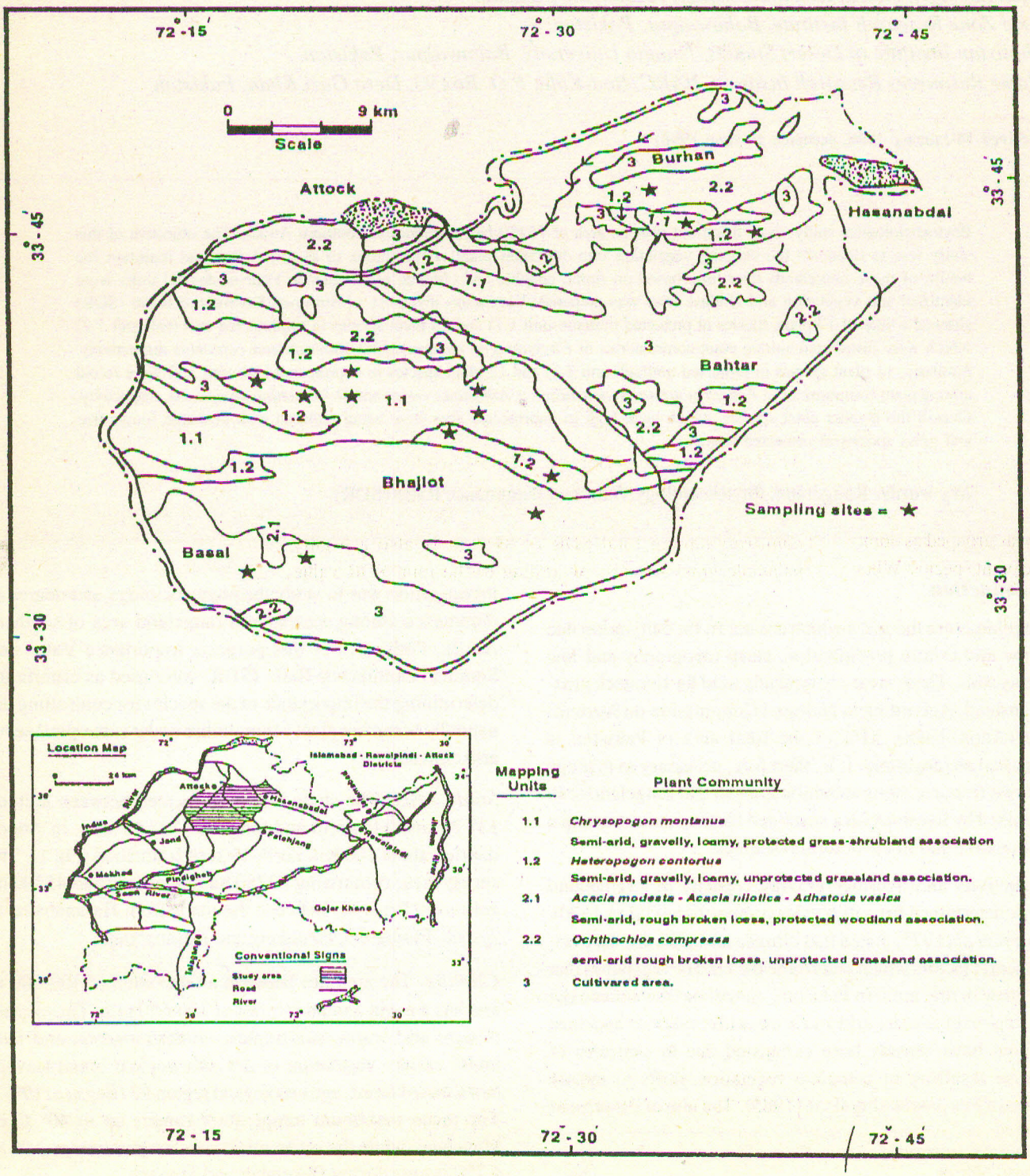

Fig 1. Vegetation and land use map of Southern Attock

sandstone and shale. The relief is above 152 m Steep slopes, water erosion, aridity and removal of top soil have reduced the productivity of grazing lands.

The soils in mapping unit 2 (sub-unit 2.1 and 2.2, Fig 1) are rough broken, gravelly coarse loamy to fine loamy, loess, dark yellowish brown and excessively drained. This soil unit is wide-spread in the survey area and mainly occurs on banks of the major streams and their associated ravines. These soils occupy sloping to gently sloping, deeply dissected loess plains broken by many intermittent drainage channels. The runoff is high and geological erosion is very active. Present landuse is poor grazing.

Materials and Methods

Survey Methodology. A field map of the study area showing soil units (1 and 2) was prepared from agro-ecological units map (Beg *et al* 1987). Protected forest areas and unprotected areas were also marked on the field map with the help of a topographic map of the area to separate sub-units, 0.1 for protected and 0.2 for unprotected areas (Fig 1). In each sub-unit criteria for the selection of a stand were adequate size of sample area and visual homogeneity of vegetation. The number of representative stands selected varied from 2 to 6 depending on the size of sub-unit and heterogeneity of the vegetation. Phytosociological surveys were conducted after monsoons. In each representative stand five Adjustable, Decimal, Collapsible (ADC) quadrats of $1m^2$ each (Khan 1974) were laid out at 10 m intervals. A total of 70 quadrats were placed in the survey area. The phytosociological data including species composition, plant cover and plant density were recorded.

Vegetation Data Analysis. For the analysis of vegetation data, plant species were grouped ecologically. Each ecological group consisted of species growing in similar environmental conditions. The ecological groups were formulated by numbering field observations of vegetation composition and soil in synthesized table forms. Groups were then refined using numerical clustering techniques (Pregitzer and Barnes 1982).The ecological groups were synthesized after Mueller-Dombois and Ellenberg (1974). The mountain region in ecological unit I was studied aspect-wise (northern and southern) while the rough broken land of ecological unit 2 was not studied aspect-wise. The following attributes were calculated for each stand; density, and relative density, cover and relative cover and frequency and relative frequency of each plant species. The relative values for all the three measures were

Table 1

Summed Dominance Ratio (SDR) of various plant species in protected ecological unit 1.1 and unprotected ecological unit 1.2

Protected		Unprotected	
Plant species	Total SDR	Plant species	Total SDR
Acacia modesta	38.2	*Acacia modesta*	11.9
Chrysopogon montanus	166.7	*Adhatoda vasica*	25.7
Cymbopogon schoenanthus	16.2	*Argyrolobium stenophyllum*	3.0
Cyprus rotundus	19.7	*Chloris gayana*	6.5
Desmostachya bipinnata	4.1	*Chrysopogon montanus*	17.3
Dichanthium annulatum	23.7	*Cymbopogon schoenanthus*	14.1
Dodonaea viscosa	76.3	*Dichanthium annulatum*	53.5
Eragrostis poaeoides	1.9	*Dicliptera roxbughiana*	4.8
Gymnosporea royleana	26.4	*Dodonaea viscosa*	19.6
Heteropogon contortus	77.9	*Euphorbia falcata*	1.6
Hyparrhenia hirta	4.7	*Gymnosporea royleana*	17.8
Olea ferruginea	38.2	*Heteropogon contortus*	81.7
Otostegia limbata	8.6	*Olea ferruginea*	18.8
Rhynchosia minima	3.0	*Oxalis corniculata*	1.6
Sida cardata	3.0	*Periploca aphylla*	1.4
Trichodesma indicum	1.8	*Rhemnus pentapomica*	4.5
Zizyphus nummularia	29.2	*Sageretia brandrethiana*	2.1
		Xanthium strumarium	1.6

Table 2

Summed Dominance Ratio (SDR) of various plant species in protected ecological unit 2.1 and unprotected ecological unit 2.2

Protected		Unprotected	
Plant species	Total SDR	Plant species	Total SDR
Acacia modesta	42.6	*Aristida motabilis*	2.9
Acacia nilotica	35.5	*Brachiaria villosa*	4.4
Adhatoda vasica	34.9	*Capparis decidua*	9.8
Chrysopogon aucheri	26.3	*Chrozophora hiersolimitana*	3.6
Conyza canadensis	9.3	*Crotalaria mysorensis*	3.7
Desmostachium bipinnata	11.5	*Cymbopogon schoenanthus*	9.3
Ehretia obtusifolia	6.4	*Desmostachya bipinnata*	18.4
Eragrostis poaeoides	9.1	*Ochthochloa compressa*	104.0
Gymnosporea royleana	6.9	*Eragrostis poaeoides*	19.4
Rhynchosia minima	12.8	*Fagonia arabica*	9.0
Zizyphus nummularia	4.5	*Heteropogon contortus*	12.7

summed into a single importance value index (I.V.I). Summed dominance ratio (SDR) of each plant species was calculated dividing the I.V.I by 3 (Chul and Moody 1983; Curits and McIntosh 1951).

The species having the highest value of SDR were considered as the leading dominants of the community. Other vegetation recorded in the community area was grouped as dominants, co-dominants, associates and rare plant species. When two or three plant species closely approached each other in order of SDR value, the community shared the names of these dominants (Marwat and Hussain 1988). Vegetation and landuse map was then prepared based on the criteria discussed above (Fig 1).

Results and Discussion

Vegetation inventory based upon SDR in protected area of ecological unit 1.1 (Table 1) showed a total of 17 plant species. The leading dominant plant species in this area was *Chrysopogon montanus* having total SDR of 166.7. According to the total SDR *Heteropogon contortus, Dodonaea viscossa, Acacia nilotica* and *Olea ferruginea* were second dominants of this plant community. Co-dominants of this plant community were *Zizyphus mummularia* and *Gymnosporea royleana.* The associated plant species recorded in this plant community were *Cyperus rotundus, Cymbopogon schoenanthus, Dichanthium annulatum* and *Otostegia limbata.* Plant species such as *Desmostachya bipinnata, Eragrotis poaeoides, Hyparrhenia hirta, Rhynchosia minima, Sida cordata* and *Trichodesma indicum* were the rare plant species of this plant community. Overall the palatable plant species with high SDR value were ranked in leading dominants, dominants, co-dominants and associates.

Total 18 plant species were recorded in the unprotected area of the same ecological unit (1.2). The leading dominant plant species of this ecological unit (1.2) was *Heteropogon contortus* having total SDR of 81.7. It is also a highly palatable grass species. According to the total SDR value the dominant and co-dominant plant species of this plant community type were *Dichanthium annulatum* and *Adhatoda vasica* respectively. Associates of this plant community were *Acacia modesta, Chrysopogon montanus, Cymbopogon schoenanthus, Dodonaea viscosa, Gymnosporea royleana* and *Olea ferruginea.* Large number of rare plant species were recorded such as *Argyrolobum stenophylhum, Chloris gayana, Dicliptera roxburghiana, Euphorbia falcata, Oxalis corniculata Periploca aphylla, Rhamnus pentapomica,Sageretia brandrethiana and Xanthium strumarium.* It is clear that invader plant species are maximum in this unprotected area.

The detailed description of ecological recovery in this ecological unit 1.2 revealed that plant species flourished more ons northern aspect as compared with the southern aspect of the mountain.

In protected area of ecological unit 2.1 (Table 2) eleven plant species were recorded. Leading dominant in this community according to the total SDR, were *Acacia modesta,Acacia nilotica* and *Adhatoda vasica. Chrysopogon aucheri* was the co-dominant plant species. Associated plant species of

this community were *Conyza canadensis, Desmostachya bipinnata, Eragrostis poaeoides* and *Rhynchosia minima.* While *Ehretia obtusifolia, Gymnosporea royleana and Zizyphus mimmularia* were the rare plant species of this plant community.

In unprotected area of the same ecological unit (2.1) also 11 plant species were recorded in which *Ochthochloa compressa* was the leading dominant plant species. Associated plant species recorded in this community were *Capparis decidua, Cymbopogon schoenanthus, Desmostachya* bipinnata, *Eragrostis poaeoides, Fagoma arabica* and *Heteropogon contortus. Aristida motabilis, Bracharia villosa, Chrozophora hierosolimitana and Crotalaria mysorensis* were the rare plant species of this community. While comparing the protected and un-protected areas of ecological unit 2, it is clear that protection played a considerable role in the recovery of desirable tree and grass species. The invaders which were at higher side in unprotected area of both the ecological units were being replaced by the desirable tree and grass species.

The vegetation and landuse map (Fig 1) presents the ecological assessment of range vegetation and offer an integrated approach for future development.

Conclusion

The unprotected areas of both the ecological units 1.2 and 2.2 were degraded in terms of woodland dominance, while protected ecological units 1.1 and 2.1 showed dominance association trends of grasss-shrubland and woodlands, respectively. These differences were real and the major effect seemed due to protection. Mapping unit 3 (Fig 1) consisting of cultivated areas, was not considered for ecological assessment of rangelands. On the basis of this study it is recommended that rangelands must be protected from grazing particularly during the time when plants set their seeds. Protection is essential to maintain the desirable forage plants in good proportion and to avoid invader plant species.

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