

INDIGENOUS VEGETATION OF SOONE VALLEY: AT THE RISK OF EXTINCTION

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Abstract

This paper reports the results of the survey conducted to investigate the eco-geographic factors for *in-situ* conservation and description of location of various taxonomic and genetic diversity for the provision of critical assistance in the formulation of effective conservation campaign for target plant species near the point of extinction. A survey of the specific valley in mountainous region of Pakistan was performed on ten study sites in the valley, selected on the basis of variation in their ecological parameters. Data were assembled on the leguminous plants, but some non-leguminous species were also included to work out frequency, density and coverage / dominance in particular area and status as well as diversity of leguminous plants was determined based on this information. The results obtained on the eco-geographical attributes were discussed in this study in terms of frequency, density, species dominance/percentage as well as relative frequency, relative density and relative coverage/dominance of the given area. A further correlation study with the various attributes regarding different study sites and distribution of species was also counted in this survey. For the effective planning for conservation of precious plant species, it is very essential to get the set of full information about eco-geographical attributes and threatening factors. Therefore the current research survey was conducted to acquire the informations regarding various parameters and threats and adaptations of present species to their environments. Results showed that most observed plant species in this specific valley may be due to some morphological and anatomical as well as physiological adaptations to this environment which is mainly responsible for their survival and perpetuation in this harsh habitat.

Introduction

Pakistan lies between 24°-37 North latitude and 61°-75.5 East longitude, covering an area of 796,095 sq. km. Out of this area 468, 000 sq. km is in the north and west in the form of mountainous land and plateau while the remaining 3,28,000 sq. km comprises the plains. Environmental variability in Pakistan is enormous, ranging from high snowy Himalayan peaks in the north to the hot humid climate of shores of the Arabian Sea in the south (Anon., 2006).

The mountain regions of Punjab, edges of Suleman range near Rajan pur have hot mountainous type vegetation (Chaghtai *et al.*, 1983; Khan, 1991). Murree hills have sub-tropical pine forests and the higher elevations like Bhurban and Patriata favour the Himalayan moist temperate forests though, they are very limited. Margilla hills and Kalachitta hills have the sub tropical evergreen forests (Chaghtai *et al.*, 1978).

The range of hills extending in an irregular arc from the Jhelum River on the East to the Indus River in the West constitutes this salt range covering a length of about 150 miles. It takes its name from the important salts deposits, which are being quarried at present at Khewora, Warchha and Kalabagh. The salt range is situated between longitude

71°-30 and 73°-30 East and between the parallels of 32°-23 and 33° North latitude. The average height of range is about, 2,200 ft. above sea level. The highest point on the range is Skasar (5,010 ft); through out its length the salt range shows a typical aspect of having steep cliffs to the south but, descending gently to the plateau to the north (Ahmed, 1964).

In the heart of this range lies the Soone valley. The climate of valley is characterized by a relatively low annual precipitation (20 inches) and average minimum temperature is 1°C (January) while average maximum temperature is 36°C (June). Hot dry winds and prolonged periods of drought are frequent; winters are accompanied by frost. Summer and winter, both are cooler than those of adjoining plains and the winter season is also longer than that in plains (Hussain, 2002).

Biodiversity is a key feature of properly functioning grazed ecosystem. Legumes are one of the keystone plant species in productive grass lands (Sanderson *et al.*, 2002). Communities are recognized with differing floristic and environmental characteristics; plots from each of these communities are viewed in winter as well as in spring to gain insight into the vegetation (Bezuidenhout & Breden-Kamp, 1990; Kirk-Patrick, 1990; Smitheman & Perry, 1990).

The vegetation of salt range comprises both legumes and non legumes (Ahmed, 1964; Hussain, 2002). Legumes have the capacity to capture nitrogen from the soil atmosphere; this allows pastures and crops to maintain productivity without depletion of soil nitrogen and some times can grow under situations where soil nitrogen levels are very low and where growth of other plant would not be possible. Further more, when legume plants die, its organic matter is broken down; there is usually a net gain in organic nitrogen to the soil (Graham, 1992; Pearson *et al.*, 1993).

It is reported that leguminous species tolerate the drought due to the presence of nodules; however, the tolerance limit of the species depends on the nodule size. Initially nitrogen fixation decreased in response to water deficit prior to many other physiological processes and soil nitrogen accumulation (Andyking & Purcell, 2001).

Little is known about the geological history of the salt range vegetation; fossil records indicate that the angiosperms date back to the tertiary period while pre tertiary fossils have no angiosperm affinities (Hussain, 2002). The vegetation of the Soone valley is under the division "Sub-tropical dry evergreen forests". *Olea ferruginea* Royle and *Acacia modesta* Wall are recorded to be two characteristic trees of the area (Champion, 1936). Due to heterogeneity in the macro and microenvironment of the valley large plant and animal diversity is expected to be endemic to it (Hussain, 2002; 2003).

Scanty reports are available about the vegetation of this region. According to Ahmed (1964) the vegetation of plains of salt range (Soone Valley) consists of an open low forest in which Thorny usually hard woody species pre-dominate. The trees usually have short trunks and low branching crowns. The dominants vary from 12-20 feet in height and tend to be longer at elevation. However, higher altitude favorably affects the size and percentage cover of the plants. *Olea-pistacia* association has been reported as the climax vegetation of the salt range (Hussain, 2003).

Eco-geographic studies are an essential component of any *In-situ* conservation programme, not only because the studies describe the location of taxonomic and genetic diversity, but also provide critical assistance in the formulation of appropriate and effective conservation programme for target plant species.

In order to assess the present status of leguminous diversity of this valley, the work was undertaken to explore the diversity and status of available leguminous species particularly and generally non-leguminous plants.

Materials and Methods

Vegetation of Soon Valley (Punjab) was ecologically studied during 2002 and 2003 to understand the present status of the vegetation. Field survey of valley was performed for the accomplishment of said objective, which comprised of the following three aspects.

- i. Selection of sites
- ii. Collection of data
- iii. Analysis of data

Site selection: On the findings of a preliminary survey (Fig. 1), ten study sites viz., Anga Site, Champal site, Dape sharif site, Khabeki Site, Knotty Garden site, Khoora site, Noshera (vicinity) site, Skasar (vicinity) site, Sodhi Site and Ucchali Site were selected mainly on the basis of variation in their ecological attributes, especially topography, vegetation type and soil composition. The ecological attributes of each study site are given in (Table 1).

Data collection: For each site data were collected from three different habitats, considering differences in their elevation, ground position and soil type. Data were collected by quadrat method. Ten randomly selected quadrates measuring 10 m² for woody species and 1 m² for herbaceous plant species were taken from each habitat. The number of individuals of each leguminous, as well as, non-leguminous species was counted to work out the under mentioned parameters.

1. Species frequency
2. Species density
3. Coverage/ Dominance

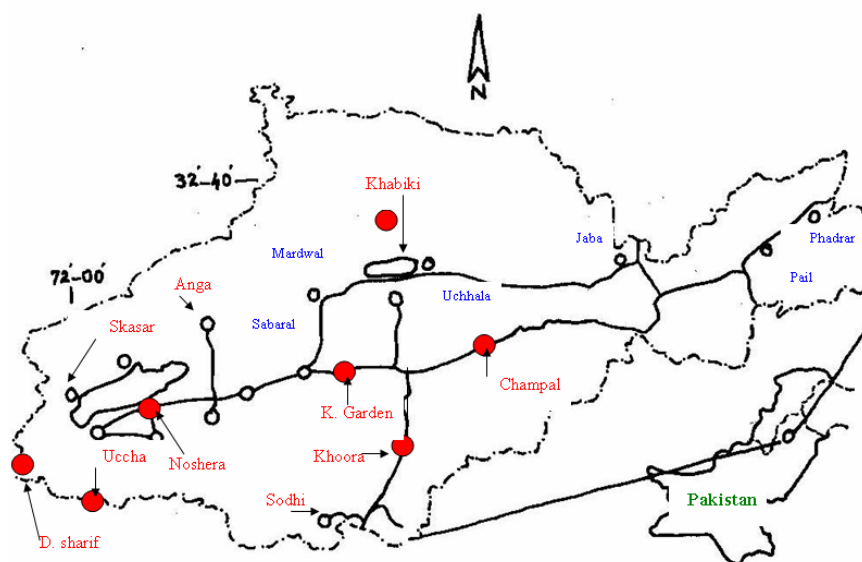


Fig. 1. Location of selected sites from Soone Valley.

From above information the following attributes were worked out and the status of available leguminous species were determined:

1. Relative frequency
2. Relative density
3. Relative coverage/ Dominance
4. Importance value

Following formulae were used to calculate the values:

$$\text{Frequency \%} = \frac{\text{Number of quadrates in which a species occurred}}{\text{Total number of quadrates taken}} \times 100$$

$$\text{Density \%} = \frac{\text{Total number of individuals of a species in a quadrate}}{\text{Total number of individuals of all the species in a quadrate}} \times 100$$

$$\text{Coverage/dominance \%} = \frac{\text{Area covered by a species in a quadrate}}{\text{Total area covered by all the species}} \times 100$$

$$\text{Relative frequency \%} = \frac{\text{Frequency value of a particular species}}{\text{Total frequency values for all the species}} \times 100$$

$$\text{Relative density \%} = \frac{\text{Density of a particular species in a site}}{\text{Total density for all the species in that site}} \times 100$$

$$\text{Coverage/dominance \%} = \frac{\text{Coverage/dominance of a particular species}}{\text{Total coverage/dominance for all the species within a stand}} \times 100$$

$$\text{Importance value} = \text{Relative density} + \text{relative frequency} + \text{relative coverage}$$

Classification of species: Available Leguminous species were classified by using the following frequency ranges (Table 2).

Table 2. Frequency ranges for classification of species.

Frequency range (%age)	Category	Symbol
1-20	Rare	R
21-40	Occasional	O
41-60	Frequent	f
61-80	Abundant	A
81-100	Very abundant	V.A

Results

Species frequency percentage: The six species differed significantly however, *Acacia modesta* was species which surpassed all of other five (Table 4). It scored the highest value of (64%) followed by *Acacia farnesiana* (42%). *Dalbergia sissoo*, *Medicago polymorpha*, *Melilotus indica* and *Vicia sativa* showed non-significant differences both from *Acacia modesta* and *Acacia farnesiana*.

Correlation among soil characteristics and species frequency showed that only pH value of soil had positive and significant relationship which means that pH played a significant role in the establishment of species in the particular site especially in case of *Acacia farnesiana* (Table 5).

Species density percentage: The data have clearly indicated that species density varied ($p > 0.05$ or 0.01 or 0.001) significantly varied at all study sites (Table 4). *Acacia farnesiana* showed maximum value but it differed non-significantly to that of *Acacia modesta*, *Medicago polymorpha* and *Vicia sativa*. Lowest value (1.28%) was calculated for *Dalbergia sissoo* showing significant variation with *Acacia modesta* and *Acacia farnesiana* but exhibited non-significant differences with remaining three species. As observed in correlation studies (Table 5) that only two species i.e. *Melilotus indica* had significant positive behavioral relationship with nitrogen content of soil while *Acacia farnesiana* indicated significant positive results towards pH value of soil.

Species coverage percentage: Coverage of species revealed that all the species varied ($p < 0.05$) significantly (Table 4). *Acacia modesta* attained the highest value (64.6%) followed by *Acacia farnesiana* (47.2%). The differences among *Dalbergia sissoo*; *Medicago polymorpha*; *Melilotus indica* and *Vicia sativa* were statistically ($p > 0.05$) non significant.

Correlation has shown species coverage percentage and different species showed that *Melilotus indica*; *Vicia sativa* and *Medicago polymorpha* shared highly significant negative relationship with respect to phosphorus concentration in the soil (Table 5).

As for as EC of soil was concerned *Acacia farnesiana* showed significant negative correlation, while *Acacia modesta* and *Dalbergia sissoo* had significant positive correlation with moisture contents of soil for this particular attribute.

Species relative frequency percentage: All the species differed ($p < 0.05$) significant for species relative frequency percentage (Table 4). *Acacia modesta* showed maximum value (9.67%) and shared non-significant ($p > 0.05$) differences only with *Acacia farnesiana* but differed ($p < 0.01$) significantly with *Dalbergia sissoo*, *Medicago polymorpha*, *Melilotus indica* and *Vicia sativa*. Correlation studies of this parameter (Table 5) towards soil attributes showed non-significant ($p > 0.05$) relationship.

Species relative density percentage: The data presented in Table 4 shows that the species had significant ($p < 0.01$) differences for relative density percentage. *Acacia modesta* among woody legume species showed maximum value and shared non-significant ($p > 0.05$) difference with only *Acacia farnesiana* and significant for other remaining four species. Although significant difference between *Acacia farnesiana* and *Dalbergia sissoo* but exhibited different response regarding *Medicago polymorpha*; *Melilotus indica* and *Vicia sativa*. All these species showed non significant ($p > 0.05$) differences and also with *Acacia farnesiana*.

Table 3. Available leguminous species indigenous to Soone Valley, Punjab, Pakistan.

Species name	Family
<i>Acacia farnesiana</i>	Mimosaceae
<i>Acacia hydaspica</i>	Mimosaceae
<i>Acacia modesta</i>	Mimosaceae
<i>Acacia nilotica</i>	Mimosaceae
<i>Albizia lebbeck</i>	Mimosaceae
<i>Argyrolobium stenophyllum</i>	Papilionaceae
<i>Dalbergia sissoo</i>	Papilionaceae
<i>Medicago laciniata</i>	Papilionaceae
<i>Medicago polymorpha</i>	Papilionaceae
<i>Melilotus alba</i>	Papilionaceae
<i>Melilotus indica</i>	Papilionaceae
<i>Prosopis glandulosa</i>	Mimosaceae
<i>Prosopis juliflora</i>	Mimosaceae
<i>Prosopis spicigera</i>	Mimosaceae
<i>Rhynchosia minima</i>	Papilionaceae
<i>Sophora mollis</i>	Papilionaceae
<i>Trigonella monantha</i>	Papilionaceae
<i>Vicia monantha</i>	Papilionaceae
<i>Vicia Sativa</i>	Papilionaceae

Significant negative correlations between *Medicago polymorpha* and *Melilotus indica* soil phosphorus content and *Melilotus indica* EC of the soil showed significant negative correlations with relative density percentage in case of *Vicia sativa* (Table 5).

Species relative coverage/dominance percentage: Significant differences were ($p < 0.05$) recorded between species relative coverage/dominance and species (Table 4). The studied species showed different behaviour to one another. *Acacia modesta* showed the maximum value followed by *Acacia farnesiana* but the difference between them was non significant ($p > 0.05$), however both species showed significant differences with remaining four species i.e., *Dalbergia sissoo*, *Medicago polymorpha*, *Melilotus indica* and *Vicia sativa*. All the remaining four species showed non-significant ($p > 0.05$) differences with one another as indicated in Table 5. The data regarding correlation studies, *Medicago polymorpha* showed highly significant negative relationship with phosphorous content of soil. Whereas significant negative and significant positive correlation with EC and pH of soil respectively for this species. *Dalbergia sissoo* and *Melilotus indica* showed significant positive and significant negative relationships regarding moisture and phosphorous contents of soil respectively.

Species importance value (RF+RD+RC): As indicated in Table 4 each species possessed significance values for species importance. *Acacia modesta* showed maximum value (31.67) followed by *Acacia farnesiana* (26.03) and differences were statistically non significant ($p > 0.05$) with one another. *Vicia sativa*, *Medicago polymorpha*, *Melilotus indica* and *Dalbergia sissoo* differed non-significantly for species importance. But they differed significantly ($p < 0.01$) with *Acacia farnesiana* and *Acacia modesta*.

Table 5. Correlation analysis.

Parameter	Species	Elevation	N	P	K	EC	pH	Moisture
Frequency (%)	<i>A. farnesiana</i>	-0.407	-0.147	0.421	-0.512	-0.767	0.931*	0.784
	<i>A. modesta</i>	0.549	-0.042	0.126	0.521	-0.698*	0.259	0.160
	<i>D. sissoo</i>	0.059	-0.188	0.292	0.423	-0.236	0.074	0.298
	<i>M. polymorpha</i>	0.474	-0.412	-0.566	0.128	-0.718	0.302	-0.118
	<i>M. indica</i>	0.565	-0.506	-0.557	0.249	-0.746	0.408	0.117
	<i>V. sativa</i>	0.143	-0.507	-0.133	-0.660	0.300	-0.281	0.123
Density (%)	<i>A. farnesiana</i>	-0.248	-0.265	0.691	-0.278	-0.595	0.878*	0.787
	<i>A. modesta</i>	0.414	-0.550	0.169	0.202	-0.157	0.084	0.606
	<i>D. sissoo</i>	-0.438	0.269	-0.087	0.452	0.310	0.028	0.480
	<i>M. polymorpha</i>	0.140	-0.112	0.263	0.073	-0.275	-0.264	-0.273
	<i>M. indica</i>	-0.357	0.834*	0.380	0.214	0.492	-0.381	-0.351
	<i>V. sativa</i>	0.250	-0.216	-0.498	-0.277	-0.207	0.110	0.029
Coverage / dominance (%)	<i>A. farnesiana</i>	-0.643	0.068	0.378	-0.474	-0.929*	0.952	0.876*
	<i>A. modesta</i>	0.046	-0.083	-0.154	0.162	-0.484	0.265	0.310
	<i>D. sissoo</i>	-0.337	-0.213	0.346	0.072	-0.177	0.548	0.906*
	<i>M. polymorpha</i>	-0.105	-0.337	-0.917**	-0.446	-0.694	0.722	0.229
	<i>M. indica</i>	0.135	-0.346	-0.851*	-0.548	-0.236	0.242	0.505
	<i>V. sativa</i>	0.134	-0.233	-0.804*	-0.152	-0.504	0.454	0.000
Relative frequency (%)	<i>A. farnesiana</i>	-0.223	-0.075	0.660	0.003	-0.354	0.783	0.412
	<i>A. modesta</i>	0.133	0.434	0.285	0.652	-0.289	0.156	-0.123
	<i>D. sissoo</i>	-0.128	0.160	0.434	0.643	-0.273	0.151	0.261
	<i>M. polymorpha</i>	0.359	-0.309	-0.625	0.223	-0.784	0.448	-0.032
	<i>M. indica</i>	0.385	-0.276	-0.615	0.293	-0.819	0.513	0.167
	<i>V. sativa</i>	-0.217	-0.421	-0.243	-0.596	-0.035	0.185	0.420
Relative density (%)	<i>A. farnesiana</i>	-0.231	-0.286	0.727	-0.254	-0.583	0.863	0.811
	<i>A. modesta</i>	-0.160	0.011	0.112	0.250	0.005	-0.090	0.526
	<i>D. sissoo</i>	-0.447	0.180	-0.176	0.360	0.313	0.043	0.518
	<i>M. polymorpha</i>	0.057	-0.322	-0.981**	-0.023	-0.626	0.524	0.281
	<i>M. indica</i>	0.005	-0.083	-0.908*	-0.273	-0.638	0.566	0.430
	<i>V. sativa</i>	-0.327	0.007	-0.439	-0.026	-0.753*	0.849	0.491
Relative coverage / dominance (%)	<i>A. farnesiana</i>	-0.318	0.026	0.648	0.032	-0.403	0.819	0.406
	<i>A. modesta</i>	-0.206	-0.043	-0.133	0.210	-0.484	0.467	0.507
	<i>D. sissoo</i>	-0.374	-0.263	0.187	-0.002	-0.145	0.526	0.902*
	<i>M. polymorpha</i>	-0.154	-0.362	-0.914**	-0.423	-0.767*	0.755*	0.315
	<i>M. indica</i>	-0.033	-0.353	-0.918**	-0.560	-0.386	0.441	0.718
	<i>V. sativa</i>	-0.070	-0.310	-0.734	-0.229	-0.627	0.759	0.421
Importance value (RD + RF + RC)	<i>A. farnesiana</i>	-0.269	-0.120	0.705	-0.084	-0.472	0.855	0.576
	<i>A. modesta</i>	-0.121	0.130	0.032	0.466	-0.389	0.283	0.476
	<i>D. sissoo</i>	-0.278	0.043	0.274	0.475	-0.122	0.244	0.554
	<i>M. polymorpha</i>	0.093	-0.369	-0.948**	-0.084	-0.806*	0.643	0.217
	<i>M. indica</i>	0.157	-0.234	-0.913*	-0.130	-0.749	0.595	0.443
	<i>V. sativa</i>	-0.268	-0.205	-0.555	-0.243	-0.649	0.786*	0.530

Correlation studies (Table 5) revealed that *Medicago polymorpha* shared highly significant negative correlation with phosphorus content of soil while significant negative correlation with EC of soil. *Melilotus indica* showed significant negative correlation with soil phosphorus, on the other hand *Vicia sativa* possessed positive correlation with soil pH value.

Discussion

For the formulation of an effective plan for *ex-situ* and *in-situ* conservation species, it is very necessary to get the true picture of species; information about habitat, ecological factors and the disturbing factors prevailing there. Therefore the present studies were

conducted on the vegetation of Soone valley and the above mentioned results were obtained for the assessment and current status of species indigenous to this particular region, above described observation were used to evaluate soil and vegetation degradation (Dalsted, 1988). Species importance values were calculated from plots for their density and frequency values as indicated by McDowell *et al.*, 1983. The species were described in terms of rare, vulnerable and endangered. In the present studies the frequency and density values of species were calculated by using quadrature method, these results are in line with those obtained by Sharma *et al.*, (1983) while working on forest vegetation and classification survey studies.

The interpretations has been made on the basis of relationship between vegetation types, elevation, soil composition and soil mineral contents which are mostly used informative criteria to describe the plant diversity of a particular area.

To make the study more scientific and representative of that particular site, the observations were made for vegetation types, soil characteristics and different plant communities existed at various heights. The study of seasonal variation in plant diversity is also necessary to estimate the importance of the plant community. Therefore sites were viewed in spring as well as in winter to figure out plant communities existed in these seasons. Similarly the environmental factors affecting the vegetation, the moisture level of soil were the primary determinant of plant growth and distribution which in turn are controlled by soil composition, soil types, and mineral nutrients of soil and topography were also recorded for the particular selected sites. The findings of the present study are in agreement to the findings of some earlier researchers (Sharma *et al.*, 1983; Austin & Heyligers, 1989; Kirk-Patrick, 1990), in different regions of the world.

Table 6. Classification of available leguminous species indigenous to Soone Valley, Punjab, Pakistan.

Species name	Family	Category
<i>Acacia farnesiana</i>	Mimosaceae	Frequent
<i>Acacia hydasypica</i>	Mimosaceae	Rare
<i>Acacia modesta</i>	Mimosaceae	Very Abundant
<i>Acacia nilotica</i>	Mimosaceae	Rare
<i>Albizzia lebbeck</i>	Mimosaceae	Occasional
<i>Argyrolobium stenophyllum</i>	Papilionaceae	Rare
<i>Dalbergia sissoo</i>	Papilionaceae	Frequent
<i>Medicago laciniata</i>	Papilionaceae	Abundant
<i>Medicago polymorpha</i>	Papilionaceae	Rare
<i>Mellilotus alba</i>	Papilionaceae	Rare
<i>Mellilotus indica.</i>	Papilionaceae	Frequent
<i>Prosopis glandulosa</i>	Mimosaceae	Rare
<i>Prosopis juliflora.</i>	Mimosaceae	Rare
<i>Prosopis spicigera</i>	Mimosaceae	Rare
<i>Rhynchosia minima</i>	Papilionaceae	Rare
<i>Sophora mollis</i>	Papilionaceae	Rare
<i>Trigonella monantha</i>	Papilionaceae	Rare
<i>Vicia monantha</i>	Papilionaceae	Rare
<i>Vicia Sativa</i>	Papilionaceae	Abundant

Results obtained on the various parameters for species importance studied in this valley frequency (6.66-90.00), density (0.55-13.00), coverage (7.00-84.00), relative frequency (0.05-2.93), relative density (0.09-15.38), relative coverage (0.66-17.39) and importance values (1.62-39.87) respectively from ten ecologically diverse sites corroborated with the work on some earlier researchers like Austin & Heyligers, (1989) and Kirk-Patrick (1990). Smitheman & Perry(1990) who supported the above criteria and described plant communities of different areas of the world. In the present investigation all the observed species were classified according to their frequency ranges. *Acacia modesta* was the only very abundant species followed by *Medicago laciniata* and *Vicia sativa* both of which were under the category of abundant. *Acacia farnesiana*, *Dalbergia sissoo* and *Melilotus indica* were frequent species of the valley *Albizia lebbeck* was the only occasional species of this region. Remaining twelve species viz., *Acacia hydasypica*, *Acacia nilotica*, *Argyrolobium stenophyllum*, *Medicago polymorpha*, *Melilotus alba*, *Prosopis glandulosa*, *Prosopis Juliflora*, *Prosopis spicigera*, *Rhynchosia minima*, *Sophora mollis*, *Trigonella monantha* and *Vicia monantha* can be placed in the category of rare. The criteria of classification fixed in the present study was strongly supported by the findings of Hussain, (2002) from Pakistan.

The species variation in plants from site to site may be due to the soil type, composition of soil; elevation of selected sites; moisture content of soil; Nature of disturbance like grazing pressure; human interference, distance of study site from population area etc. All these factors determine the category of species in which the species fall. From the results it can be concluded that *Acacia modesta* is the most abundant species in the Soone valley that may be due to its adaptation to the environment and osmotic adjustment to various types of environments under both winter and summer season; This species was found to be most successful in maintaining its high diversity that may also be due to its strong root system, as a result of which it may be able to absorb the nutrients from different depth and from different type of soil. Similar observation were also reported by Ahmad, (2002) and Hussain (2002, 2003) in Pakistan while working on exploration of vegetation indigenous to Soone Valley.

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