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# STATUS OF PLANT DIVERSITY IN THE SOONE VALLEY, SALT RANGE, PAKISTAN

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**Abstract**

The aim of the present study was to access the current status of biodiversity in Soone Valley of Salt Range, Pakistan. For this purpose, the Valley was divided into six main regions (Khabeki, Khoora, Dape Sharif, Anga, Knotti Garden and Jallar) depending of their geographic location, geophysical attributes and vegetation type. The total number of species existing in that area was recorded and data for their density, frequency and cover values were collected. The data were analyzed using Canonical Correspondence Analysis (CCA). Results showed a highly significant variation in these phyto-sociological attributes at various study sites. Among all study sites, Khoora had the highest vegetation diversity while the frequency values were almost equal at Khoora and Khabeki sites. Surprisingly, Khabeki, Khoora and Anga sites had the highest effect on vegetation cover while all other sites (Dape Sharif, Knotti Gardena and Jallar) had a little effect on vegetation cover. Among all species recorded in this study, *Prosopis juliflora*, *Nerium oleander*, *Diclyptera bupleuroides*, *Buxus papillosa* and some others did not showed any significant effect of sites. It was concluded that Khoora, Khabeki and Anga sites were the richest in biodiversity while Dape Sharif, Knotti Gardena and Jallar having the lowest density, frequency and cover values were at the high risk of biodiversity loss.

## Introduction

Salt Range has a very rich floral diversity and a treasure of valuable natural resources. The area has a mountainous dry subtropical climate with semi-evergreen forests, typically with *Acacia modesta, Dodonaea viscosa, Olea ferruginea, Reptonia buxifolia and Salvadora oleoides*. Broadly three types of vegetation such as the subtropical semi-evergreen forests, dry tropical thorny evergreen forests and the degraded scrubs can be found in the Salt Range. The sub-tropical semi evergreen forests comprise mainly of *Acacia modesta, Olea ferruginea* and *Dodonaea viscosa*. This type of forest occupies mainly the high elevated hill tract above 750 m. The dry tropical thorny evergreen forests includes *Acacia nilotica, Salvadora oleoides, Capparis decidua*, and *Maytenus royleanus* etc. and degraded scrubs are mostly those plants with stunted growth and under extreme grazing pressure (Said, 1951; Khan, 1960; Ahmad *et al*., 2010).

Overall, the vegetation of the Salt Range has been placed under the division of sub-tropical dry evergreen forests. *Acacia modesta* and *Olea ferruginea* were recorded to be the two distinguishing trees of the area (Champion, 1936). However, it is exposed to severe habitat losses resulting in accelerated usage of physical and biological resources (Ahmad & Waseem, 2004). Geophysically, the Salt Range consists of two distinct hill tracts running parallel, from the east to southern-west direction. The parallel series of mountains are repeatedly intervened by ridges and hills leading to the formation of valleys and lakes of diverse phyto-geographic and agro-climatic regimes (Ahmad *et al.*, 2010).

The majority of the species are threatened by physical stresses and anthropogenic disturbances, such as *Litsea* and *Neolitsea* are greatly exploited for their marketable bark products. These species are also widely used in the ethno-veterinary medicines. Such extensive uses are common threats to most of the plant species. They have narrow ecological amplitude and their unwise use has threatened their survival in the Salt Range (Ahmad *et al*., 2002; Naz *et al*., 2010). At present, there is little understanding of current status for conservation or a collection plan, and so this natural resource faces significant risk of depletion. Keeping in view all these facts, a detailed vegetation survey was planed to evaluate the current status of plant diversity in the Soone Valley of Punjab, Pakistan.

## Material and Methods

The valley was extensively surveyed for vegetation studies and enlisting of plant species, especially the medicinally important plants. The valley was divided into six main regions (Khabeki, Khoora, Dape Sharif, Anga, Knotti Garden and Jallar) depending upon their distance from a main city of Naushera. Twenty transect lines were laid (each of 200 m long) at different areas within each region. Ten quadrats (10 x 10 m for trees and large shrubs, 5 x 5 m for shrubs and under-shrubs, and 1 x 1 m for forbs and grasses) were laid at each transect line, each separated by 20 m from the subsequent quadrat. Density, frequency and percent cover of each species using following formulae:

$$\text{Density (\%)} = \frac{\text{Total no. of individuals of a species in a quadrate}}{\text{Total no. of individuals of all species in a quadrate}} \times 100$$

$$\text{Frequency (\%)} = \frac{\text{No. of quadrates in which a species occurred}}{\text{Total no. of quadrates taken}} \times 100$$

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

**Statistical analysis:** The data for species density, frequency and cover was analyzed by Canonical Correspondence Analysis (CCA) using Canoco computer package for MS Windows (version 4.5).

## Results

For the development of an effective plan for identification of threats and conservation of plant species, it is necessary to get the true picture of species, information about habitat at different sites, ecological factors and the disturbing factors prevailing there in. These objectives were achieved by conducting an extensive survey of the vegetation and analyzing the data for species density, frequency and percent cover. The results of the present study are as follows:

**Density:** The *CCA* of density data indicated highly significant variations ($p<0.001$, eigenvalue 0.302) along axis 1 (Table 1). It was observed that species in group I was associated with Khoora, Jallar and Anga, however, *Melilotus indica* (30), *Salvia moocroftiana* (36) and *Solanum surratens*e (40) were more associated with Anga and *Ziziphus nummularia* (10), *Alternanthera sessilis* (14), *Fagonia indica* (26), *Cyperus niveus* (48), *Withania coagulens* (45), *Peganum hermala* (35) and *Veronica arvensis* (53) had more density values at Khoora. Species of group II, III and IV were associated with Khabeki, Knotti Garden and Dape Sharif respectively. Although species of group V had more distribution in Khoora, Jallar and Anga sites, however less than group I species. Species in group VI were equally distributed between group I, II and III in Khoora, Jallar and Anga sites. Species in group VII and VIII showed relatively less effect of sites on their distribution. However, these seem to be a little associated with Dape and Knotti Garden. Species in group IX were distributed equally in Khabeki and Knotti Garden sites (Fig. 1).

**Table 1. Summary of eigenvalues from CCA of the vegetation data for species density, frequency and cover at various study sites.**

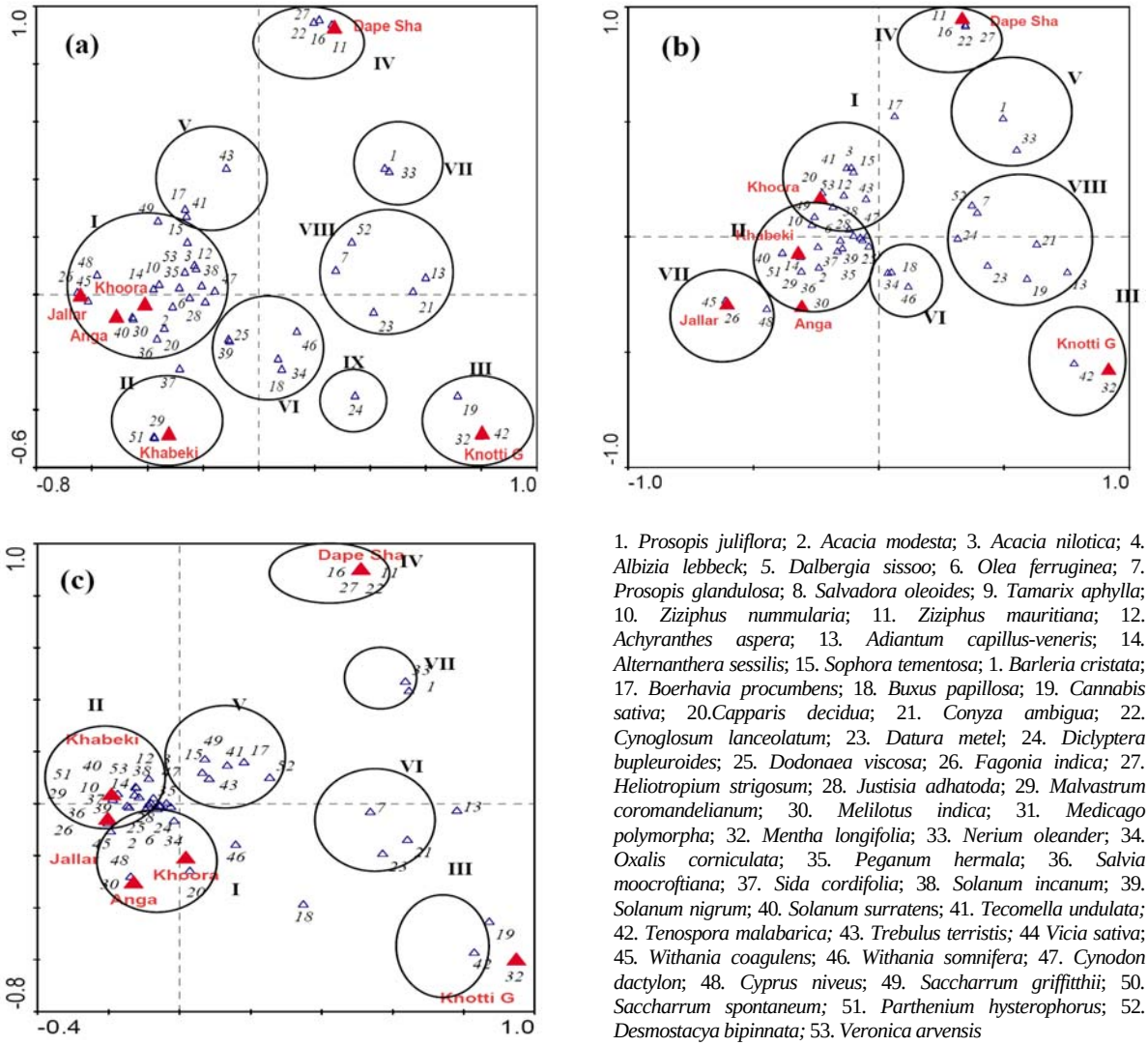
| Parameters and data | Axes | | Total inertia | F-ratio | *P* value |
|---|---|---|---|---|---|
| | 1 | 2 | | | |
| Density | 0.302 | 0.071 | 0.784 | 12.114 | 0.0020 *** |
| Frequency | 0.248 | 0.111 | 1.032 | 5.816 | 0.0020 *** |
| Cover | 0.252 | 0.065 | 0.616 | 13.570 | 0.0020 *** |

**Frequency:** The *CCA* Ordination biplot of frequency data also showed highly significant variation ($p<0.001$, eigen value 0.248). *CCA* ordination bi plot of frequency of species atd different sites showed that most of the species (Group-I and Group-II) were associated with Khoora site. In Group-II most of species were frequent at Anga and Khabeki sites. In Group-III, *Mentha longifolia* (32) and *Tenospora malabarica* (42) were frequent at Knotti Garden. At Dape Sharif species of Group-IV were strongly associated. Species of Group-V were associated with Dape Sharif but less than Group-IV. Species of Group-VI were equally associated with Anga, Khabeki and Knotti Garden sites. Species of Group-VII were associated with Jallar. However, species of Group-VIII had frequency associated with both Knotti Garden and Dape Sharif but more with Knotti Garden.

**Plant cover:** The *CCA* of cover data showed highly significant variations ($p<0.001$, eigen values, 0.252). The *CCA* bi plot of plant cover at different sites showed that different species had different cover values at different sites. Species of Group-I had more association with Anga and Khoora sites, however *Melilotus indica* (30) and *Capparis decidua* (20) were entirely associated with Anga and Khoora sites respectively. Species of Group-III were frequent at Khabeki site. Species *Justisia adhatoda* (28) and *Datura metel* (23) were equally associated with Anga, Khoora and Khabeki sites where as *Fagonia indica* (26) and *Withania coagulens* (45) were associated with Jallar. Species of Group-III and Group-IV were entirely associated with Knotti Garden and Dape Sharif. Species of Group-V had some association with Khabeki and Khoora but less than Group-I and Group-II. Species of Group-VI were more associated with Knotti Garden and of Group-VII more associated with Dape Sharif.

## Discussion

Of the environmental factors affecting the vegetation, the moisture level of soil resulting from rainfall is the primary determinant of plant growth (Skarpe, 1990; Michael *et al.,* 2002; Hameed *et al.,* 2011) and distribution which is also controlled by soil composition, soil type and mineral nutrients of soil and topography. The results of present study are in accordance with Austin and Heylgens (1989) and Smitheman and Perry (1990) who supported the criteria mentioned above in determining the distribution of plant communities in the world.




1. *Prosopis juliflora*; 2. *Acacia modesta*; 3. *Acacia nilotica*; 4. *Albizia lebbeck*; 5. *Dalbergia sissoo*; 6. *Olea ferruginea*; 7. *Prosopis glandulosa*; 8. *Salvadora oleoides*; 9. *Tamarix aphylla*; 10. *Ziziphus nummularia*; 11. *Ziziphus mauritiana*; 12. *Achyranthes aspera*; 13. *Adiantum capillus-veneris*; 14. *Alternanthera sessilis*; 15. *Sophora tementosa*; 1. *Barleria cristata*; 17. *Boerhavia procumbens*; 18. *Buxus papillosa*; 19. *Cannabis sativa*; 20.*Capparis decidua*; 21. *Conyza ambigua*; 22. *Cynoglosum lanceolatum*; 23. *Datura metel*; 24. *Diclyptera bupleuroides*; 25. *Dodonaea viscosa*; 26. *Fagonia indica;* 27. *Heliotropium strigosum*; 28. *Justisia adhatoda*; 29. *Malvastrum coromandelianum*; 30. *Melilotus indica*; 31. *Medicago polymorpha*; 32. *Mentha longifolia*; 33. *Nerium oleander*; 34. *Oxalis corniculata*; 35. *Peganum hermala*; 36. *Salvia moocroftiana*; 37. *Sida cordifolia*; 38. *Solanum incanum*; 39. *Solanum nigrum*; 40. *Solanum surratens*; 41. *Tecomella undulata;* 42. *Tenospora malabarica;* 43. *Trebulus terristis;* 44 *Vicia sativa;* 45. *Withania coagulens*; 46. *Withania somnifera*; 47. *Cynodon dactylon*; 48. *Cyprus niveus*; 49. *Saccharrum griffitthii*; 50. *Saccharrum spontaneum;* 51. *Parthenium hysterophorus*; 52. *Desmostacya bipinnata;* 53. *Veronica arvensis*

Fig. 1. A CCA ordination biplot showing species density (a), frequency (b) and percent cover (c) at various study sites in Soone Valley.

Spatial variation showed that most of the salt tolerant species such as *Fagonia indica* and *W. cogulans* were distributed around Jallar as it is a saline area (soil characteristics are already published in Ahmad *et al.*, 2011). It also had high field capacity which helps to maintain more moisture even when it rained rarely. Most of the herbs and shrubs were distributed around Khoora which is fertile area around cultivated lands and grazing is the common threat and tree species are mostly very sensitive to grazing where as grasses and herbs are tolerant. Some species were associated with Khabeki as macronutrients and field capacity was more associated with this site.

*Cannabis sativa*, *Mentha longifolia* and *Tinospora malabarica* were entirely associated with Knotti Garden around the water springs as these species are mostly found at high moisture containing sites (Dupont & Plummer, 1997) and dry spell is a threat for these species. Moreover enough macronutrients were also available at Knotti Garden (Ahmad *et al.*, 2011) which is essential for maximum growth of herbs (Nanette *et al.*, 2007). There were many groups of species which were distributed between Dape, Khabeki and Knotti Garden sites as their distribution was almost equal at all these sites depending upon their requirements. *Nerium oleander* is also found around moist places. It was equally associated between moist places of Dape Sharif and Knotti Garden. Species of group VIII were also equally associated between Dape Sharif, Knotti Garden and Khabeki sites due to their requirement for macronutrients (Skarpe, 1990; Nanette *et al.*, 2007; Ahmad *et al.*, 2008).

Most of the species were more frequent around Khabeki and Khoora due to its association with macronutrients and high field capacity (Ahmad *et al.*, 2011). Salt and drought tolerant species were associated around Jallar. Moisture loving and moderately moisture requiring species were associated with and equally between the Knotti Garden and Dape Sharif. Among the sites, most of the species showed maximum plant cover at Khabeki site followed by Khoora depending upon the

enough availability of nutrient, moisture and suitable temperature (Dupont & Plummer, 1997; Nanette *et al*., 2007; Naz *et al*., 2010), salt and drought tolerant species showed maximum cover at Jallar and water loving species at Knotti Garden and Dape Sharif (Dupont & Plummer, 1997). Most of the species showed higher importance values around summer and few during autumn whereas spring and winter had least association with importance values (Ahmad *et al*., 2009).

In sites, Khabeki, Khoora and Anga showed high importance values for most of the species. Moisture loving plants had higher importance value at Dape Sharif and Knotti Garden (Dupont & Plummer, 1997) whereas salt and drought tolerant at Jallar site. The spatial variations might be due to the soil type, composition of soil, elevation of selected sites, moisture contents of soil, nature of disturbance like grazing pressure, human interference and distance of study site from population area etc. All these factors determined the group in which the species fall. From the results it can be concluded that among medicinal plants, *Justicia adhatoda* was the most abundant species in the Soone Valley. That might be due to its adaptations to the environmental and osmotic adjustment to various types of environments during all the seasons. This species was successful in maintaining its high diversity that might also be due to its strong root system, as a result of which it may be able to absorb the nutrients from the different depth and from different types of soils (Ahmad *et al*., 2011).

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