Benchmark of Plant Communities of Cholistan Desert

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Abstract: In Cholistan desert various landform units and associated plant communities were recognized. Out of sixteen, ten communities were identified in smaller Cholistan i.e. Calligonum polygonoides–Haloxylon salicornicum, Tamarix aphylla–Suada fruticosa, Haloxylon recurvum, Calligonum polygonoides–Lasius scindicus–Cyperus conglomatus, Prosopis cineraria–Haloxylon salicornicum, Capparis decidua–Aerva persica–Haloxylon salicornicum – Haloxylon recurvum, Capparis decidua–Calligonum polygonoides and Haloxylon recurvum–Haloxylon salicornicum. While six plant communities were identified in greater Cholistan viz; Calligonum polygonoides–Haloxylon salicornicum–Dipterygium glaucom, Calligonum polygonoides–Aerva pseudodentomosa, Haloxylon salicornicum, Calligonum polygonoides–Aerva pseudodentomosa – Panicum turgidum, Calligonum polygonoides and Ochthochloa compressa. Thrauphytes were dominant during the rainy season and initially colonized the bare sand dunes. Perennial trees, shrubs, grasses and herbs were of the stable plant communities.

Key words: Plant communities, Cholistan, landforms, thrauphytes, perennial, desert

Introduction

The vegetation of Cholistan desert is typical of arid regions and represents xerophytic species adapted to extremes of salinity, temperature, moisture fluctuations and wide variety of endemic factors. Compared with the hyper arid southern region, vegetation cover is comparatively better in Greater Cholistan. A wide variety of nutritious and multiple stress tolerant species of grasses, shrubs and trees grow there. These plant species, though slow growing, respond very well to the favourable climatic conditions particularly, the timely rains and produce ample fodder. Important genera of grasses include Lasius, Conchorus, Sporobols, Cymbopogon and Panicum; shrubs include Suada, Capparis, Calligonum, Lepidocaulus, Salacia & Haloxylon, Prosopis, Tamarix, Zygophyus and Acacia are notable indigenous trees. Each site depicts a typical plant community with xeric genetic adaptations (Akbar et al., 1996; Akbar & Arshad, 2000).

Communities, in fact are the mirrors of landmass or indicators of land’s biological resources. Based upon this information, the plant communities are reliable indicators of environments and economic potentials of the area. Update benchmark about plant communities in Cholistan desert being presented in this paper will be the basis of future planning particularly with regard to conservation strategies of biological resources, management of ranges and other developmental activities. No concrete information is available about the plant communities of Cholistan however, Dasti and Agnew (1994) recognized six of them. Apparently they scanned a very small area of the desert. Arshad and Rao (1965) studied the vegetation pattern in Cholistan desert in relation to the physiographic states. Rao et al. (1989) explored the vegetation of Cholistan desert and identified eleven distinct phytosociological categories. Arshad et al (2002) identified plant communities in fenced and unfenced desert reserve areas of National Park, Lalsuwarna. Investigations on phytosociological distribution of plants have been conducted by Iqrae et al. (2000); Qain (1989) and Qain et al. (1996). To study the vegetation of Cholistan desert, much stress has been paid to the plant communities.

The vegetation of Cholistan desert has not so far been studied properly. The present study is the first rational approach to explore the plant communities of Cholistan desert. Besides this it is a matter of significance that several plant species collected during this study and incorporated in this manuscript are new record from this desert as these plant species have never been reported previously from Cholistan desert. The main objectives of this study were:

* To explore the benchmark of plant communities of Cholistan desert.

Materials and Methods

Study area: Cholistan desert located in southern Punjab, Pakistan occupies about 26000 km² area having a length of about 480 km and the width varying from 32 to 102 km. This desert can be divided into two geomorphic regions; the northern region or Lesser Cholistan, bordering canal irrigated areas and the southern region or the Greater Cholistan. The Lesser Cholistan consists of large saline alluvial flats locally called ‘dahars’ alternating with low sandy ridges/sand dunes. The Greater Cholistan is a wind eroded sandy terraced desert having large sand dunes and less depressions with dune heights of 100 m or so (Akbar et al., 1996; Akbar & Arshad, 2000).

Climate: Cholistan is a hot arid sandy desert. The mean annual rainfall varies from less than 100 mm in the west to 250 mm in the east. Rain usually falls during monsoon with a few showers in winter and spring. Cholistan is one of the hottest deserts in Pakistan. Mean minimum temperature is 20°C. The mean maximum summer temperature (May–June) is 34°C with the highest reaching above 51°C (Arshad et al., 2002). Prolonged sand/dust storms are the most striking features of this desert. Low rainfall, high rate of water infiltration coupled with high evaporation prevents the accumulation of surface water. Fresh rainwater is collected in dug out playas (water ponds locally called ‘tobas’) for subsequent use. Underground brackish water is at a depth of 30-40 m with an E.C. level ranging from 200-2900 mg/hectare (Anonymous, 1993).

To assess the plant communities in the representative habitats of Cholistan desert, several plant collecting trips were undertaken from 1999 to 2000. The representative habitats (collecting study sites) were selected on the basis of differing species composition, their density, overgrowing, texture and structure of soil, dune height and other related factors. To record the vegetation parameters like plant cover, frequency and density line intercept method was used (Canfield, 1940; Mueller-Dombois and Ellenberg 1974).

Results and Discussion

In Cholistan desert, sixteen plant communities were identified in different land forms. Out of these sixteen plant communities, ten were identified in Smaller (south western) Cholistan and six in Greater (north eastern) Cholistan. The composition and structure of these plant communities are being described along with their habitats.
Arshad and Akbar: Benchmark of plant communities of Cholistan desert

I - Smaller Cholistan

Calligonum polygonoides-Haloxylon salicornicum community

Habitat: Deep hummocky arid soil with clayey substratum. Supposedly originated around individual clumps of plants apparently because of grazing activity of animals loosening the fragile soil layers and making it erodible.

Composition and Structure: The top plant layer is composed of Calligonum polygonoides followed by Haloxylon salicornicum. Other plant species found in the area were: Prosopis cineraria, Capparis decidua, Leptadenia pyrotechnica, Calotropis procera (seedlings), Crotophala barbata, Heliotropium strigosum, Diplopygium glaucescens, Indigofera argentea, Tribulus lucipetalus, Linum indicum, Aerva persica, Fagonia stricta, Corchorus depressus, Polygala eriopetala, Boerhavia diffusa, Haloxylon recurvum, sesuvium sesuvioides, Tribulus longipetalus, Euphorbia prostrata and Mollugia cerviana. Among the grasses and sedges are Lasiurus scindicus, Conulus biflorus, Conclusus ciliaris, Aristida mutabilis, Aristida adscensionis, Eragrostis barbata, Stipagrostis plumosa, Leptodiaphora sanagense, Conclusus ciliaris, Cyperus conglomeratus, Orchtchocha compressa and Cymbopogon jwarancusa were prominent. Aristida spp. and Conclusus biflorus density is very high because this area had been subjected to heavy grazing pressure in the past. Palatable grasses like Stipagrostis plumosa, Lasiurus scindicus and Conclusus ciliaris are making a come back but slowly. Aristida species and Conclusus biflorus may decrease with the increase in vegetation cover by other species.

Tamarix aphylla-Suaeda fruticosa community

Habitat: Levelled habitat shaping up by the flow of water into or through the area or after the erosion of upper deposits of fine silt. The soil is clayey and highly saline.

Composition and structure: The community consist of Tamarix aphylla as the first strata, followed by Suaeda fruticosa as the second dominant. Other associated plants are: Prosopis cinerarie, Cleome brachycarpa, Cressa cretica, Fagonia cretica, Farsetia bracteata, Euphorbia prostrata, Triandroma crystallina and Sesuvium sesuvioides. The grass species at this community area are: Antheropus lagopus, Sperpolius subacutus, Cymbopogon jwarancusa and Orchtchocha compressa. This community is a typical of saline soils, moisture remains available to the plants for longer period.

Haloxylon recurvum community

Habitat: Flat piece of land with silty clay loam or clay loam but alkaline in nature.

Composition and structure: Haloxylon recurvum bushes are interspersed with some Haloxylon salicornicum and Salsola barysma shrubs. Other plant species found are: Acacia nilotica (seedling), Aerva persica, Fagonia cretica, Corchorus depressus, Euphorbia prostrata, Sesuvium sesuvioides, Triandroma crystallina and Antheropus lagopus. Among the grasses and sedges are Aristida mutabilis, Aristida byzantina, Orchtchocha compressa, Cymbopogon jwarancusa and Eragrostis barbata are the prominent species of this community. Obviously a halophytic community consisting of only Haloxylon recurvum and some of the highly salt tolerant species, low salinity tolerant are present on the accumulated patches of soil.

Calligonum polygonoides-Lasiurus scindicus-Cyperus conglomeratus community

Habitat: A large and tall dune with sandy composition showing some fine soil in deeper layers.

Composition and structure: This differs from the Calligonum polygonoides-Haloxylon salicornicum community in that Haloxylon salicornicum is occasionally present but not as a dominant component because of greater depth of soil. Lasiurus scindicus and Cyperus conglomeratus appear to be the distinct and dominant component of this community. The species present here are: Haloxylon salicornicum, Aerva persica, Diplopygium glaucescens, Farsetia bracteata, Calotropis procera (seedlings), Linum indicum, Gisiska pharmacoeides, Tribulus longipetalus, Boerhavia diffusa, Mollugia cerviana, Polygala eriopetala, Mucia madraspatana, Antichloris linearis and Convalvulus microphyllus. Grasses and sedges found at this community are: Conclusus biflorus, Conclusus ciliaris, Aristida mutabilis, Aristida adscensionis, Conclusus pruriens, Panicum turgidum, Cyperus conglomeratus, Lasiurus scindicus, Cymbopogon jwarancusa and Leptotrichium sapanalese.

Prosopis cineraria-Haloxylon salicornicum community

Habitat: Old bed of the dried up "Hekra" river, mostly flat terrain with small sandy hummocks of sandy loam soil.

Composition and structure: Strikingly this community is having two storeys of the old and young trees of Prosopis cineraria over and above the Haloxylon salicornicum layer forming the third storey with some bushes of Suaeda fruticosa and Aerva persica. A very characteristic feature of this community is the abundance of dwarf annual Aristida hystriculata forming small tussocks in the landscape and the other species are: Aerva persica, Suaeda fruticosa, Diplopygium glaucescens, Antichloris linearis, Tribulus terestris, Tribulus longipetalus, Cleome scaposa, Triandroma crystallina, Corchorus depressus, Euphorbia prostrata and Citrullus colocynthis. Cymbopogon jwarancusa, Conclusus biflorus, Ochthochloa compressa, Aristida hystriculata, Tragus racemosus and Eragrostis barbata are the important grasses and sedges of the area.

Capparis decidua-Aerva persica-Haloxylon recurvum-Haloxylon salicornicum community

Habitat: An old and stable 4-5 m high dune partially eroded and covered with small concretions.

Composition and structure: An interesting dune-dune community with a combination of Capparis decidua, Haloxylon recurvum and Haloxylon salicornicum. The top storey is formed by Capparis while the two Haloxylon spp. form the second layer. The third layer is composed of Aerva persica, Chrozophora plicata. The other species present are: Crotophala barbata, Diplopygium glaucescens, Calotropis procera (seedlings), Tribulus longipetalus, Citrullus colocynthis, Cucumis melo spp. Fagari, Sesuvium sesuvioides, Gisiska pharmacoeides, Euphorbia prostrata, Linum indicum and Mollugia cerviana. Among the grasses and sedges are Cymbopogon jwarancusa, Lasiurus scindicus, Conclusus biflorus, Ochthochloa compressa, Aristida adscensionis, Eragrostis barbata and Eragrostis ciliaris.

Capparis decidua-Cymbopogon jwarancusa community

Habitat: A compact plain "dhubar" buried under the eroded sand.

Composition and structure: A community having first layer of Capparis decidua and second layer of stubbles of Cymbopogon jwarancusa. Some plants of Ochthochloa compressa, Tragus racemosus, Aristida hystriculata, Corchorus depressus and Euphorbia prostrata were sparsely seen.

Prosopis cineraria-Haloxylon recurvum-Haloxylon salicornicum community

Habitat: A disturbed sloppy habitat extending to a "Toba" receiving runoff water after rains. Its "Ovarum" resulted in the losses of old deposits of soils, leaving some patches of thin soil.
cover or bare areas with clayey substrates. The terrain obviously traces the human activity for water harvesting and may have been the site of encampment of travelers in the older days.

**Composition and structure:** The tree layer in this community is of *Prosopis cineraria* which, generally, had been looped heavily. *Calligonum polygonoides* is present where the sand cover was deep or was once deeper. *Haloxylon recurvum* and *Haloxylon salicorniacum* occupy areas of shallow sand cover above the clayey lower substrates. *Haloxylon recurvum* and *Haloxylon salicorniacum* being better salt tolerant, were seen colonizing brackish standing water having higher concentration of salts. Other plant species of this community are: *Aerva persica*, *Suaeda fruticosa*, *Fagonia cretica*, *Cleome scoposa*, *Calotropis procera* (seedlings), *Dipterygium glaucum*, *Sesuvium sesooides*, *Lineum indicum*, *Euphorbia prostrata*, *Boerhavia diffusa*, *Trianthema crystallina*, *Polygala ericifolia*, *Launia nudicaulis*, *Tribulus longispinus*, *Mollugo cervinae* and *Conchorus depressus*, *Lasiurus siccicus*, *Cymbopogon jwarancusa*, *Cenchrus ciliaris*, *Cenchrus pireiuli*, *Tragus racemosus*, *Eragrostis barrelian*. *Aristida adscensionis* and *Ochthochloa compressa* are the grass species found at this community.

**Prosopis cineraria-Capparis decidua-Calligonum polygonoides community**

Habitat: Irregular high sand dune with loose top crust. Dominant spp. *Capparis decidua* had been harvested.

**Composition and structure:** Tree and tall shrub layer was constituted by *Prosopis cineraria* and *Calligonum polygonoides*. Rare *Capparis decidua* had been felled. *Calligonum* is surviving patchily but in relatively poor stand. Other plants noted are: *Aerva persica*, *Haloxylon salicorniacum*, *Dipterygium glaucum*, *Calotropis procera* (seedlings). *Tribulus longispinus*, *Lineum indicum*, *Ciris tus coloecythi* and *Mollugo cervinae*. Among the grasses *Lasiurus siccicus*, *Cenchrus ciliaris*, *Cenchrus biflorus*, *Aristida mutabilis*, *Cymbopogon jwarancusa* and *Stipagrostis plumosa* were prominent.

**Haloxylon recurvum-Haloxylon salicorniacum community**

Habitat: Flat, compact clayey “Dahar” with a few small hummocks of trapped sand, partially impervious to rain water.

**Composition and structure:** *Haloxylon recurvum* present with *Haloxylon salicorniacum* on the small hummocks. The entity remains plantless until flying sand settles down forming top layer for colonization. The composition of other plant species is: *Suaeda fruticosa*, *Cleome brachycarpa*, *Cleome scoposa* and *Trianthema crystallina*. Grasses are: *Lasiurus siccicus*, *Aristida mutabilis*, *Eragrostis barrelian* and *Ochthochloa compressa*.

**II - Greater Cholistan**

*Calligonum polygonoides-Haloxylon salicorniacum-Dipterygium glaucum community**

Habitat: Low to high dunes generally unconsolidated with moving sand. Vegetation cover rather high going up to 30% or so.

**Composition and structure:** First layer of this community is *Calligonum polygonoides* and *Haloxylon salicorniacum*. Others plants are *Dipterygium glaucum*, *Tribulus longispinus*, *Polygala ericifolia*, *Lineum indicum*, *Boerhavia diffusa*, *Neurada procumbens*, *Lasiurus siccicus*, *Aristida mutabilis*, *Aristida adscensionis*, *Cenchrus biflorus*, *Cenchrus ciliaris*, *Cenchrus pireiuli* and *Stipagrostis plumosa*.

**Calligonum polygonoides-Aerva pseudotomentosa community**

Habitat: Large dunes and highly sandy.

**Composition and structure:** The dominant layer at this community are *Calligonum polygonoides* and *Aerva pseudotomentosa*. Other plants recorded at this community are *Dipterygium glaucum*, *Euphorbia prostrata*, *Tribulus longispinus*, *Mollugo cervina*, *Indigofera argentea*, *Makia madraspatana*, *Lasiurus siccicus*, *Cenchrus pireiuli*, *Aristida mutabilis*, *Aristida adscensionis* and *Stipagrostis plumosa*.

**Haloxylon salicorniacum community**

Habitat: Flat, eroded, duneless, degraded site, with lot of dead stubbles of *Cymbopogon jwarancusa* due to over grazing and denuded root system caused by wind erosion.

**Composition and structure:** The leading dominant at this community is *Haloxylon salicorniacum* associated with *Prosopis cineraria*, *Capparis decidua*, *Aerva persica*, *Dipterygium glaucum*, *Crotalaria barhia*, *Anticharis linearis*, *Lineum indicum*, *Amehra hispidissima*, *Euphorbia prostrata*, *Cochihos depressus*, *Cochihos tridens*, *Tribulus longispinus*, *Citrullus coloecythi*, *Boerhavia diffusa*, *Gisea pharmaoides*, *Cocunus max ssp. agrostis*, *Convolvulus microphyllus*, *Convolvulus deserti*, *Cleome scoposa*. Among the grasses *Aristida adscensionis*, *Ochthochloa compressa*. *Eragrostis barrelianis*, *Cynodon dactylon*, *Cenchrus biflorus*, *Cenchrus pireiuli*, *Cymbopogon jwarancusa*, *Tragus racemosus* and *Aristida mutabilis* are prominent.

**Calligonum polygonoides-Aerva pseudotomentosa-Panicum turgidum community**

Habitat: Badly disturbed and sloping habitat of very high and large dunes. Vegetation cover 40%. Lot of dead stubbles of *Cyperus semilatilis*. Locust on salinity phase.

**Composition and structure:** *Calligonum polygonoides*, *Aerva pseudotomentosa*, *Legationaria pyrotechnica* and *Aerva persica* appeared as first layer at this community. Other plants are *Crotalaria barhia*, *Indigofera sessiliflora*, *Indigofera argentea*, *Tribulus longispinus*, *Lineum indicum*, *Mollugo cervina*, *Panicum turgidum*, *Lasiurus siccicus*, *Cenchrus biflorus*, *Cenchrus pireiul*, *Aristida mutabilis*, *Aristida adscensionis*, *Ochthochloa compressa* and *Cyperus semilatilis*.

**Calligonum polygonoides community**

Habitat: Very large and high unstable mass of shifting sand dunes.

**Composition and structure:** This community differs from other communities because of fast moving sand dominated by *Calligonum polygonoides* interspaced with the *Aerva persica*, *Haloxylon salicorniacum*, *Faretoria hamiltonii*, *Dipterygium glaucum*, *Euphorbia prostrata*, *Lineum indicum*, *Mollugo cervina*, *Aristida adscensionis*, *Cymbopogon jwarancusa*, *Lasiurus siccicus* and *Cyperus turgidum*.

**Ochthochloa compressa community**

Habitat: Intertidal sandy areas lying in between very high sand dunes. Vegetation cover about 60%. A lot of dry plants of *Haloxylon salicorniacum*. A dominant community near Fort Bilajat.

**Composition and structure:** First layer at this community are *Haloxylon salicorniacum*, *Aerva persica* and *Calligonum polygonoides*. Other plants recorded are *Capparis decidua*, *Prosopis cineraria*, *Laptadalia pyrotechnica*, *Crotalaria barhia*, *Cirtulus coloecythi*, *Tribulus longispinus*, *Cleome scoposa*, *Halophyllum strigosum*, *Indigofera sessiliflora*. Among grasses and sedges *Lasiurus siccicus*, *Cenchrus biflorus*, *Cymbopogon jwarancusa*, *Stipagrostis plumosa*, *Panicum turgidum*, *Ochthochloa compressa* and *Cyperus turgidum* were prominent plants.

Floral records of Cholistan desert remain woefully deficient due to
lack of interest, inaccessibility, inadequacy of rainfall and over exploitation. Besides vegetation, the flora differed in composition of species (climatic forms) very much, thus the dynamic rhythm of plant life was seen varying in magnitude as one passed through the desert, however, the sharp changes were there in relation to topographic features, heterogeneity of soil and distance among the habitats. At places, particularly close to rain water collecting ponds (tobas) over exploitation and heavy grazing pressure marred the plant community structure and failed to maintain its optimal posture. Prolonged droughts of many years also affected the growth patterns and distribution of vegetation in the desert.

References