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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–Suaeda fruticosa, Haloxylon recurvum, Calligonum polygonoides-Lasiurus scindicus–Cyperus conglomeratus, Prosopis cineraria–Haloxylon salicornicum, Capparis decidua–Aerva persica–Haloxylon salicornicum – Haloxylon recurvum, Capparis decidua–Cymbopogon jwarancusa, Prosopis cineraria–Haloxylon recurvum–Haloxylon salicornicum, Prosopis cineraria–Capparis deciduas-Calligonum polygonoides* and *Haloxylon recurvum–Haloxylon salicornicum.* While six plant communities were identified in greater Cholistan viz; *Calligonum polygonoides–Haloxylon salicornicum–Dipterygium glaucum, Calligonum polygonoides–Aerva pseudotomentosa, Haloxlon salicornicum, Calligonum polygonoides–Aerva pseudotomentosa – Panicum turgidum, Calligonum polygonoides* and *Ochthochloa compressa.* Threuophytes were dominant during the rainy season and initially colonized the base sand dunes. Perennial trees, shrubs, grasses and herbs were of the stable plant communities.

Key words: Plant communities, Cholistan, ladforms, threuophytes, 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 *Lasiurus, Cenchrus, Sporobolus, Cymbopogon* and *Panicum*; shrubs include *Suaeda, Capparis, Calligonum, Leptadenia, Salsola & Haloxylon. Prosopis, Tamarix, Zizyphus* 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 potentialities 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 desert however, Dasti and Agnew (1994) recognized six of them. Apparently they scanned a very small area of the desert. Arshad and Rao (1995) studied the vegetation pattern in Cholistan desert in relation to the phytogeographic 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 Lalsuhanra. Investigations on phytosociologcial distribution of plants have been conducted by Hoare *et al.* (2000); Qain (1999) and Qain *et al.* (1999). 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.

** To study the vegetation of Cholistan desert.

Materials and Methods

Study area: Cholistan desert located in southern Punjab, Pakistan occupies about 26000 km^2 area having a length of about 480 km and the width varying from 32 to 192 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 aridity/droughts 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 620-29800 mg/hectare (Anonymous, 1993).

To assess the plant communities in the representative habitats of Cholistan desert, several plant collecting trips were undertaken from 1990 to 2000. The representative habitats (collecting study sites) were selected on the basis of differing species composition, their density, overgrazing, 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-Dumbois 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 (south eastern) Cholistan. The composition and structure of these plant communities are being described along with their habitats.

I – Smaller Cholistan

***Calligonum polygonoides-Haloxylon salicornicum* community**

Habitat: Deep hummocky aeolian 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), Crotalaria burhia, Heliotropium strigosum, Dipterygium glaucum, Indigofera argentea, Tribulus longipetalus, Limeum indicum, Aerva persica, Fagonia cretica, Corchorus depressus, Polygala erioptera, Boerhaavia diffusa, Haloxylon recurvum, sesuvium sesuvioides, tribulus longipetalus, Euphorbia prostrata* and *Mollugo cerviana*. Among the grasses and sedges *Lasiurus scindicus, Cenchrus biflorus, Cenchrus ciliaris, Aristida mutabilis, Aristida adscensionis, Eragrostis barrelieri, Stipagrostis plumosa, Leptothrium senegalense, Cenchrus ciliaris, Cyperus conglomeratus, Ochthochloa compressa* and *Cymbopogon jwarancusa* were prominent.

Aristida spp. and *Cenchrus 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 *Cenchrus ciliaris* are making a come back but slowly. *Aristida* species and *Cenchrus biflorus* may decrease with the increase in vegetation cover by other species.

***Tamarix aphylla-Suaeda fruticosa* community**

Habitat: Leveled 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 storey, followed by *Suaeda fruticosa* as the second dominant. Other associated plants are: *Prosopis cineraria, Cleome brachycarpa, Cressa cretica, Fagonia cretica, Farsetia hemiltonii, Euphorbia prostrata, Trianthema crystallin* and, *Sesuvium sesuvioides.* The grass species at this community area are: *Aeluropus lagopoides, Sporobolus iocladus, Cymbopogon jwarancusa* and *Ochthochloa 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 interspaced with some *Haloxylon salicornicum* and *Salsola baryosma* shrubs. Other plant species found are: *Acacia nilotica (*seedling*), Aerva persica, Fagonia cretica, Corchorus depressus, Euphorbia prostrata, Sesuvium sesuvioides, Trianthema crystallina* and *Anticharis linearis.* Among the grasses and sedges *Aristida mutabilis, Aristida hystricula, Ochthochloa compressa, Cymbopogon jwarancusa* and *Eragrostis barreler* 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 tolerants 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, Dipterygium glaucum, Farsetia hamiltonii, Calotropis procera (*seedlings*), Limeum indicum, Gisekia pharnaceoides, Tribulus longipetalus, Boerhavia diffusa, Mollugo cerviana, Polygala erioptera, Mukia madraspatana, Antichoris lineari* and *Convolvulus microphyllus.* Grasses and sedges found at this community are: *Cenchrus biflorus, Cenchrus ciliaris, Aristida mutabilis, Aristida adscensionis, Cenchrus prieurii, Panicum turgidum, Cyperus conglomeratus, Lasiurus scindicus, Cymbopogon jwarancusa* and *Leptothrium senegalense.*

***Prosopis cineraria-Haloxylon salicornicum* community**

Habitat: Old bed of the dried up "Hakra" 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 hystricula* forming small tussocks in the landscape and the other species are: *Aerva persica, Suaeda fruticosa, Dipterygium glaucum, Antichoris linearis, Tribulus terresteris, Tribulus longipetalus, Cleome scaposa, Trianthema crystallina, Corchorus depressus, Euphorbia prostrat* and, *Citrulus colocynthis. Cymbopogon jwarancusa, Cenchrus biflorus, Ochthochloa compressa, Aristida hystricula, Tragus racemosu* and, *Eragrostis barreleri* 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 dunned 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: *Crotalaria burhia, Dipterygium glaucum, Calotropis procera* (seedling), *Tribulus longipetalus, Citrulus colocynthis, Cucumis melo* ssp. *figarii, Sesuvium sesuvioides, Gisekia pharnaceoides, Euphorbia prostrata, Limeum indicu* and, *Mollugo cerviana*. Among the grasses and sedges *Cymbopogon jwarancusa, Lasiurus scindicus, Cenchrus biflorus, Ochthochloa compressa, Aristida adscensionis, Eragrostis barrelieri* and *Eragrostis ciliaris.*

***Capparis decidua-Cymbopogon jwarancusa* community**

Habitat: A compact plain 'dahar' 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 *Octhochloa compressa, Tragus racemosus, Aristida hystricula, 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 overuse resulted in the loss of old deposits of soils, leaving some patches of thin soil-

cover or bare areas with clayey substrate. 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 salicornicum* occupy areas of shallow sand cover above the clayey lower substrate. *Haloxylon recurvum* and *Haloxylon salicornicum* being better salt tolerants, were seen colonizing brackish standing water having higher concentration of salts. Other plant species of this community are: *Aerva persica, Suaedafruticosa, Fagonia cretica, Cleome scaposa, Calotropis procera (seedlings), Dipterygium glaucum, Sesuvium sesuvioides, Limeum indicum, Euphorbia prostrata, Boerhavia diffusa, Trianthema crystallina, Polygala erioptera, Launia nudicaulis, Tribulus longipetalus, Mollugo cerviana* and *Corchorus depressus. Lasiurus scindicus, Cymbopogon jwarancusa, Cenchrus ciliaris, Cenchrus prieurii, Tragus racemosus, Eragrostis barrelieri, 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 salicornicum, Dipterygium glaucum, Calotropis procera (seedling), Tribulus longipetalus, Limeum indicum, Citrulus colocynthi* and *Mollugo cerviana.* Among the grasses *Lasiurus scindicus, Cenchrus ciliaris, Cenchrus biflorus, Aristida mutabilis, Cymbopogon jwarancusa* and *Stipagrostis plumosa.* were prominent.

***Haloxylon recurvum-Haloxylon salicornicum* 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 salicornicum* 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 brachycharpa, Cleome scapos* and *Trianthema crystallina.* Grasses are: *Lasiurus scindicus, Aristida mutabilis, Eragrostis barrelier* and *Ochthochloa compressa.*

II – Greater Cholistan
***Calligonum polygonoides-Haloxylon salicornicum-Dipterygium glaucum* community**
Habitat: Low to high dunes generally unstabilized 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 salicornicum.* Others plants are *Dipterygium glaucum, Tribulus longipetalus, Polygala erioptera, Limeum indicum, Boerhavia diffusa, Neurada procumben, Lasiurus scindicus, Aristida mutabilis, Aristida adscensionis, Cenchrus biflorus, Cenchrus ciliaris, Cenchrus prieurii* 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 polygonoide* and *Aerva pseudotomentosa.* Other plants recorded at this community are *Dipterygium glaucum, Euphorbia prostrata, Tribulus longipetalus, Mollugo cerviana, Indigofera argentea, Mukia madraspatana, Lasiurus scindicus, Cenchrus prieurii, Aristida mutabilis, Aristida adscensioni* and *Stipagrostis plumosa.*

***Haloxylon salicornicum* 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 salicornicum* associated with *Prosopis cineraria, Capparis deciduas, Aerva persica, Dipterygium glaucum, Crotalaria burhia, Anticharis linearis, Limeum indicum, Arnebia hispidissima, Euphorbia prostrata, Corchorus depressus, Corchorus tridens, Tribulus longipetalus, Citrulus colocynthis, Boerhavia diffusa, Gisekia pharmaceoides, Cocumis melo* ssp. *agrestis, Convolvulus microphyllus, Convolvulus desertii, Cleome scaposa.* Among the grasses *Aristida adscensionis, Ochthochloa compressa, Eragrostis barrelieri, Cynodon dactylon, Cenchrus biflorus, Cenchrus prieurii, 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 conglomeratus.* Locust on solitary phase.

Composition and structure: *Calligonum polygonoides, Aerva pseudotomentosa, Leptadenia pyrotechnica* and *Aerva persica* appeared as first layer at this community. Other plants are *Crotalaria burhia, Indigofera sessiliflora, Indigofera argentea, Tribulus longipetalus, Limeum indicum, Mollugo cerviana, Panicum turgidum, Lasiurus scindicus, Cenchrus biflorus, Cenchrus prieurii, Aristida mutabilis, Aristida adscensionis, Ochthochloa compressa* and *Cyperus conglomeratus.*

***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 salicornicum, Farsetia hamiltonii, Dipterygium glaucum, Euphorbia prostrata, Limeum indicum, Mollugo cerviana, Aristida adscensionis, Cymbopogon jwarancusa, Lasiurus scindicus* and *Cyperus conglomeratus..*

***Ochthochloa compressa* community**
Habitat: Interdunal sandy areas lying in between very high sand dunes. Vegetation cover about 60%. A lot of dry plants of *Haloxylon salicornicum.* A dominant community near Fort Bijnot.

Composition and structure: First layer at this community are *Haloxylon salicornicum, Aerva persic* and, *Calligonum polygonoides.* Other plants recorded are *Capparis decidua, Prosopis cineraria, Leptadenia pyrotechnica, Crotalaria burhia, Citrulus colocynthis, Tribulus longepetalus, Cleome scaposa, Heliotropium strigosum, Indigofera sessiliflora.* Among grasses and sedges *Lasiurus scindicus, Cenchrus biflorus, Cymbopogon jwarancusa, Stipagrostis plumosa, Panicum turgidum, Ochthochloa compressa* and *Cyperus conglomeratus* were prominent plants.
Floral records of Cholistan desert remain awfully 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.

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