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DIVERSITY OF MICRO-HABITATS AND THEIR PLANT RESOURCES IN NARA DESERT, PAKISTAN

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Abstract

Five habitats were identified for plant communities from Nara Desert, Pakistan. A total of 145 species belonging to 104 genera and 43 families were recorded during 1998-2001. Species composition in the different habitat types showed differences in species richness. The highest species richness of 77.24% is recorded from flat habitat. Crest habitat possesses less number of species (15 species; 10.34%) as compared to the rest of habitats. The vegetation over major area is characterized by xerophytic adaptation. The most common plants in this desert are *Calligonum polygonoides, Aerva javanica, Dipterygium glaucum, Crotalaria burhia, Prosopis cineraria, Tamarix aphylla, Capparis decidua, Salvadora oleoides, Leptadenia pyrotechnica, Aristida* spp., *Limeum indicum* and *Stipagrostis plumosa* growing in Crest, Slope and flat habitats, whereas saline/ sodic land and wetland habitat possess halophytic and hydrophytic characteristic features. The common vegetation of different habitats of this aridland is presented.

Introduction

Sindh is the southeastern Province of Pakistan, bounded on the east by the Indian border of Rajasthan, in the south by the Ran of Kutch, the Arabian Sea, in the west by the arid rocky mountains of Baluchistan and in the North by irrigated plains of Punjab. About 88,000 sq. km. area of Sindh has been regarded as arid zone that is nearly 60% of total geographical area of Sindh province (Anon., 1992). Administratively, Sindh Arid Zone Development Authority (SAZDA) has divided the Arid Zone of Sindh Province into three regions as follows:

i. Kohistan (the western side of the Indus Valley),
ii. Thar (the eastern area of the province). It was further subdivided into:
- **a. Nara region** in the North
- **b. Thar region** in the South.

The Nara Desert lies between lat 26º to 28º N and long 68º to 70º E. The altitude is between 50 and 115 meters above mean sea level. It spreads over from Taluka Ubaro, Daharki, Mirpur Mathelo and Khan Pur Mahar of Ghotki District, Rohri and Saleh Pat taluka of Sukkur District, Nara, Kotdeji and Faiz Ganj Talukas of Khairpur district; Taluka Sanghar and Khipro of district Sanghar. Eastern side boundaries of all these talukas have been marked by Rajasthan, India (Jodhpur & Jaisalmer). The study area is semiarid in nature (Qureshi, 2004).

Topography and climate: The topography of the study area is distinctly marked with sandy hills, steep slopes and vast low laying flat areas locally known as *Patt*. The accumulation of sand in huge mass in the form of a hill is known as sand dune/ridges. The area in between two successive dunes is called interdunal valley (Qureshi & Bhatti, 2005a).

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Nara desert is characterized by high wind velocity, massive shifting and rolling of sand dunes; high diurnal variation of temperature; scanty rainfall; extreme solar radiation and high rate of evapo-transpiration. The mean minimum and maximum temperatures are 20° and 45°C respectively. The hottest months are May-July, where temperature ranges from 47-51 °C. The lowest temperature 27-28°C is recorded in the month of January. The annual rainfall is between 88-135 mm mostly received in between July and September. The ground water resources are limited and are met at a depth of 50-300 feet from the surface. The only source of water for human beings and livestock is from dugout/natural ponds, in which the water is stored during monsoon (Qureshi & Bhatti, 2005b)

Various floristic works have been reported from in and out of the country. Arshad & Rao (1994) has recorded the flora of Cholistan Desert (Systematic list of trees, shrubs and herbs). A lot of work has been done in Indian desert which is on other side of Thar Desert of Sindh (Bhandhari, 1978; Shetty & Singh, 1991). Carvalho da Costa *et al.,* (2007) identified 133 plant species belonging to 47 families. They categorized them as Therophytes (42.9%), phanerophytes (26.3%), chamaephytes (15.8%), hemicrytophytes (12.8%) and cryptophytes (2.3%) based on physiognomic and life form. They concluded that floristic richness cannot be underestimated and that the herbaceous/woody proportion varies according to its physiognomy and water status. In the same way, Devineau & Fournier (2007) assessed the composition and richness of herbaceous species of Western African Sudan Type Savanna. They identified 130 herbaceous species from the study area. The floristic composition of Gorakh hill (Khirthar range) has been reported by Parveen & Hussain (2007). They identified 74 species belonging to 62 genera and 34 families.

Nara Desert is endowed with wide range of typical habitats and vegetation types. The present study was carried out to compile the Flora of Nara Desert. Previously, Chaudhari & Chuttar (1966) carried out a preliminary survey on Range Flora of Thar Desert and recorded a list of 122 species. Since then, no further study has so far been carried out in this aridland. Therefore, a dire need was being felt amongst the scientific community to explore the area extensively to revise the flora of this desert.

Materials and Methods

The whole study area was explored for the collection of plants from September 1998 to December, 2001. During the survey, 5 distinct habitats were established based on the topography of the area. The collected specimens were identified with the help of Flora of Pakistan (Nasir & Ali, 1970-2000; Ali & Qaiser, 2001) alongwith other floras (Cooke, 1903-1906; Jafri, 1966; Batanouny, 1981; Matthew, 1981-83; Shetty & Singh, 1987 & 1991; Bhandari, 1987; Boulos, 1991). The collected specimens were deposited in the Herbarium of Shah Abdul Latif University, Khairpur for record.

Results and Discussion

A total of 145 species belonging to 104 genera and 43 families have been recorded during 1998-2001. Five habitats were identified for plant communities from Nara Desert, Pakistan. Poacea was the dominant family which contributed the highest number of species (20 spp., 13.79%) in the flora of Nara Desert followed by Fabaceae (15 spp., 10.34%) and Boraginaceae (7 spp., 4.83%) (Table 2). Species composition in the different habitat types showed differences in species richness. The highest species richness of 77.24% is recorded from flat habitat. Crest habitat possesses less number of species (15 species; 10.34%) as compared to the rest of habitats. The vegetation over major area is characterized by xerophytic adaptation. The most common plants in this

desert are *Calligonum polygonoides, Aerva javanica, Dipterygium glaucum, Crotalaria burhia, Prosopis cineraria, Tamarix aphylla, Capparis decidua, Salvadora oleoides, Leptadenia pyrotechnica, Aristida* spp., *Limeum indicum* and *Stipagrostis plumosa* growing in Crest, slope and flat habitats, whereas saline/ sodic land and wetland habitat possess halophytic and hydrophytic characteristic features. Four types of plant groups observed in this area are described on the basis of their characters and their performance:

1. True xerophytes: The common species of this category includes *Haloxylon stocksii, Arthrocnemum indicum, Saueda fruticosa, Salsola imbricata, Aerva* spp., *Glinus lotoides* etc.

2. Semi-xerophytes: The group comprised of *Acacia nilotica, Calotropis procera, Heliotropium europium, H. currasavicum* and *Withania somnifera* as the members of this group. These plants are mostly growing on the periphery of the desert.

3. Pseudo-xerophytes: Ephemerals which complete their life cycle within 6-8 weeks before the advent of summer includes *Neurada procumbense, Mollugo* spp., *Gisekia pharancoides, Cleome brachycarpa* and *Boerhavia procumbense* and grasses like *Eragrostis minor, Stipagrostis plumosa* and *Aristida* spp., are the member of this category.

4. Hydrophytes: The members of this category are *Cyperus rotundus, Fimbristylis dichotoma, Phragmites karka, Saccharum bengalense, Typha domengensis* and *T. elephantina*.

Microhabitats and their plants: Five distinct habitats were recognized based on topographical features as follows:
1) Crest (Top of the sand dune); 2) Slopes/swale/flanks; 3) Sandy plains (*Tar-Tarai*- low laying flat areas); 3) Lake/wetland habitat and 5) Saline/sodic Land.

Their geomorphological features along with plants are as under:

1. Crest habitat: Sand dunes are the main characteristic features of the study area. Topography of this habitat varies from undulating to moderately steep, whereas elevation of the dunes is from 70 to 120 meters. These sand dunes are very excessively drained. Most of the area is barren and only 15 plant species (10.34%) are recorded (Table 1; Fig. 1) from this habitat type. These plants can be regarded as sand loving plants and they have the capability to survive over there. The floristic composition of this habitat include *Calligonum polygonoides, Aerva javanica, Dipterygium glaucum, Limeum indicum, Indigofera argentea, Tribulus longipetalus, Aristida adscensionis, A. funiculata, Panicum turgidum, Lasiurus sindicus, Stipagrostis plumosa, Cyperus arenarius* and *C. conglomeratus.*

2. Slopes/Swale/Flank habitat: This habitat is also covered with the same type of plant species as those of crest habitat. A total of 33 species (22.76%) were recorded from this habitat (Table 1; Fig. 1). In addition, few trees are also observed growing in this habitat like *Prosopis cineraria, Tamarix aphylla, Salvadora oleoides* and *Capparis decidua*. The common plants which are forming typical vegetation type of this habitat are *Calligonum polygonoides, Aerva javanica, Dipterygium glaucum, Limeum indicum, Indigofera argentea, Tribulus longipetalus, Aristida adscensionis, A. funiculata, Panicum turgidum, Lasiurus sindicus, Stipagrostis plumosa, Cyperus arenairus* and *C. conglomeratus*.

Table 1. Species recorded from different habitats of Nara Desert, Sindh, Pakistan.

S. No.	Family name/ Plant species	Local name	Micro-habitats				
			1	2	3	4	5
	A. Pteridophyte/ Equisetatceae						
1.	*Equisetum arvense* L.		---	---	---	---	+
	B. Gymnosperm/ Ephederaceae						
2.	*Ephedra ciliata* Fisch. & Mey. ex C.A.Meyer.	Saanth	---	---	+	---	---
	C. Monocotyledons						
	Cyperaceae						
3.	*Cyperus arenarius* Retz.	Moniah Gaah	+	+	---	---	---
4.	*C. conglomeratus* Rottb.,	Moniah Gaah	+	+	---	---	---
5.	*C. rotundus* Linn	Kabah	---	---	---	---	+
6.	*Fimbristylis dichotoma* Clarke.	Kal	---	---	---	---	+
	Liliaceae						
7.	*Aloe barbadensis* Miller.	Kunwar Buti	---	---	+	---	---
8.	*Asphodelus tenuifolius* Cavan	Basri	---	---	+	---	---
	Poaceae						
9.	*Aeluropus lagopoides* (Linn.) Trin. ex. Thw	Kalar Gaah	---	---	---	+	---
10.	*Aristida adscensionis* Linn.	Lumb Gaah	+	+	+	---	---
11.	*A. funiculata* Trin. & Pupr.	Lumb Gaah	---	+	+	---	---
12.	*Cenchrus biflorus* Roxb.	Mohabbat Buti	---	+	+	---	---
13.	*C. ciliaris* Linn.	Bhurt	---	---	---	+	---
14.	*Cymbopogon jawarancusa* (Jones) Schult.	Kattan	---	---	+	---	---
15.	*Cynodon dactylon* (Linn.) Pers.	Chhabar	---	---	+	---	---
16.	*Dactyloctenium aegyptium* (Linn.) P. Beauv.	Gandheer Gaah	---	+	+	---	---
17.	*Desmostachya bippinata* (Linn.) Stapf.	Drabh	---	---	---	+	---
18.	*Dichanthium annulatum* (Forsskal) Stapf.	Dinohi	---	---	+	---	---
19.	*Dinebra retroflexa* (Vahl.) Panzer.	----------	---	---	+	---	---
20.	*Eragrostis minor* Host.	Makhni Gaah	---	---	+	---	---
21.	*Lasiurus sindicus* Henr.	Booro	---	---	+	---	---
22.	*Ochthochloa compressa* (Forssk..) Hilu.	Gandheer Gaah	---	+	+	+	---

Table 1. (Cont'd.).

S. No.	Family name/ Plant species	Local name	Micro-habitats				
			1	2	3	4	5
23.	*Panicum turgidum* Forsk.	Sewan	+	+	+	---	---
24.	*Phragmites karka* (Retz.) Trin. ex Steud.	Narr/Naro	---	---	---	---	+
25.	*Saccharum bengalense* Retz.	Booro	---	---	---	---	+
26.	*S. spontaneum* Linn.	Booro/Munian	---	---	---	+	+
27.	*Setaria pumila* (Pouir.) Roem. & Schult.	Sawri	---	---	+	---	+
28.	*Stipagrostis plumosa* (Linn.) Munro ex T. Anders.	Lumb Gaah	+	---	---	---	---
	Typhaceae						
29.	*Typha domingensis* Pers.	Pan	---	---	---	---	+
30.	*T. elephantina* Roxb.	Pan	---	---	---	---	+
	D. Dicotyledons						
	Acanthaceae						
31.	*Blepharis sindica* Stocks ex. Anders	Utangan	---	---	+	---	---
	Aizoaceae						
32.	*Gisekia pharancoides* Linn.	----------	---	---	+	---	---
33.	*Limeum indicum* Stocks ex T. Anderson.	Dhoor Chhapri	+	+	+	+	---
34.	*Sesuvium sesuvioides* (Fenzl) Verdc.	Lonak	---	---	+	+	---
35.	*Trianthema triquettra* Rottl. and Willd.	Wasanh/Waho	---	---	---	+	---
36.	*Zelya petandra* (Linn.) Jeffrey	Wasanh/Waho	---	---	+	---	---
	Amaranthaceae						
37.	*Achyranthes aspera* Linn.	Ubat Kandri	---	---	+	---	---
38.	*Aerva javanica* var. *bovei* Webb.	Booh	+	+	+	---	---
39.	*A. javanica* var. *javanica* (Burm.f.) Juss. ex.	Booh	+	+	+	---	---
40.	*Amaranthus graecizans* (Nevski) Gusev.	Mariro	---	---	+	---	---
41.	*A. virdis* Linn.	Mariro	---	---	+	---	+
42.	*Digera muricata* (Linn.) Mart.	Lulur	---	---	+	---	---
	Asclepiadaceae						
43.	*Calotropis procera* (Willd.) R. Br.	Ak	---	---	+	---	---
44.	*Leptadenia pyrotechnica* (Forsk.) Decne.	Khip	---	+	+	---	---
45.	*Oxystelma esculentum* (L.f.) R. Br.	Phuli	---	---	---	---	+

Table 1. (Cont'd.).

S. No.	Family name/ Plant species	Local name	Micro-habitats				
			1	2	3	4	5
	Asteraceae						
46.	*Amberboa ramosa* (Roxb.) Jafri.	----------	---	---	+	---	---
47.	*Carthamus oxycantha* Bieb.	Pohli	---	---	+	---	---
48.	*Echinops echinatus* DC.	Kanderi Bhattar	---	---	+	---	+
49.	*Launaea procumbens* (Roxb) Ramayya & Rajagopal.	Bhattar	---	---	+	---	+
50.	*Pluchea lanceolata* (DC.) Oliv. & Hiern.	Phaar Buti	---	---	+	---	+
51.	*Xanthium indicum* Koenig ex Roxb.	Bhurt	---	---	+	---	---
	Boraginaceae						
52.	*Arnebia hispidissima* (Sieber) DC.	Rohiro	---	---	+	---	---
53.	*Cordia myxa* Linn.	Lesuro	---	---	+	---	---
54.	*Heliotropium crispum* Desf.	Kharsan	---	---	+	+	---
55.	*H. curassavicum* Linn.	Kharsan	---	---	---	+	---
56.	*H. europeum* Linn.	Uth Charo	---	---	+	---	---
57.	*H. strigosum* Willd.	Kharsan	---	---	+	+	---
58.	*H. subulatum* (Hochst. ex DC.) Vatke.	Kharsan	---	---	+	---	---
	Brassicaceae						
59.	*Farsetia hamiltonii* Royale.	----------	---	---	+	---	---
	Caesalpiniaceae						
60.	*Caesalpinia bonduc* (Linn.) Roxb.	Pahar Wal	---	---	+	---	---
61.	*Cassia italica* (Mill.) F.W.Andr.	Ghora Wal	---	+	+	---	---
	Capparidaceae						
62.	*Capparis decidua* (Forssk.) Edgew.	Kirar	---	---	+	+	---
63.	*C. spinosa* Linn.	Golaro	---	---	+	---	---
64.	*Cleome brachycarpa* Vahl.	Dhanaar Khathoori	---	---	+	---	---
65.	*C. scaposa* D.C.	Khathoori	---	+	+	---	---
66.	*C. viscosa* Linn.	Kinni Buti	---	---	+	---	+
67.	*Dipterygium glaucum* Decne.	Phair	+	+	+	---	---
68.	*Gynandropsis gynandra* (Linn.) Briq.	Kinro	---	---	+	---	---

Table 1. (Cont'd.).

S. No.	Family name/ Plant species	Local name	Micro-habitats				
			1	2	3	4	5
	Chenopodiaceae						
69.	*Chenopodium album* Linn.	Chil	---	---	+	---	---
70.	*Haloxylon stocksii* (Boiss.) Benth. & Hook.	Sacho Lano	---	---	---	+	---
71.	*Salsola imbricata* Forssk..	Lano	---	---	+	+	---
72.	*Suaeda fruticosa* (Linn.) Forsk.	Lani	---	---	+	+	---
	Convolvulaceae						
73.	*Cressa cretica* Linn.	Oin	---	---	---	+	---
74.	*Convolvulus arvensis* Linn.	Naro	---	---	+	---	+
75.	*C. glomeratus* Choisy.	Kirhanj	---	---	+	---	---
76.	*C. prostratus* Forssk.	Kirhanj	---	---	+	---	---
	Cucurbitaceae						
77.	*Citrullus colocynthis* (Linn.) Schrad.	Trooh	---	---	+	---	---
78.	*Cucumis melo* var. *agrestis* Naudin.	Mitero	---	---	+	---	---
79.	*Mukia maderaspatana* (Linn.) M. J. Roem.,	----------	---	+	+	---	---
	Cuscutaceae						
80.	*Cuscuta chinensis* Lam.	Bepari	---	---	+	---	---
	Elatinaceae						
81.	*Bergia aestivosa* Wight & Arn.	----------	---	---	+	---	+
	Euphorbiaceae						
82.	*Chrozophora plicata* (Vahl) A. Juss. ex Spreng.		---	---	---	+	---
83.	*Euphorbia hirta* Linn.	Kheer Wal	---	---	+	---	+
84.	*E. thymifolia* Linn.	Kheera Wal	---	+	+	---	---
	Fabaceae						
85.	*Alhagi maurorum* Medic.	Kandero	---	---	---	+	+
86.	*Alysicarpus monilifer* (Linn.) DC.	----------	---	---	+	---	---
87.	*A. scariosus* Grah. ex Thwaites	----------	---	---	+	---	---
88.	*Crotolaria burhia* Ham. ex Benth.	Chag	+	+	+	---	---
89.	*Indigofera argentea* Burm.f.	Lathio	+	+	---	---	---

Table 1. (Cont'd.).

S. No.	Family name/ Plant species	Local name	Micro-habitats				
			1	2	3	4	5
90.	*I. cordifolia* Heyne ex Roth	Lathio	---	---	+	---	---
91.	*I. hochstetteri* Baker	Bheekar	---	---	+	---	---
92.	*I. linifolia* (Linn.) Retz.	----------	---	---	+	---	---
93.	*I. oblongifolia* Forsk.	Jhil	---	---	+	---	---
94.	*I. sessiliflora* DC.	Vekar	---	---	+	---	---
95.	*Rhynchosia minima* (Linn.) DC.	Wan Wehri	---	---	+	---	---
96.	*R. schimperii* Hochst. ex Boiss.	----	---	+	+	---	---
97.	*Tephrosia falciformis* Romaswami.	----------	---	+	---	---	---
98.	*T. uniflora* (Blatter & Hallberg) Gillett & Ali	Andhri/Siringh	---	---	+	---	---
99.	*T. villosa* (Linn.) Pers.	Andhri/Siringh	---	---	+	---	---
	Fumariaceae						
100.	*Fumaria indica* (Hausskn.) H.N. Pugsley	Doonhi Buti/Shahtaro	---	---	+	---	---
	Geraniaceae		---	---	---	---	+
101.	*Monsonia heliotropoides* (Cav.) Boiss.	----------	---	+	---	---	---
	Lamiaceae						
102.	*Leucaus aspera* (Willd.) Link.	Goomi Buti	---	---	+	---	---
	Malvaceae						
102.	*Abutilon indicum* (Linn.) Sweet	Pat Teer	---	---	+	---	---
103.	*A. fruticosum* Guill. & Perr.	Pat Teer	---	---	+	---	---
104.	*Malvastrum coromendelianum* (Linn.) Garcke	----------	---	---	+	---	---
105.	*Pavonia glechomaefolia* S. Abedin	----------	---	---	+	---	---
	Menispermaceae						
106.	*Cocculus hirsutus* (Linn.) Diels	Fareed Buti	---	---	+	---	---
	Mimosaceae						
107.	*Acacia jacquemontii* Benth.	Banwar	---	+	+	---	---
108.	*A. nilotica* (Linn.) Delile	Sindhi Babur	---	---	+	---	+
109.	*A. senegal* (Linn.) Willd.	Angrezi Babur	+	+	---	---	---
110.	*Prosopis cineraria* (Linn.) Druce	Kandi	---	+	+	+	---
111.	*P. juliflora* (Swartz) DC.	Devi	---	---	+	+	+

Table 1. (Cont'd.).

S. No.	Family name/ Plant species	Local name	Micro-habitats				
			1	2	3	4	5
	Molluginaceae						
112.	*Glinus lotoides* Linn.	Kotak Buti	---	---	+	---	---
113.	*Mollugo cerviana* (Linn.)Ser.	Hazar Dani	---	+	+	---	---
114.	*M. nudicaulis* Lamk.	Hazar Dani	---	+	+	---	---
115.	*M. pentaphylla* Linn.	Hazar Dani	---	+	+	---	---
	Moraceae						
116.	*Ficus religiosa* Linn.	Pepul	---	---	+	---	---
	Moringaceae						
117.	*Moringa oleifera* Lamk.	Suhandaro/ Suhanjro	---	---	+	---	---
	Neuradaceae						
118.	*Neurada procumbens* Linn.	Chhapri/Chhipri	---	+	---	---	---
	Nyctaginaceae						
119.	*Boerhavia procumbens* Banks ex Rxb.	Dakhri	---	---	+	---	---
120.	*Commicarpus boisseiri* (Heimer) Cufod.	Dakhri	---	---	+	---	---
	Orobanchaceae						
121.	*Cistanche tubulosa* (Schrenk) Hook. f.	Bhunjro	---	---	+	---	---
	Polygalaceae						
122.	*Polygala erioptera* DC.	Hiran Buti	---	---	+	---	---
123.	*P. irregularis* Boiss.		---	---	+	---	---
	Polgonaceae						
124.	*Calligonium polygonoides* Linn.	Phog	+	+	---	---	---
125.	*Polygonum plebejum* R.Br.	Kheer Wal	---	---	+	---	---
	Salvadoraceae						
126.	*Salvadora oleoides* Decne.	Jar/Peroon	---	+	+	---	---
127.	*S. persica* Linn.	Khabbar	---	---	---	+	---
	Scrophulariaceae						
128.	*Schweinfurthia papilionacea* (Burm. f.) Boiss.	Akri/Paneer Wal	---	---	+	---	---

Table 1. (Cont'd.).

S. No.	Family name/ Plant species	Local name	Micro-habitats				
			1	2	3	4	5
	Solanaceae						
129.	*Datura metel* Linn.	Charyo Dhaaturo	---	---	+	---	---
130.	*Solanum surattense* Burm.f.	Kanderi Wal	---	---	---	---	+
131.	*S. nigrum* var. *nigrum* Linn.	Kanwal Buti	---	---	---	---	+
132.	*Withania somnifera* (Linn.) Dunal	Akri	---	---	+	---	---
	Tamaricaceae						
133.	*Tamarix aphylla* (Linn.) Karst.	Lawo	+	+	+	---	---
134.	*T. indica* willd.	Lai	---	---	---	+	---
135.	*T. passernioides* Del ex. Desv	Lai	---	---	---	---	+
	Tiliaceae						
136.	*Corchorus depressus* (Linn.) Stocks.	Mundheri	---	---	+	---	---
137.	*C. tridens* Linn.	Datehri	---	---	+	---	---
138.	*C. trilocularis* Linn.	Datehri	---	---	+	---	---
	Verbenaceae						
139.	*Phyla nodiflora* (L.) Greene.	Bukkan	---	---	---	---	+
	Zygophyllaceae						
140.	*Fagonia bruguieri* DC. var. *rechingeri* Had.	Dramaaho	---	---	+	---	---
141.	*F. indica* var. *schweinfurthii* Hadidi	Dramaaho	---	---	+	---	---
142.	*Seetzania lanata* (Willd.) Bullock.	----	---	---	+	---	---
143.	*Tribulus longipetalus* Viv.	Bakhro/Bhurt	+	+	+	---	---
144.	*T. terrestris* Linn.	Bakhro/Bhurt	---	---	+	---	+
145.	*Zygophyllum simplex* Linn.	Jand Laani	---	---	---	+	---
		No. of species	**15**	**33**	**112**	**23**	**26**
		Percentage	**10.34**	**22.76**	**77.24**	**15.86**	**17.93**

Key: 1 = Crest; 2 = Slope/Swale/Flank; 3 = Sandy Plains; 4 = Saline/Sodic Land; 5= Lakes/Wet Land.

Table 2. Indicating share of plant families (in decreasing order) in the flora of Nara Desert, Sindh.

S. No.	Family	No. of species	Percentage
1.	Poaceae	20	13.79
2.	Fabaceae	15	10.34
3.	Boraginaceae	7	4.83
4.	Capparidaceae	7	4.83
5.	Amaranthaceae	6	4.14
6.	Asteraceae	6	4.14
7.	Zygophyllaceae	6	4.14
8.	Aizoaceae	5	3.45
9.	Mimosaceae	5	3.45
10.	Chenopodiaceae	4	2.76
11.	Convolvulaceae	4	2.76
12.	Cyperaceae	4	2.76
13.	Malvaceae	4	2.76
14.	Molluginaceae	4	2.76
15.	Solanaceae	4	2.76
16.	Asclepiadaceae	3	2.07
17.	Cucurbitaceae	3	2.07
18.	Euphorbiaceae	3	2.07
19.	Tamaricaceae	3	2.07
20.	Tiliaceae	3	2.07
21.	Caesalpiniaceae	2	1.38
22.	Liliaceae	2	1.38
23.	Nyctaginaceae	2	1.38
24.	Polgonaceae	2	1.38
25.	Polygalaceae	2	1.38
26.	Salvadoraceae	2	1.38
27.	Typhaceae	2	1.38
28.	Acanthaceae	1	0.69
29.	Brassicaceae	1	0.69
30.	Cuscutaceae	1	0.69
31.	Elatinaceae	1	0.69
32.	Ephederaceae	1	0.69
33.	Equisetaceae	1	0.69
34.	Fumariaceae	1	0.69
35.	Geraniaceae	1	0.69
36.	Lamiaceae	1	0.69
37.	Menispermaceae	1	0.69
38.	Moraceae	1	0.69
39.	Moringaceae	1	0.69
40.	Neuradaceae	1	0.69
41.	Orobanchaceae	1	0.69
42.	Scrophulariaceae	1	0.69
43.	Verbenaceae	1	0.69

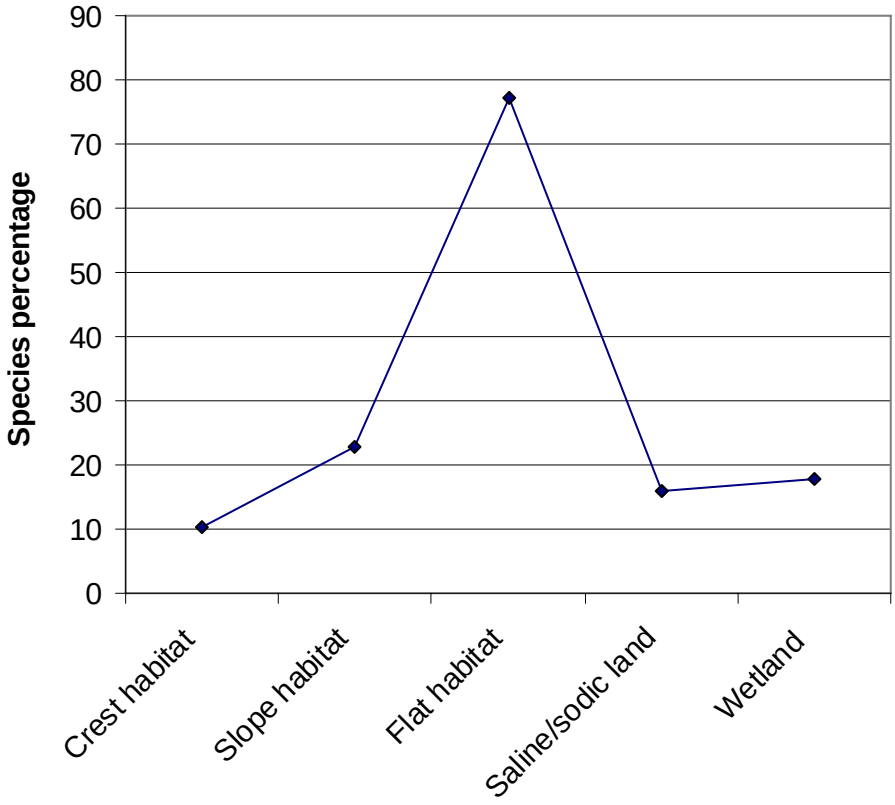

Fig. 1. Showing %age of plant species in different microhabitats.

3. Sandy plains habitat (Tarr-Tarai/ low Lying Flat area): This is low lying flat area encircled by sand dunes. There are *Tarrs* (where wells are situated) with permanent settlements. There are *Wandhs* near the Tarai (Low-lying area where water can be stored for some time after rainfall). Besides, there are *Tobas* (Rainwater stored in man made Tanks) in *Taries*. There is a mixed population of tall and old trees of *Prosopis cineraria, Tamarix aphylla* and *Capparis decidua* presenting a look of forest. There are wells in the *Taraies,* where the livestock take water and spending the hotter hours of the day under their shadow. Maximum number of species is recorded from this habitat containing 112 species (77.24%) observed growing on this habitat type (Table 1; Fig. 1). The most common plant species in this habitat include *Aerva javanica, Aristida adscensionis, A. funiculata, Boerhavia procumbense, Calligonum polygonoides, Capparis decidua, Cassia italica, Cenchrus ciliaris, Cleome brachycarpa, C. scaposa, Corchorus depressus, Cymbopogon jawarancusa, Cynodon dactylon, Cyperus rotundus, Dactyloctenium aegyptium, Heliotropium strigosum, Limeum indicum, Polygala erioptera, Salsola imbricata, Stipagrostis plumosa, Tephrosia uniflora, Tribulus longipetalus,* and *Zaleya pentandra*. Trees are very commonly observed in this habitat forming a mini forest. These include *Prosopis cineraria, Tamarix aphylla, Capparis decidua* and *Salvadora oleoides*.

4. Saline/Sodic Land (*Kharror*): This habitat was formed by evaporation of salt water of the lakes leaving behind residue of salts and is found between interdunal areas of the desert. These saltish lands locally called as *Kharror* are occupying the edges of saline lakes. A total of 23 plant species (15.86%) are recorded from this habitat (Table 1; Fig. 1). The commonest plants of this habitat are *Tamarix indica, Saccharum spontaneum, Salsola imbricata, Pluchea lanceolata, Prosopis cineraria, Limeum indicum, Aeluropus lagopoides, Desmostachya bipinnata* and *Alhagi maurorum*.

5. Lake/Wetland Habitat: This habitat is established on both the banks of the Nara canal due to the seepage from canal. The rise of water in Wetland (locally called *Dhand*) solely depends up the water availability in Nara Canal, which lies in the same topographical region. There were 26 species (17.93%) growing in this habitat (Table 1; Fig. 1). The edges of lakes are dominated with under story plant community like *Saccharum bengalense, S. spontaneum* and *Tamarix passernioides*. Besides, *Aeluropus lagopoides, Cynodon dactylon, Desmostachya bipinnata* and *Phragmites karka* are forming common vegetation in this habitat. These plants typify emergent vegetation, which has its roots in soil covered or saturated with water and its leaves held above water. Nearly 40 lakes are observed in the study area.

Conclusion

The vegetation in this region is sparse consisting mainly of stunted, thorny or prickly shrubs and perennial herbs capable of drought resistance. Trees are few and scattered. The ephemerals come up during the rainy season, complete their life cycle before the advent of summer and the bulk of the area is once more transformed into open sandy plain, desolate and barren.

Dune lands and slopes are dominated by the tussock grasses *Panicum turgidum* and *Lasiurus sindicus* grazed by flocks of goat, cows and camels at medium and high rates of utilization in either the early wet, late wet or dry seasons. Effects of grazing on species composition were greatest in the early wet season. Therefore, the habitats of the Nara Desert are under immense pressure and needs to be conserved. Moreover range management programmes should be launched in these depleted areas in order to maintain the continuity of plant and human life.

Plants are the only resources which enrich the rangeland in the shape of pasture. Besides supplying food for livestock, the people of the study area use these plants in their different needs such as turf, fuel, human nutrition and medicine (Bhatti *et al.*, 2001; Qureshi, 2004). The genetic diversity of range and forage grasses, legumes, and other forbs needs to be collected and preserved. These plants will be capable to triumph over restrictions to their growth and development, produce high quality forage, and serve a variety of conservation and other uses. Therefore, managed livestock grazing is very essential for the sustainable use of most aridland and pasture resources.

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References

Ali, S.I. and M. Qaiser. 2001. *Flora of Pakistan*, (*Fascicle series*, *204-205*), Department of Botany, University of Karachi, Pakistan.

Anonymous. 1992. *Pak. Swiss Range and Livestock Improvement Project*.

Arshad, M. and A.R. Rao. 1994. Flora of Cholistan Desert (Systematic list of trees, shrubs and herbs). *Jour. Econ. Tax. Bot.*, 18(3): 615-625.

Batanouny, K.H. 1981. *Ecology and Flora of Qatar*. Centre for scientific and applied Research, University of Qatar, P.O. Box 2713, Doha.

Bhandhari, M.M. 1978. *Flora of Indian Desert*. Scientific Publishers, Jodhpur.

Bhatti, G.R., R. Qureshi and M. Shah. 2002. Ethnomedicinal observation of *Cymbopogon jawarancusa* (Jones) Schult., in Nara Desert (Sindh). Proc: *Workshop on Curriculum Development in Applied Ethnobotany, WWF*. pp 34-39.

Bhatti, G.R., R. Qureshi and R.A. Memon. 1999. Present Flora of Rohri Hills, Sindh, Pakistan. *Ancient Sindh*, 5: 7-22.

Bhatti, G.R., R. Qureshi and S.M. Shah. 1998. Ethnobotany of *Calotropis procera* with especial reference to the people of Nara Desert. *Scientific Sindh*, 05: 13-22.

Bhatti, G.R., R. Qureshi and Shah, M. 2001. Ethnobotany of Qadan Wari of Nara Desert., *Pak. J. Bot.,* 33 (especial issue):801-812.

Boulos, L. 1991. *Flora of Egypt*. Al Hadara Publishing Cairo, Egypt, Vol. 1.

Carvalho da Costa., F., Soares de Araujo and L .Wilson Lima-Verde. 2007. Flora and life form spectrum in an area of deciduous thorn woodland (caatinga) in north eastern, Brazil. *Journal of Arid Environment*, 68(2): 237-247.

Devineau, J.L. and A. Fournier. 2007. Integrating environmental and sociological approaches to assess the ecology and diversity of herbaceous species in a Sudan Type Savanna (Bondoukuy, Western Burkina Faso). *Flora,* 202(5): 350-370.

Jafri, S.M.H. 1966. *The Flora of Karachi.* The Book Corporation, Karachi, Pakistan.

Matthew, K.M. 1981-3. *Flora of Tamilnadu Carnatic*. The Rapinat Herbarium, St. Joseph's College, Tiruchirapalli 620002, India, vol. 1-3.

Nasir, E. and S.I. Ali. 1972-2000. *Flora of Pakistan* (Fascicle series), Department of Botany, University of Karachi, Pakistan.

Parveen, A. and M.I. Hussain. 2007. Plant biodiversity and phytosociological attributes of Gorakh hill (Khirthar range). *Pak. J. Bot.*, 38 (3): 691-698.

Qureshi, R. 2002. Ethnobotany of Rohri Hill, Sindh, Pakistan. *Hamdard Medicus,* 45(1): 86-94.

Qureshi, R. 2004. *Floristic and Ethnobotanical study of Desert Nara region, Sindh*. (Ph.D. Thesis), Department of Botany, Shah Abdul Latif University, Khairpur, Sindh, Pakistan. pp. 1-454.

Qureshi, R. and G.R. Bhatti. 2005a. Nara Desert, Pakistan: Part I: Soils, Climate and Vegetation. *Rangelands*, 27(5): 27-31.

Qureshi, R. and G.R. Bhatti. 2005b. Nara Desert, Pakistan: Part II: Human Life, *Rangelands*, 27(5): 32-35.

Qureshi, R., G.R. Bhatti and M. Shah. 2001. Ethnomedicinal properties of *Aloe barbadensis* Mill., with particular reference to the people of Nara Desert. *Hamdard Medicus,* 44 (3): 46-50.

Shetty, B.V. and V. Singh. 1991. Flora of Rajasthan, Botanical Survey of India. Old Connaught Place Dehra Dun. Vol. I & II.

Singh and Pandy. 1983. Economic and medicinal plants of Indian desert. In: *Desert Resources and Technology*. (Ed.): A. Singh. Scientific Publishers, Jodhpur, India, 307-366.

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