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FLORA OF LAL SUHANRA NATIONAL PARK, BAHAWALPUR, PUNJAB, PAKISTAN

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Abstract

Lal Suhanra National Park is located in the southeastern Punjab of Pakistan with altitudes ranging from 125 to 140 meters. The flora of Park consists of 212 species belonging to 162 genera and 50 families. The Dicots having 41 families, 118 genera and 158 species, were the most diverse and dominating group of plants in this area followed by Monocots with 5 families, 40 genera and 50 species, Pteridophytes with 3 families, 3 genera and 3 species and Bryophytes represented by monotypic species. Poaceae was the leading family that contributed 43 grasses, followed by Fabaceae (16 spp.), Asteraceae (15 spp.), Chenopodiaceae (10 spp.), Euphorbiaceae (9 spp.), Boraginaceae (8 spp.), Amaranthaceae (7 spp.), Aizoaceae, Cucurbitaceae, Mimosaceae and Solanaceae (6 spp. each), Capparaceae, Caryophyllaceae and Scrophulariaceae (5 spp. each), whereas, the largest genera were *Chenopodium* (5 spp.), *Cenchrus* (4 spp.) and *Amaranthus* (3 spp.).

Introduction

Pakistan has an area of 80,943 km^2, and lies between 60° 55' to 75° 30' E longitude and 23° 45' to 36° 50' N latitude. Pakistan has an altitude ranging from 0 to 8,611 m; therefore, it presents a variety of climatic zones and a unique biodiversity. It has about 6,000 species of higher plants (Ali & Qaiser, 1986). It has also been estimated that 70% of the total species are uni-regional and about 30% are bi-or pluri-regional. The country has four phytogeographical regions: (i) Irano-Turanian (45% of species); (ii) Sino-Himalayan (10%); (iii) Saharo-Sindian (9.5%) and (iv) Indian element (6%). Despite the Saharo-Sindian Region being the biggest area, the diversity of species confined to this area is the lowest (Ali & Qaiser, 1986).

The knowledge of the floristic composition of an area is a perquisite for any ecological and phytogeographical studies and conservation management activities. In studying any particular piece of vegetation, from an ecological point of view, there is need to determine the flora and vegetation linking with habitat types (Nicholes, 1930). Plant biodiversity and phytogeography are other important factors which should be considered for evaluating the conservational value of an area (Qureshi, 2012).

Traditionally the designation of protected areas in Pakistan was largely based on fauna and in particular large mammals and birds which are more attracted for hunters. The Lal Suhanra Park was formally declared as National Park in 1972. The park was established to protect existing wildlife and vegetation; reintroduce extirpated species; rehabilitate wildlife habitat; create education/research facilities for local and foreign tourists, and recreational facilities for the local population (Rafay *et al*., 2013). Flora and vegetation of Lal Suhanra National Park had been scarcely studied hitherto, only few botanists visited the area for a particular plant group during their plant expedition. Historically, no detailed survey was carried out previously to record complete flora of this park. The adjoining area i.e. Cholistan desert was previously explored for floristic survey by Arshad & Rao (1994). They recorded 118 plant species belonging to 82 genera and 32 families. After establishment of this park, some sporadic information on the flora and vegetation is available. In a preliminary survey, Hameed *et al.,* (2002) reported 56 plant species belonged to 20 families from this region. Arshad & Akbar (2002) recorded 19 plant species from the fenced un-irrigated, 17 from fenced irrigated and 13 from unfenced un-irrigated areas of National Park Lal Suhanra during a phytosociological study of the area. Mian & Ghani (2007) opinioned that plant species supposed to increase due to increasing protection efforts from different enclosures of National Park Lal Suhanra. The protection was more pronounced in sand dunes as compared to saline habitats. Keeping in view, present study was carried out during 2005-2007 to update floristic list of the Lal Suhanra National Park.

Materials and Methods

Study area: Lal Suhanra National Park (LSNP) with its 65790.36 hectares surface area is situated between 29° 12' and 29° 28′ northern latitudes and 71° 48′ and 72° 08′ eastern longitudes, with an altitude ranging from 125 to 140 meters, on southeastern part of the Punjab Province, 32 kilometers away from the Bahawalpur city towards East at the main Bahawalpur-Bahawalnagar highway (Fig. 1). Because of high diversity of wildlife, microhabitats and landscapes, the area was designated as Protected Area in 1972. LSNP is of immense value due to forest plantation, wildlife enclosures, picnic spots and fishing in the pond area. The variability of habitat plays an important role in preserving biodiversity of the area. Natural vegetation inside the plantation is of weedy nature while the desert area supports the vegetation of xeric and semi-xeric type. Lake area has the aquatic or semi-aquatic vegetation that is of submerged, floating or marshy type (Hameed *et al.,* 2002).

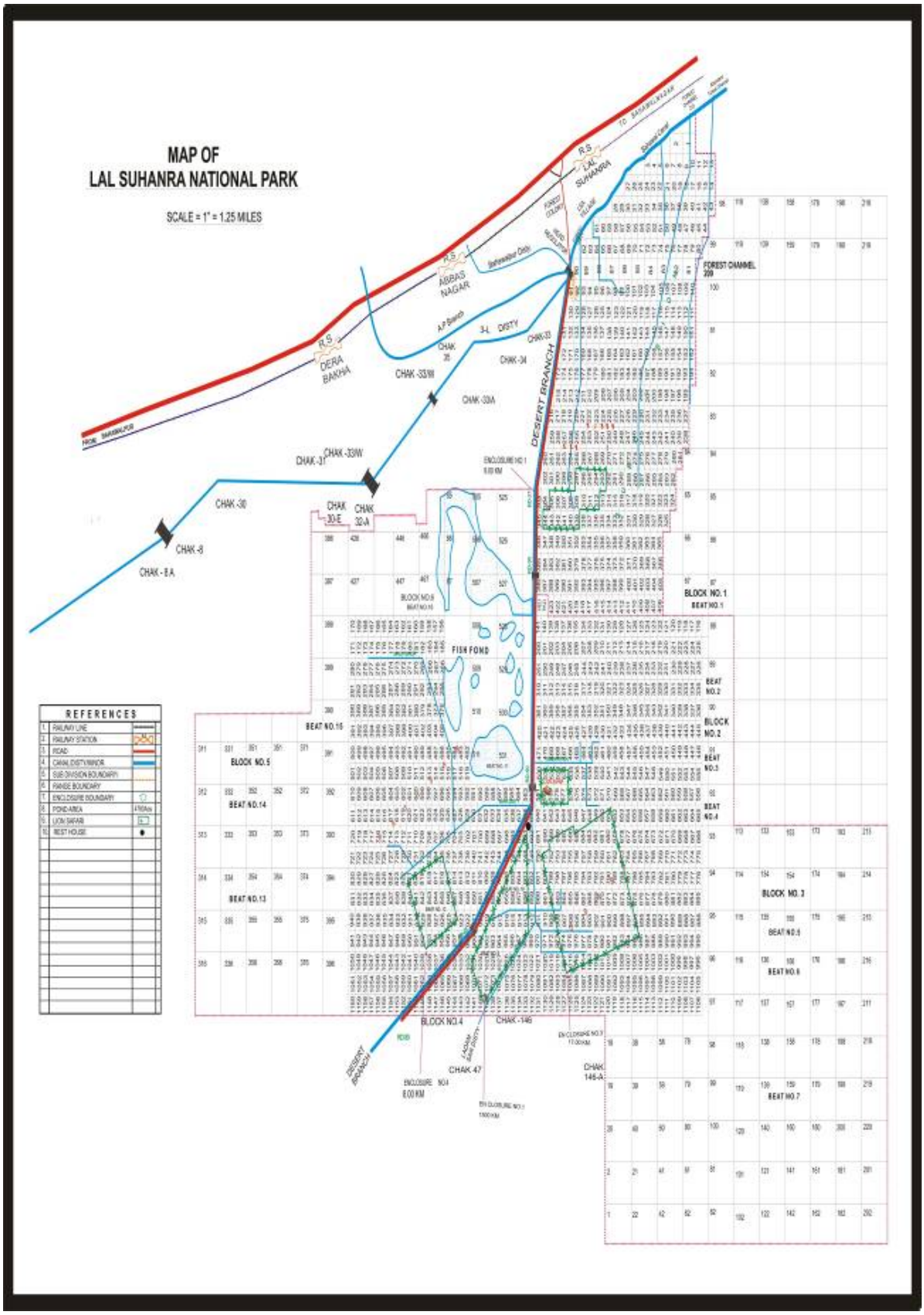

Fig. 1. Location map of Lal Suhanra National Park.

Geology and climate: The climate of the area is of sub-tropical continental type, characterized by low and sporadic rainfall, high temperatures, low relative humidity, high rate of evaporation and strong summer winds. Temperature ranges from 50ºC during summer to -2ºC during winter and the hottest months are May and June. Annual rainfall varies between 90 to 200 mm and average relative humidity is about 60%. Wind direction in summer is southeastern and in winter it is northeastern. The soil in general is made up of alluvial deposits having clayey loam at "Dahars" (flat areas between dunes) with low sand dunes at scattered places. The size of sand dunes ranges from 0.01 to 0.50 km^2 and up to the height of 6 m. clayey loam deposits are about 1.5 to 5.0 m thick and pure sand starts below the hard clayey surface (Hameed *et al*., 2002).

Floristic survey: The whole area was explored for botanical excursions during 2007 to 2009. Based on physiognomic features, topography and soil conditions, seven microhabitats such as (i) Children Park (ii) Black Buck Enclosure at RD 25 (iii) Pond Area at RD 30 (iv) Lion Safari Park at RD 50 (v) Rest House at RD 50 (vi) East Enclosure at RD 65 and (vii) Black Buck Enclosure at RD 65 were marked and visited on seasonal basis for the collection of plant specimens and relevant data. The collected specimens were pressed, dried and mounted on standard herbarium specimens and identified using available floristic literature (Jafri, 1966; Chaudhary 1989; Cope 1982; Nasir & Ali 1970-1989; Ali & Nasir 1989-1993; Ali & Qaiser, 1993-1995, 2000-2006; Bhandari, 1987; Qureshi, 2012). The voucher specimens were deposited in the herbarium of Botany Department, Govt. College Bosan Road, Multan. Nomenclature follows mostly after the Flora of Pakistan (Nasir & Ali 1970-1989; Stewart, 1972; Ali & Nasir 1989-1993; Ali & Qaiser, 1993-1995; and 2000-2006).

Results and Discussion

Flora: During the survey, a total of 212 species belonging to 162 genera and 50 families were identified from Lal Suhanra National Park (LSNP) that is reflected in Appendix 1. The Dicots having 41 families, 118 genera and 158 species were the most diverse and dominating group of plants in this area, followed by Monocots with 5 families, 40 genera and 50 species, Pteridophytes with 3 families, 3 genera and 3 species and Bryophytes with monotypic species (Table 1). Earlier, Hameed *et al*., (2002) recorded 56 species from the area; therefore 156 species are addition to the study area from the boundaries of the LSNP. The major contributing families are provided under Table 2 in which Poaceae was the leading one with 43 grasses, followed by Fabaceae (16 spp.), Asteraceae (15 spp.), Chenopodiaceae (10 spp.), Euphorbiaceae (9 spp.), Boraginaceae (8 spp.), Amaranthaceae (7 spp.), Aizoaceae, Cucurbitaceae, Mimosaceae and Solanaceae (6 spp. each), Capparidaceae, Caryophyllaceae and Scrophulariaceae (5 spp. each). Qureshi (2008) and Qureshi & Bhatti (2008) reported similar kinds of studies from the Chotiari wetlands complex (Nawab Shah) and Nara Desert, Pakistan, respectively. Other significant studies include Qureshi *et al.*, (2014) and Shaheen *et al.,* (2014) from Khanpur Dam (KPK) and Thal desert (Punjab) respectively.

Table 1. Summary of floristic groups in LSNP.

Plant group	Families	Genera	Species
Dicots	41	118	158
Monocots	5	40	50
Pteridophyta	3	3	3
Bryophyta	1	1	1

Table 2. Major families of plants in LSNP.

Families	Species	Genera
Poaceae	43	33
Fabaceae	16	12
Asteraceae	15	12
Chenopodiaceae	10	4
Euphorbiaceae	9	5
Boraginaceae	8	6
Amaranthaceae	7	5
Aizoaceae	6	5
Cucurbitaceae	6	6
Mimosaceae	6	4
Solanaceae	6	5
Capparidaceae	5	3
Caryophyllaceae	5	5
Scrophulariaceae	5	4

Micro-habitats: Overall seven different microhabitats were determined from the whole project area with reference to the distribution of plant. The complete list of species along with microhabitats is compiled and provided in Table 4. Highest number of species were identified from Black Buck Enclosure at RD 25 (102 spp.) with overall 48.34% of the total flora of Lal Suhanra National Park. It was followed by Children Park (94 spp., 44.55%), East Enclosure at RD 65 (79 spp., 37.44), Black Buck Enclosure at RD 65 (73 spp., 34.60%), Lion Safari Park at RD 50 (65 spp., 30.81%), Pond Area at RD 30 (56 spp., 26.54%), whereas, Rest House at RD 50 had less number of species i.e.49 species with 23.22% (Fig. 2). Qureshi & Bhatti (2008) reported six microhabitats from the Nara Desert, which is adjoining with the Cholistan Desert.

Life form spectra: Life forms of the flora of LSNP was studied and classified according to Raunkiaer' system of classification (1934) and given under Fig. 3. The dominate life from is Therophyte (111 spp., 52.4%), followed by Chamaephytes (43 spp., 20.3%), Hemicryptophytes (25 spp., 11.8%), Phanerophyte (24 spp., 11.3%) and Cryptophyte (9 spp., 4.25%). Qureshi & Bhatti (2010) reported that Therophytes are prevailing in the desert habitats in which pseudo-xerophytes are dominating ones. Our results are in agreement of aforesaid study. Various scientists contributed the flora and life form spectra from different parts of the country such as Qureshi (2008), Qureshi & Bhatti (2008), Qureshi & Bhatti (2010), Qureshi *et al.,* (2011a & b) and Qureshi *et al.*, (2014). Our results are in the line of those studies.

Appendix 1. Checklist of plants of Lal Suhanra National Park. Numbers in parenthesis refers to voucher specimen(s) and Collectors: W=Wariss.

Dicotyledons

Acanthaceae: *Peristrophe paniculata* (Forssk.) Brummitt (W-60)

Aizoaceae: *Gisekia pharnaceoides* L. (W-19), *Limeum indicum* Stocks ex T. Anders. (W-88), *Sesuvium sesuvioides* (Frenzl) Verde. (W-57), *Trianthema portulacastrum* L. (W-186), *Trianthema triquetra* Rottl. And Willd. (W-157), *Zaleya pentandra* (L.) Jeffrey. (W-51).

Amaranthaceae: *Achyranthus aspera* L. (W-131), *Aerva javanica* (Brum.f.) Juss. Ex J.A. Schultes. (W-63), *Alternanthera sessilis* (L.) DC. (W-107), *Amaranthus graecizans* subsp. s*ilvestris* (Vill.) Brenan. (W-108) *Amaranthus graecizans* subsp. *thellungianus* (Nevski) Gusev. (W-20), *Amaranthus viridis* L. (W-5), *Digera muricata* (L.) Mart. (W-125).

Apiaceae: *Anethum graveolens* L. (W-204), *Conium maculatum* L. (W-187).

Asclepiadaceae: *Calotropis procera* (Ait.) Ait. f. (W-138), *Leptadenia pyrotechnica* (Forssk.) Decne. (W-171), *Oxystelma esculentum* (L. f.) R.Brown. (W-151), *Pentatropis spiralis* (Forssk.) Decne. (W-43).

Asteraceae: *Blumea axillaris* (Lamarck) Candolle (W-169), *Carthamus oxycantha* Beib. (W-212), *Cirsium arvensis* Hoffin. Deutschl. (W-106), *Conyza bonariensis* DC. (W-23), *Echinops echinatus* Roxb. (W-149), *Eclipta alba* Hassk. (W-159), *Gnaphalium luteo-album* (L.) O. M. Hilliard & B. L. Burtt (W-129), *Launaea nudicaulis* Hook. (W-192), *Launaea resedifolia* (Roxb.) Ramayya (W-172), *Pulicaria crispa* Sch. ex Bip. (W-126), *Sonchus arvensis* L. (W-174), *Sonchus asper* (L.) Hill. (W-156), *Sonchus oleraceous* L. (W-84), *Vernonia cinerascens* Schultz-Bip. (W-118), *Xanthium strumarium* L. (W-62).

Bignoniaceae: *Tacomella undulata* (Roxb.) Seeman. (W-117).

Boraginaceae: *Arnebia hispidissima* (Lehm.) A.DC. (W-76), *Coldenia procumbens* L. (W-105), *Cynoglossum lanceolatum* Forssk. (W-158), *Gastrocotyle hispida* (Forssk.) Bunge. (W-202), *Heliotropium crispum* Desf. (W-122), *Heliotropium europaeum* L. (W-119), *Heliotropium strigosum* subsp. *strigosum* Willd (W-143), *Nonea edgeworthii* A. DC. (W-199).

Brassicaceae: *Coronopus didymus* (L.) Smith. (W-183), *Farsetia hamiltonii* Royle. (W-71), *Sisymbrium loeselii* L. (W-194).

Caesalpiniaceae: *Cassia occidentalis* L. (W-40).

Capparaceae: *Capparis decidua* (Forssk.) Edgew. (W-152), *Cleome brachycarpa* Vahi ex DC. (W-127), *Cleome scaposa* DC. (W-91), *Cleome viscosa* L. (W-114), *Dipterygium glaucum* Decne. (W-90).

Caryophyllaceae: *Cerastium cerastioides* (L.) Britton. (W-205), *Gypsophila alsinoides* Bunge. (W-98), *Silene conoidea* L. (W-191), *Spergula pentendra* L. (W-206), *Stellaria media* (L.) Vill. (W-175).

Chenopodiaceae: *Chenopodium album* L. (W-1), *Chenopodium atripliciforme* Murr. (W-69), *Chenopodium ficifolium* subsp. *blomianum* (Aellen) Aellen (W-70), *Chenopodium murale* L. (W-11), *Chenopodium* sp. L. (W-48), *Haloxylon recurvum* Sensu Bunge. (W-146), *Haloxylon salicornicum* (Moq.) Bunge ex Boiss. (W-102), *Salsola imbricata* Forssk. (W-4), *Suaeda fruticosa* Forssk. Ex J. F. Gmelin. (W-209).

Convolvulaceae: *Convolvulus arvensis* L. (W-79), *Convolvulus prostratus* Forssk. (W-111), *Convolvulus stocksii* Boiss. (W-136), *Cressa cretica* L. (W-154).

Cucurbitaceae: *Citrullus colocynthis* (L.) Schrad. (W-25), *Coccinia grandis* (L.) Voigt. (W-113), *Cucumis melo* var. *agrestis* Naud. (W-10), *Momordica balsamina* L. (W-75), *Mukia maderaspatana* (L.) M. J. Roem. (W-145), *Praecitrullus fistulosus* (Stocks) Pangalo. (W-95).

Cuscutaceae: *Cuscuta reflexa* Roxb. (W-211).

Euphorbiaceae: *Chrozophora sabulosa* Kar. & Kir. (W-72), *Croton sparsiflorus* Morong. (W-29), *Euphorbia dracunculoides* ssp. *dracunculoides* Lam. (W-195), *Euphorbia granulata* Forssk. (W-100), *Euphorbia hirta* L. (W-15), *Euphorbia prostrata* Ait. (W-13), *Phyllanthus amarus* Schum. & Thonn. (W-41), *Phyllanthus fraternus* Webster. (W-39), *Ricinus communis* L. (W-47).

Fumariaceae: *Fumaria indica* (Haussk.) Pugsley (W-200).

Lamiaceae: *Mentha viridis* L. (W-78).

Malvaceae: *Abutilon muticum* Sweet (W-124), *Hibiscus gossypifolius* Mill. (W-67), *Malva nicacensis* All. (W-207), *Malvastrum coromendelianum* (L.) Garcke (W-14).

Mimosaceae: *Acacia jacquemontii* Benth. (W-74), *Acacia nilotica* (L.) Delile. (W-34), *Albizia lebbeck* (L.) Benth. (W-31), *Leucaena leucocephala* (Lam.) de Wit. (W-65), *Prosopis cineraria* L. (W-150), *Prosopis glandulosa* Torr. (W-21).

Molluginaceae: *Glinus lotoides* L. (W-164), *Mollugo cerviana* (L.) Seringe (W-89), *Mollugo nudicaulis* Lamk. (W-161).

Myrtaceae: *Eucalyptus camaldulensis* L. (W-160), *Eucalyptus* sp. L. (W-156).

Nyctaginaceae: *Boerhavia diffusa* L. (W-45), *Boerhavia repens* L. (W-94).

Oxalidaceae: *Oxalis corniculata* L. (W-128).

Papavaraceae: *Argemone mexicana* L. (W-2).

Fabaceae: *Alhagi maurorum* Desv. (W-3), *Crotalaria burhia* Hamilt. (W-93), *Crotalaria medicaginea* var. *medicaginea* Lamk. (W-66), *Dalbergia sissoo* Roxb. (W-58), *Indigofera argentea* Brum. f. (W-156), *Indigofera sessiliflora* DC. (W-101), *Lathyrus aphaca* L. (W-197), *Medicago laciniata* (L.) Mill. var. *brachycantha* Boiss. (W-189), *Melilotus alba* Desr. (W-181)**,** *Melilotus parviflorus* Desf. (W-182), *Rhynchosia capitata* DC. (W-99), *Rhynchosia minima* DC. (W-80), *Sesbania sesban* L. Merrill. var. *sesban* (W-54), *Tephrosia uniflora* subsp. *petrosa* (Blatter & Hallberg) Gillett & Ali. (W-59), *Trifolium resupinatum* L. (W-190), *Vicia sativa* L. (W-198).

Polygalaceae: *Polygala abyssinica* R. Br. ex Fresen. (W-50), *Polygala erioptera* DC. (W-141).

Polygonaceae: *Calligonum polygonoides* L. (W-137), *Persicaria glabra* (Willd.) M. Gómes (W-37), *Polygonum plebejum* L. (W-133), *Rumex chalepensis* Mill. (W-193).

Portulacaceae: *Portulaca oleracea* L. (W-109), *Portulaca quadrifida* L. (W-110).

Primulaceae: *Anagallis arvensis* L. (W-180).

Ranunculaceae: *Ranunculus sceleratus* L. (W-132).
Resedaceae: *Oligomeris linifolia* (Vahl) McBride (W-210).

Rhamnaceae: *Ziziphus mauritiana* Lamk. (W-170), *Ziziphus nummularia* Wight & Arn. (W-49), *Ziziphus spina-christi* (L.) Willd. (W-135).

Salvadoraceae: *Salvadora oleoides* Decne. (W-77).

Scrophulariaceae: *Anticharis linearis* (W-144), *Mazus rugosus* Lour. (W-184), *Verbascum thapsus* L. (W-162), *Veronica agrestis* L. (W-201), *Veronica anagallis-aquatica* L. (W-203).

Solanaceae: *Datura metel* L. (W-17), *Nicotiana plumbaginifolia* Viv. (W-130), *Physalis minima* L. (W-120), *Solanum nigrum* L. (W-121), *Solanum surattense* Burm. (W-153), *Withania somnifera* Dunal. (W-12).

Tamaricaceae: *Tamarix aphylla* (L.) Karst. (W-44), *Tamarix dioica* Roxb. (W-46).

Tiliaceae: *Corchorus depressus* (L.) Stocks (W-163), *Corchorus trilocularis* L. (W-123).

Verbenaceae: *Phyla nodiflora* (L.) Rich. (W-9).

Zygophyllaceae:*Fagonia bruguieri* var. *laxa* Boiss. W-142), *Tribulus longipetalus* Viv. (W-155), *Tribulus terrestris* L. (W-16).

Monocotyledons

Arecaceae: *Phoenix dactylifera* L. (W-103), *Phoenix sylvestris* Roxb. (W-104).

Cyperaceae: *Carex foliosa* D. Don. (W-115), *Cyperus rotundus* L. (W-116), *Fimbristylis dichotoma* (L.) Vahl (W-8).

Liliaceae: *Asphodelus tenuifolius* Cav. (W-179).

Poaceae: *Aeluropus lagopoides* (L.) Trin. (W-147), *Aristida adscensionis* L. (W-73), *Aristida funiculata* Trin. & Rupr. (W-85), *Arundo donax* L. (W-61), *Brachiaria reptans* (L.) Gard. & Hubb. (W-6), *Cenchrus biflorus* Roxb. (W-81), *Cenchrus ciliaris* L. (W-18), *Cenchrus prieurii* (Kunth.) Maire (W-97), *Cenchrus setigerus* Vahl. (W-134), *Cymbopogon jwarancusa* (Jones) Schultz. (W-112), *Cynodon dactylon* Pers. (W-139), *Dactyloctenium aegyptium* (L.) Beauv. (W-82), *Desmostachya bipinnata* (L.) Stapf (W-22), *Dicanthium annulatum* (Forssk.) Stapf (W-35), *Digitaria sanguinalis* (L.) Scop. (W-83), *Digitaria* sp. Haller. (W-56), *Diplachne fusca* (L.) Beauv. (W-165), *Echinochloa crus-galli* (L.) Beauv. (W-166), *Echinochloa colona* (L.) Link. (W-7), *Eleusine indica* (L.) Gaertn. (W-26), *Eragrostis barrelieri* Dav. (W-52), *Eragrostis ciliaris* (L.) R. Br. (W-32), *Eragrostis minor* (W-53), *Imperata cylindrica* (L.) Beauv. (W-140), *Lasiurus scindicus* (W-92), *Leptochloa panicea* (L.) Nees (W-55), *Leptothrium senegalense* (Kunth) W. D. Clayton. (W-87), *Lolium temulentum* L. (W-196), *Mnesithea laevis* (Retz.) Kunth. (W-27), *Ochthochloa compressa* (Forssk.) Hilu. (W-148), *Panicum antidotale* Retz. (W-168), *Paspalum paspalodes* (Michx.) Scribner. (W-42), *Pennisetum thunbergii* Kunth. (W-86), *Phalaris minor* Retz. (W-178), *Poa annua* L. (W-185), *Polypogon monspeliensis* (L.) Desf. (W-177), *Saccharum bengalense* Retz. (W-64), *Saccharum spontaneum* L. (W-36), *Setaria pumila* (Poir.) Roem. & Schult. (W-24), *Sorghum halepense* (L.) Pers. (W-38), *Sporobolus ioclados* (Nees ex Trin) Nees (W-167), *Tragus racemosus* (L.) All. (W-96), *Tragus roxburghii* Panigrahi (W-176).

Typhaceae: *Typha angustata* Bory & Chaub. (W-30).

Pteridopytes

Adiantaceae: *Adiantum capillus-veneris* L. (W-103).

Equisetaceae: *Equisetum arvense* L. (W-188).

Marsileaceae: *Marsilea quadrifolia* L. (W-110).

Bryophytes

Funariaceae: *Funaria hygrometrica* Hedw. (W-173).

Table 3. List of important genera of plants in LSNP.

Genus	Species	Genus	Species
Chenopodium	5	*Indigofera*	2
Cenchrus	4	*Launaea*	2
Euphorbia	4	*Melilotus*	2
Amaranthus	3	*Mollugo*	2
Cleome	3	*Phyllnthus*	2
Convolvulus	3	*Polygala*	2
Eragrostis	3	*Polygonum*	2
Heliotropium	3	*Portulaca*	2
Sonchus	3	*Prosopis*	2
Ziziphus	3	*Rhynchosia*	2
Acacia	2	*Saccharum*	2
Aristida	2	*Solanum*	2
Boerhavia	2	*Tamarix*	2
Corchorus	2	*Tragus*	2
Crotalaria	2	*Trianthema*	2
Echinochloa	2	*Tribulus*	2
Eucalyptus	2	*Veronica*	2

With reference to genera, *Chenopodium* contributed maximum species (5), followed by *Cenchrus* and *Euphorbia* (4 spp. each), *Amaranthus*, *Cleome*, *Convolvulus*, *Eragrostis*, *Heliotropium*, *Sonchus* and *Ziziphus* (3 spp. each), while *Acacia, Aristida*, *Boerhavia*, *Corchorus*, *Crotalaria*, *Echinochloa*, *Eucalyptus*, *Indigofera*, *Launaea*, *Melilotus*, *Mollugo*, *Phyllanthus*, *Polygala*, *Polygonum*, *Portulaca*, *Prosopis*, *Rhynchosia*, *Saccharum*, *Solanum*, *Tamarix*, *Tragus*, *Trianthema*, *Tribulus* and *Veronica* contributed 2 species (Table 3).

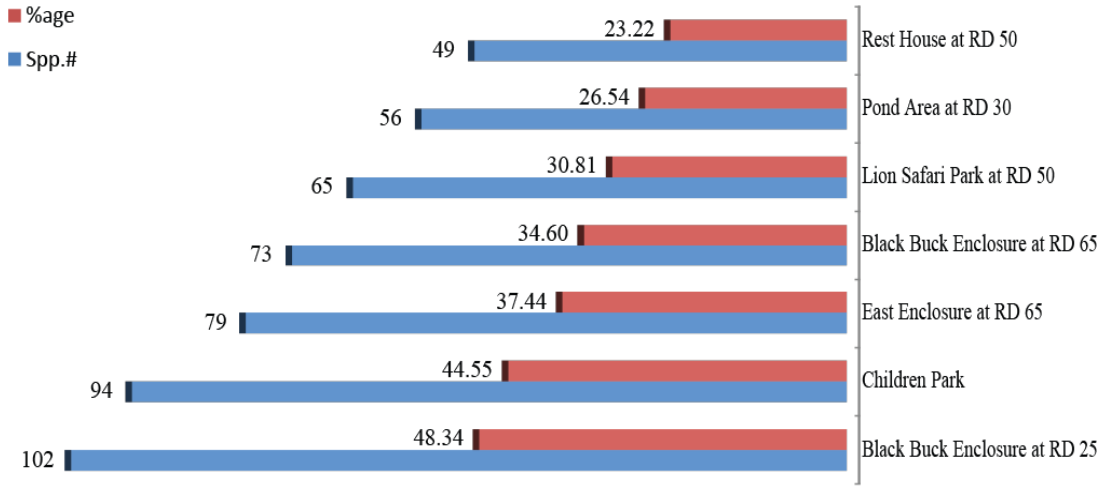

Fig. 2. Floristic composition versus Microhabitats in LSNP.

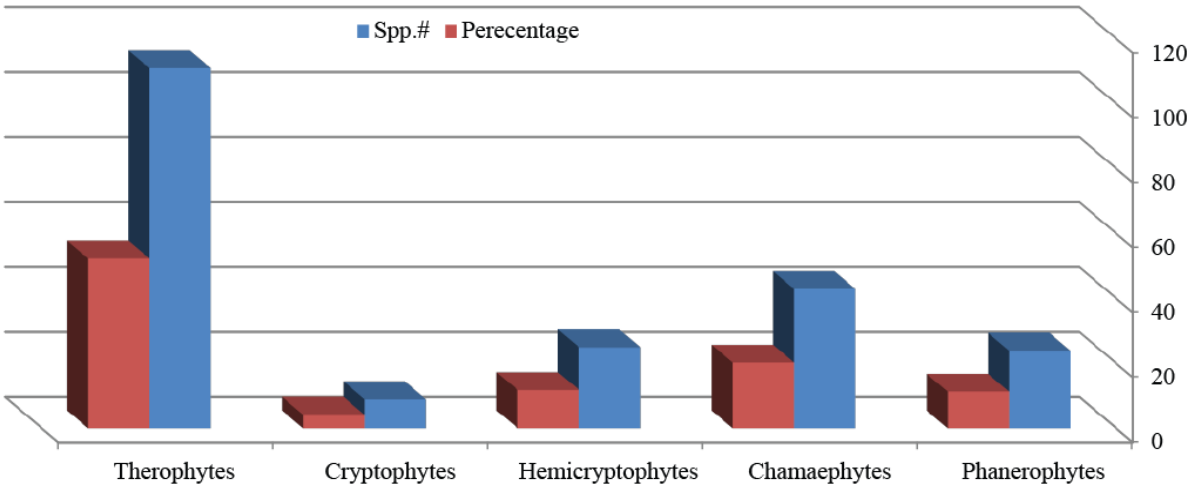

Fig. 3. Life form spectra of the recorded species in LSNP.

Table 4. Distribution of plants in different habitats of LSNP.

Families	Species	Microhabitats						
		CP	BB	PA	LSP	RH	EE	BB65
1. Acanthaceae	*Peristrophe paniculata*	+	+	-	-	+	-	-
2. Adiantaceae	*Adiantum capillus -veneris*	-	+	+	-	+	-	-
3. Aizoaceae	*Gisekia pharnaceoides*	+	-	-	-	+	-	-
	Limeum indicum	-	+	-	-	-	+	-
	Sesuvium sesuvioides	-	+	-	-	-	-	-
	Trianthema portulacastrum	-	+	-	-	-	-	-
	Trianthema triquetra	-	-	-	-	-	-	+
	Zaleya pentandra	-	+	-	+	-	-	-
4. Amaranthaceae	*Achyranthus aspera*	-	+	-	+	-	+	-
	Aerva javanica	-	+	+	+	-	+	+
	Alternanthera sessilis	-	-	+	-	-	-	-
	Amaranthus graecizans subsp. *silvestris*	-	-	+	-	-	-	-
	Amaranthus graecizans subsp. *thellungianus*	+	-	-	+	-	-	-
	Amaranthus viridis	-	-	+	-	-	-	-
	Digera muricata	+	-	-	-	+	-	-
5. Apiaceae	*Anethum graveolens*	-	-	-	-	+	-	-
	Conium maculatum	-	-	+	-	-	-	-
6. Arecaceae	*Phoenix dactylifera*	+	-	+	-	+	-	+
	Phoenix sylvestris	+	-	+	-	+	-	+
7. Asclepiadaceae	*Calotropis procera*	+	+	+	+	+	+	+
	Leptadenia pyrotechnica	-	-	-	-	-	+	-
	Oxystelma esculentum	-	+	-	-	-	-	+
	Pentatropis spiralis	-	+	-	+	-	-	-
8. Asteraceae	*Blumea axillaris*	-	-	-	-	-	+	-
	Carthamus oxycantha	-	-	-	-	-	+	-
	Cirsium arvensis	+	+	+	-	+	+	-
	Conyza bonariensis	+	+	+	+	+	+	+
	Echinops echinatus	-	-	-	-	-	-	+
	Eclipta alba	+	+	+	+	+	+	+
	Gnaphalium luteo-album	-	-	-	+	-	-	-
	Launaea nudicaulis	-	+	-	-	-	-	-
	Launaea resedifolia	-	+	+	+	+	+	+
	Pulicaria crispa	-	-	-	-	-	-	+
	Sonchus arvensis	+	+	-	-	-	+	-
	Sonchus asper	+	+	-	+	-	+	-
	Sonchus oleraceous	+	+	+	-	+	+	-
	Vernonia cinerascens	+	-	-	+	-	-	-
	Xanthium strumarium	+	-	-	-	-	-	-
9. Bignoniaceae	*Tacomella undulata*	-	+	-	-	+	-	-
10. Boraginaceae	*Arnebia hispidissima*	-	+	-	-	-	-	-
	Coldenia procumbens	-	-	+	-	-	-	-
	Cynoglossum lanceolatum	-	+	-	-	-	-	-
	Gastrocotyle hispida	-	+	-	-	-	-	-
	Heliotropium crispum	+	+	-	+	+	-	+
	Heliotropium europaeum	-	-	-	+	-	-	-
	Heliotropium strigosum subsp. *strigosum*	-	-	-	-	-	-	+
	Nonea edgeworthii	-	-	+	-	-	-	-
11. Brassicaceae	*Coronopus didymus*	+	+	-	-	+	-	+
	Farsetia hamiltonii	+	-	-	-	-	-	-
	Sisymbrium loeselii	+	+	-	-	-	-	-
12. Caesalpiniaceae	*Cassia occidentalis*	+	-	-	-	-	-	-
13. Capparaceae	*Capparis decidua*	+	+	+	+	+	+	+
	Cleome brachycarpa	-	-	-	+	-	+	-
	Cleome scaposa	-	+	-	-	-	-	+
	Cleome viscosa	-	-	-	+	-	-	-
	Dipterygium glaucum	-	+	-	+	-	+	+

Table 4. (Cont'd.).

Families	Species	Microhabitats						
		CP	BB	PA	LSP	RH	EE	BB65
14. Caryophyllaceae	*Cerastium cerastioides*	-	-	-	-	+	-	-
	Gypsophila alsinoides	-	+	-	-	-	-	-
	Silene conoidea	+	-	-	-	-	-	-
	Spergula pentendra	-	-	-	-	+	-	+
	Stellaria media	+	+	-	-	+	-	-
15. Chenopodiaceae	*Chenopodium album*	+	-	-	+	+	+	-
	Chenopodium atripliciforme	+	-	-	-	-	-	-
	Chenopodium ficifolium subsp. *blomianum*	+	-	-	-	-	-	-
	Chenopodium murale	+	-	-	-	-	-	-
	Chenopodium sp.	+	-	-	-	-	-	-
	Haloxylon recurvum	+	-	-	-	-	-	-
	Haloxylon salicornicum	-	+	-	-	-	-	+
	Salsola imbricata	-	+	-	-	-	-	+
	Suaeda fruticosa	+	+	-	-	-	-	+
16. Convolvulaceae	*Convolvulus arvensis*	+	+	-	-	-	-	-
	Convolvulus prostratus	-	-	+	-	-	-	-
	Convolvulus stocksii	-	-	-	+	-	-	-
	Cressa cretica	-	-	-	-	-	-	+
17. Cucurbitaceae	*Citrullus colocynthis*	+	-	-	-	-	+	-
	Coccinia grandis	-	-	-	+	-	-	-
	Cucumis melo var. *agrestis*	+	-	-	+	-	-	-
	Momordica balsamina	-	+	-	-	-	-	-
	Mukia maderaspatana	+	-	-	+	-	-	+
	Praecitrullus fistulosus	-	+	-	-	-	-	+
18. Cuscutaceae	*Cuscuta reflexa*	+	-	-	-	-	+	-
19. Cyperaceae	*Carex foliosa*	-	-	-	+	-	+	-
	Cyperus rotundus	+	+	+	+	+	+	+
	Fimbristylis dichotoma	-	-	-	+	-	-	-
20. Equisetaceae	*Equisetum arvense*	+	-	-	-	+	-	-
21. Euphorbiaceae	*Chrozophora sabulosa*	-	+	-	-	-	-	-
	Croton sparsiflorus	+	-	-	-	-	-	-
	Euphorbia dracunculoides ssp. *dracunculoides*	-	+	-	-	-	-	-
	Euphorbia granulata	+	+	-	-	-	+	-
	Euphorbia hirta	-	+	-	-	-	+	-
	Euphorbia prostrata	+	-	-	-	-	+	-
	Phyllanthus amarus	+	+	-	-	-	+	-
	Phyllanthus fraternus	+	-	-	-	-	-	-
	Ricinus communis	+	-	-	-	-	-	-
22. Fumariaceae	*Fumaria indica*	+	+	-	-	+	-	-
23. Funariaceae	*Funaria hygrometrica*	+	-	-	-	-	-	-
24. Lamiaceae	*Mentha viridis*	-	+	+	-	-	-	-
25. Liliaceae	*Asphodelus tenuifolius*	+	-	-	-	-	-	-
26. Malvaceae	*Abutilon muticum*	-	-	+	+	-	+	-
	Hibiscus gossypifolius	+	-	-	-	-	-	-
	Malva nicacensis	-	-	-	-	-	-	+
	Malvastrum coromendelianum	+	-	-	-	-	-	-
27. Marsileaceae	*Marsilea quadrifolia*	-	-	+	-	-	-	-
28. Mimosaceae	*Acacia jacquemontii*	-	+	+	-	-	-	-
	Acacia nilotica	+	+	+	+	+	+	+
	Albizia lebbeck	+	-	+	+	-	+	-
	Leucaena leucocephala	+	-	-	+	-	+	+
	Prosopis cineraria	-	+	+	+	+	+	+
	Prosopis glandulosa	+	+	+	+	+	+	+

Table 4. (Cont'd.).

Families	Species	Microhabitats						
		CP	BB	PA	LSP	RH	EE	BB65
29. Molluginaceae	*Glinus lotoides*	-	-	-	-	-	+	-
	Mollugo cerviana	-	+	-	-	-	+	-
	Mollugo nudicaulis	-	-	-	-	-	+	-
30. Myrtaceae	*Eucalyptus camaldulensis*	+	+	+	+	+	+	+
	Eucalyptus sp.	+	+	+	+	+	+	+
31. Nyctaginaceae	*Boerhavia diffusa*	+	+	-	-	-	-	-
	Boerhavia repens	-	+	-	-	-	+	-
32. Oxalidaceae	*Oxalis corniculata*	-	+	+	+	+	+	+
33. Papavaraceae	*Argemone mexicana*	+	-	-	-	-	-	-
34. Fabaceae	*Alhagi maurorum*	+	+	+	+	+	+	+
	Crotalaria burhia	-	+	-	-	-	+	-
	Crotalaria medicaginea var. *medicaginea*	-	+	-	-	-	-	-
	Dalbergia sissoo	+	+	-	-	+	-	-
	Indigofera argentea	-	+	+	+	+	+	+
	Indigofera sessiliflora	-	+	+	-	+	-	+
	Lathyrus aphaca	-	+	+	-	+	-	-
	Medicago laciniata var. *brachycantha*	+	+	-	-	-	-	-
	Melilotus alba	+	-	-	-	-	-	-
	Melilotus indica	+	+	-	-	-	+	-
	Rhynchosia capitata	+	+	-	-	+	-	-
	Rhynchosia minima	+	+	-	-	+	-	-
	Sesbania sesban var. *sesban*	-	+	-	-	-	-	-
	Tephrosia uniflora	+	+	-	+	-	+	-
	Trifolium resupinatum	+	-	-	-	-	-	-
	Vicia sativa	-	-	-	-	-	-	+
35. Poaceae	*Aeluropus lagopoides*	+	-	-	-	-	-	-
	Aristida adscensionis	-	+	-	-	-	-	+
	Aristida funiculata	-	+	-	-	-	-	+
	Arundo donax	+	-	+	-	-	+	+
	Brachiaria reptans	+	-	-	-	-	-	-
	Cenchrus biflorus	-	+	-	+	-	+	-
	Cenchrus ciliaris	+	+	+	+	-	+	+
	Cenchrus prieurii	-	+	-	-	-	-	-
	Cenchrus setigerus	-	-	-	+	-	-	-
	Cymbopogon jwarancusa	-	+	-	+	-	+	+
	Cynodon dactylon	+	+	+	+	+	+	+
	Dactyloctenium aegyptium	+	+	-	-	-	+	+
	Desmostachya bipinnata	+	+	+	+	+	+	+
	Dicanthium annulatum	+	+	+	+	+	+	+
	Digitaria sanguinalis	+	+	-	-	-	-	-
	Diplachne fusca	-	-	-	-	-	+	-
	Echinochloa crusgalli	-	-	-	-	-	+	-
	Echinochloa colona	+	-	-	-	-	+	-
	Eleusine indica	+	-	-	-	-	-	-
	Eragrostis barrelieri	+	+	-	-	-	-	-
	Eragrostis ciliaris	+	-	-	-	-	-	-
	Eragrostis minor	+	-	-	-	-	-	-
	Imperata cylindrica	+	-	-	-	-	-	+
	Lasiurus scindicus	-	+	-	+	-	+	+
	Leptochloa panicea	+	-	-	-	-	-	-
	Leptothrium senegalense	-	+	-	-	-	-	-
	Lolium temulentum	-	+	-	-	-	-	-

Table 4. (Cont'd.).

Families	Species	Microhabitats						
		CP	BB	PA	LSP	RH	EE	BB65
	Mnesithea laevis	+	-	-	-	-	-	-
	Ochthochloa compressa	-	-	-	-	-	-	+
	Panicum antidotale	+	-	-	-	-	+	-
	Paspalum paspalodes	+	-	-	+	-	-	-
	Pennisetum thunbergii	+	-	-	-	-	-	-
	Phalaris minor	+	-	-	-	-	-	-
	Poa annua	+	+	-	-	+	+	-
	Polypogon monspeliensis	+	+	-	-	+	+	+
	Saccharum bengalense	-	+	+	+	+	+	+
	Saccharum spontaneum	-	+	+	+	-	+	+
	Setaria pumila	+	+	-	-	-	-	-
	Sorghum halepens	+	+	-	-	-	+	-
	Sporobolos ioclados	-	-	-	-	-	+	+
	Tragus racemosus	-	+	-	-	-	-	-
	Tragus roxburghii	+	-	-	-	-	-	+
36. Polygalaceae	*Polygala abyssinica*	-	-	-	-	-	-	+
	Polygala erioptera	-	-	-	-	-	-	+
37. Polygonaceae	*Calligonum polygonoides*	-	+	+	-	-	+	+
	Persicaria glabra	-	-	+	-	-	+	-
	Polygonum plebejum	-	-	+	-	-	-	+
	Rumex chalepensis	-	-	+	-	-	-	+
38. Portulacaceae	*Portulaca oleracea*	-	-	+	-	-	-	+
	Portulaca quadrifida	-	-	+	-	-	-	-
39. Primulaceae	*Anagallis arvensis*	-	+	+	-	+	-	-
40. Ranunculaceae	*Ranunculus sceleratus*	-	-	+	+	-	-	+
41. Resedaceae	*Oligomeris linifolia*	-	-	-	-	-	-	+
42. Rhamnaceae	*Zizyphus mauritiana*	-	-	-	+	-	+	-
	Zizyphus nummularia	-	-	-	+	-	+	+
	Zizyphus spina-christi	-	-	-	+	-	+	-
43. Salvadoraceae	*Salvadora oleoides*	-	+	+	+	+	+	+
44. Scrophulariaceae	*Anticharis linearis*	-	-	-	-	-	-	+
	Mazus rugosus	+	-	-	-	-	-	-
	Verbascum thapsus	+	-	-	-	-	+	-
	Veronica agrestis	-	+	-	-	-	-	-
	Veronica anagallis-aquatica	-	-	-	+	-	-	-
45. Solanaceae	*Datura metel*	-	-	-	-	+	-	+
	Nicotiana plumbaginifolia	-	-	-	+	-	+	+
	Physalis minima	-	-	-	+	-	-	-
	Solanum nigrum	+	+	-	+	-	+	-
	Solanum surattense	-	+	+	+	+	+	+
	Withania somnifera	-	+	-	+	-	+	-
46. Tamaricaceae	*Tamarix aphylla*	-	+	+	+	+	-	+
	Tamarix dioica	-	+	+	+	+	-	+
47. Tiliaceae	*Corchorus depressus*	-	-	-	+	-	+	+
	Corchorus trilocularis	-	-	-	+	-	+	-
48. Typhaceae	*Typha angustata*	-	-	+	-	-	-	-
49. Verbenaceae	*Phyla nodiflora*	-	-	+	-	-	+	-
50. Zygophyllaceae	*Fagonia bruguieri* var. *laxa*	-	+	-	-	-	+	+
	Tribulus longipetalus	-	+	-	-	-	-	+
	Tribulus terrestris	-	+	+	+	-	+	-
Total	**212**	**94**	**102**	**56**	**65**	**49**	**79**	**73**

Legends: **CP:** Children Park, **BB:** Black Buck Enclosure at RD 25, **PA:** Pond Area at RD 30, **LSP:** Lion Safari Park at RD 50, **RH:** Rest House at RD 50, **EE:** East Enclosure at RD 65, **BB65:** Black Buck Enclosure at RD 65; **(+)** Present, **(-)** Absent

Conclusion

The present study evaluated the species distribution in the areas that could be used as source of material for intrinsic ecological values of the local flora and characteristics of species composition with ecological functions. Besides, this baseline information can be used for planning and proper conservation measures to safeguard phytodiversity faced by the ever growing biotic stress.

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