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STUDIES ON PHYTODIVERSITY OF LITTLE RANN OF KACHCHH WITH SPECIAL REFERENCE TO WILD ASS SANCTUARY, GUJARAT

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ABSTRACT

The floristic studies of any protected area *viz.* National Park, Wildlife Sanctuary, Biosphere Reserve etc are important for the effective assessment of phytodiversity and the resultant data act as precursor for sustainable habitat management and to formulate future planning strategies for conservation of Biodiversity. The present paper envisages an account of vegetation, floral composition of vascular plants comprising 372 species belonging to 224 genera under 72 families. Besides this, economically important plants of bioperspective nature have been given. The present study also envisages a list of 20 crop / cultivated plants along with their 24 wild relatives occurring in the sanctuary area. The present paper also analysed rare and threatened taxa and their conservation in the area. At last management constraints and recommendations have also been dealt.

INTRODUCTION

Major portion of 'Little Rann of Kachchh' (LRK) is occupied by Wild Ass Sanctuary (WAS) in Gujarat State. The Rann is a salt-impregnated wilderness area and is often known as "saline waste" Though the 'LRK' is internationally famous for the endangered 'Asiatic Wild Ass' (*Equus hemionus khur*), it is an abode of a variety of other mammals, birds, reptiles, amphibians, fish and micro/macro invertebrates and plants. At present Gujarat State is having 4 National Parks and 21 sanctuaries. Out of these 21 sanctuaries, four are situated in Kachchh (**Table 1**) itself only, which is a remarkable feature for conservation of Biodiversity of the area.

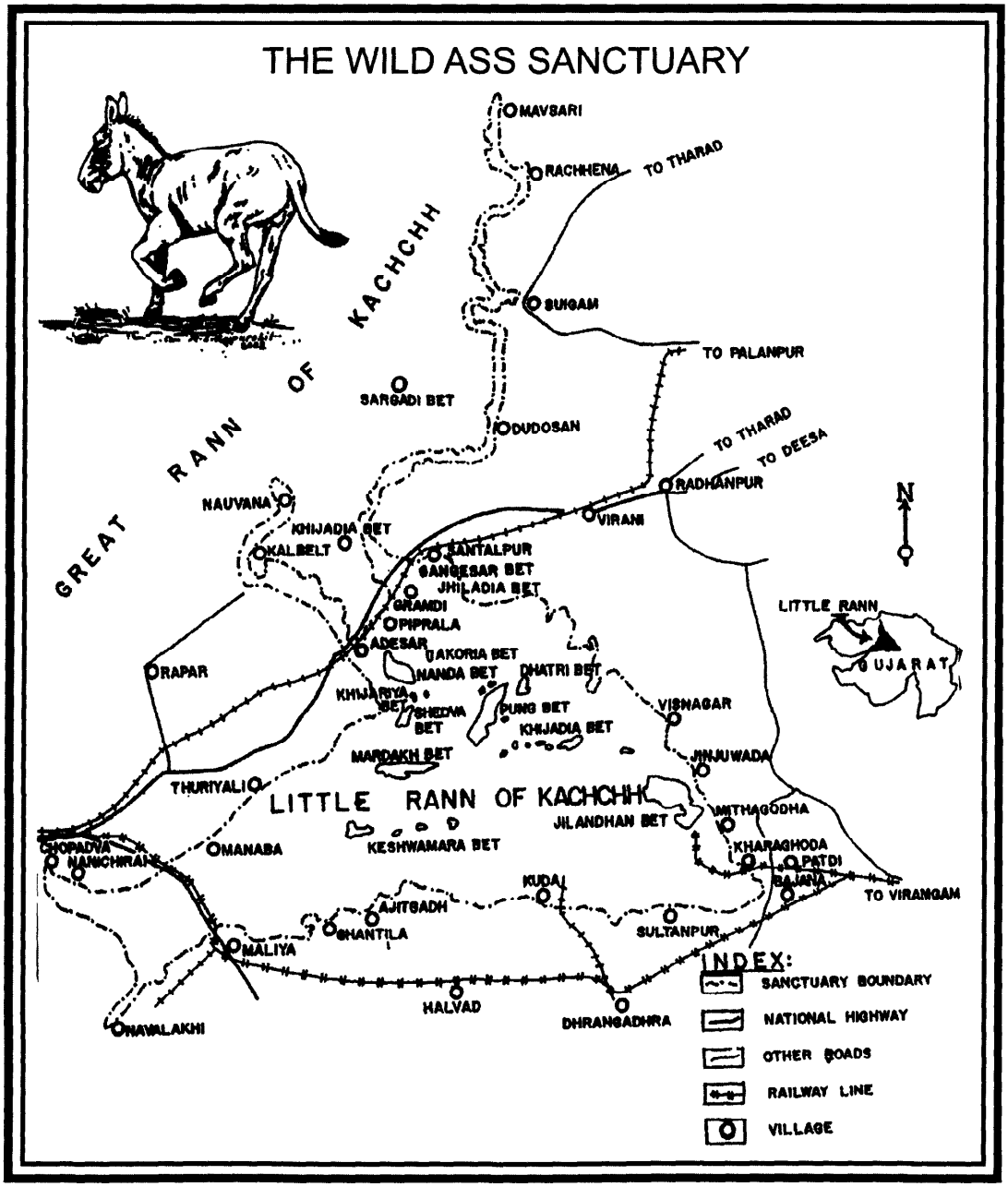
Table 1. Distribution of Wildlife Protected Areas in Biogeographic Zone-3 Indian Desert, Biotic Province-3 A Kutch : (After, Rodger & Panwar, 1988).

Biogeographic Sub-div	**Areas (sq km)**	**Sanctuary**	**Areas (sq km)**
Little Rann	5000	Wild Ass Sanctuary in Little Rann of Kachchh (LRK) / Desert Wildlife	4953.7
Great Rann	10000	Sanctuary in Great Rann of Kachchh (GRK)	7506.2
Southern hills	330000	Narayan Sarovar Wildlife Sanctuary	444.2
		Kachchh Bustard Sanctuary	2.0
Total	**3450000 (23%)**		**12906.1 (28.7%)**

Area and topography

The Wild Ass Sanctuary is located between 22° 55' N to 24° 35' latitude and 70° 30' to 71° 45' E longitude. It is spread over districts of Kachchh (Bhuj), Banaskantha, Pattan, Mehsana, Rajkot and Surendranagar in Gujarat State. The largest area of the sanctuary falls in Kachchh district. The sanctuary covers the area of about 4953.7 sq km comprising the Little Rann and adjoining wastelands (**Map 1**). Of this, the area of 3569 sq km comprising the Little Rann whereas 1384 sq km area is known as fringe area of the Rann.

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Map 1. The Wild Ass Sanctuary : It spreads in 5 districts viz. Kachchh (Bhuj), Banaskantha, Pattan, Rajkot and Surendernagar. The largest area of the Sanctuary falls in Kachchh district. The "WAS" covers the area of about 4953.7 sq km comprising the Little Rann and adjoining wastelands.

The Little Rann is characterized by vast desiccated bare mud-flats consisting of dark silt and encrusted with salts. It is dotted with about 74 elevated plateau or islands-locally called 'Bet' The largest plateau or Bet called Pung Bet has a-n area of about 30.5 sq km and highest Bet Mardakh is 55 m above mean sea level. The low parts of the Rann's surface are salt encrusted and form the salt pans during rains. The Wild Ass Sanctuary (WAS) in the Little Rann of Kachchh (LRK) was notifid in 1973 under section 18 of Wildlife (Protection) Act, 1972 by the State Government of Gujarat. The LRK has been listed, by the Government of India, among the first 13 wilderness areas selected for development as *Biosphere Reserve.*

Geology

Geological formations of Kachchh range from Jurassic to Recent. The Jurassic rocks occupy a large area in Kachchh and are exposed in the form of broken islands. The Little Rann, in which the Wild Ass Sanctuary is located, is the southern extention of the "Great Rann" The Little Rann is low throughout, wet on the south on Saurashtra side, dry and rocky on the north or "*Vagad side*' It is similar to the 'GRK' as far as physiography, ecoclimate, vegetation and overall edaphic condition. However, the silts of the LRK show strong affinity of the material derived from the local sources of Gujarat unlike the silts of the GRK which are the deposits of the Indus river.

Climate

The area mainly characterized by dry Tropical monsoon climate with average annual rainfall less than 300 mm, which occurs mainly in July-August in monsoon, high temperature in hot summers and low temperature in cold winters. The average maximum and minimum temperature in "WAS" is about 42°C and 12°C. The relative humidity is very low about 25%. The unusual very high temperature as 50°C and minimum 1°C are quite common. The area is characterizes by having highest evaporation rate in the country. The Rann is also having characteristic of unseasonal rains or violent stormy south-west winds and earthquake at any time.

VEGETATION

The vegetation of WAS in LRK is quite unique and consist of great plant diversity. The Rann area at certain places quite devoid of any vegetation which is a common characteristic of the Rann. The saline habitats shows some permanent vegetation. But Bets which are having elevated rocky plateau having thorny scrub type vegetation while the fringe area is having dense vegetation particularly after rains. For the sake of convenience the vegetation of LRK can be classified as under :

1. Saline habitats
2. Bets
3. Rocky-gravelly undulating habitats
4. Marshy/aquatic habitats
5. Weeds

1. Saline habitats

The greater part of the LRK along coastal region is covered by dense population of *Prosopis juliflora*, which is a very nonsense species which does not allow any other herbaceous species under it. But where ever little flats and moist area is available the common plants of saline habitats noted are : *Ammannia baccifera, Arthrocnemum indium, Artiplex stockii; Bergia ammanniodes, Chrozophora prostrata, Cressa cretica, Glinus lotoides, Haloxylum recurvum, Heliotropium curassavicum, H. ovalifolium, Eclipta prostrata, Limonium stocksii, Portulaca oleracea, Salicornia brachiata, Sesuvium portulacastrum, Taverniera cuneifolia, Trianthema portulacastrum, T. triquetra, Suaeda nudiflora, S. fruiticosa, Polygonum plebeium, Tamarix indica, Zygophylum simplex* etc.

The common sedges are *Scirpus roylii, S. tuberosus, Cyperus rotundus* etc. The common grasses of these habitats are : *Aeluropus lagopoides* and *Urochondra setulosa* associated with *Sporobolus helvolus, S. coromandelianus, S. marginatus, S. ioclados, Ochthochloa compressa* and *Aristida* spp.

Away from these Rann area wherever there is deposition of sand, the appearance of *Salvadora oleoides, S. persica, Capparis decidua, Prosopis cinerarea* are quite common.

The coastal area of Kachchh is surrounded on the south by the 'Gulf of Kachchh' and on the west by the Arabian sea. The Mangrove swamps area not common in the sanctuary area. But occasionally near coastal area the common species recorded are : *Avicennia marina*, *Casuarina equisetifolia*, *Tamarix ericoides*, *T. indica*, *Astragalus prolixus*, *Heliotropium ovalifolium*, *Peganum harmala* var. *stenophylla* etc. Sometimes *Avicennia marina* with *Urochondra setulosa* form pure formation.

Champion and Seth (1968) classified these forest under broad category Northern Tropical Thorn forests. The following forests under this category were observed in the saline habitats :

1. 6/E4 *Salvadora* scrub
2. 5/E8 - Saline alkaline scrub
3. 6/DS1 *Senna auriculata* scrub
4. 6/DS2 *Euphorbia* scrub

The last two forests types are more common in fringed area and in rocky to gravelly habitats.

A large portion of sanctuary in LRK has been colonized by *Prosopis juliflora*, covering an area of 40,821 ha. But now this species has spread in almost all the grasslands and thorny scrub forests which are grazing grounds for most of the wild animals in the sanctuary. The data available show that the area under *Prosopis juliflora* has increased from 334 sq km (1983) to 428 sq km (1995) in the sanctuary at the rate of 677 ha/year (Singh & al., 1999).

2. Bets

The common Bets in the LRK are about 74. The important ones are : Jiladiya, Mardakh, Shedwa, Wasraj, Khijardia, Kharabir, Dhutarimata etc. The Mardakh Bet is having 8 km long rocky plateau of igneous rocks having a famous mine of "precious stones" This mine is now closed due to sanctuary area. These plateau have thick population of *Prosopis juliflora*. The other associates in this area are; *Euphorbia caducifolia*, *Acacia senegal*, *Capparis decidua*, *Salvadora oleoides*, *Acacia nilotica* subsp. *indica* etc. On these plateau particularly at Mardakh *Commiphora wightii* and few trees of *Moringa oleifera* are quite common. An interesting plant *Pegoletia senegalensis* emeting turpentine like smell with yellow flowers found in Mardakh Bet and elsewhere.

The common forests type noted here are :

i. 6B/DS2 *Euphorbia* scrub forest

ii. 6b/E2 *Acacia senegal* forest

3. Rocky-gravelly Undulating Habitats

Such type of habitats are quite common throughout the Sanctuary in LRK. The vegetation in these habitats are facing heavy biotic interference. The vegetation is Desert thorny scrub type. The common trees and shrubs noted in these habitats are : *Acacia senegal*, *A. leucophloea*, *A. nilotica* subsp. *indica*, *A. nilotica* subsp. *subalata*, *Capparis decidua*, *Commiphora wightii*, *Dipteracanthus patulus* var. *alba*, *Dalechampia scandens* var. *cordofana*, *Cordia gharaf*, *Dichrostachys cineria*, *Dyerophytum indicum*, *Euphorbia caducifolia*, *Grewia tenax*, *Kickxia ramosissima*, *Lantana camara*, *Lindernia parviflora*, *Lycium barbarum*, *Leptadenia pyrotechnica*, *Prosopis cinerea*, *P. juliflora*, *P. persica*, *Salvadora oleoides*, *Schweinfurthia papilionacea*, *Tecomella undulata*, *Tephrosia strigosa*, *Ziziphus nummularia* etc. During monsoon season the annual herbaceous ephemerals are quite common wherever there is deposition of sand over these habitats the plants of psamophitic communities make there appearance.

The common climbers making thickets over these habitats are : *Clitoria ternatea, Ipomoea verticillata, Rhynchosia minima, Periploca aphylla, Cryptostegia grandiflora, Leptadenia reticulata* etc. After rains the Cucurbitacous twiners / climbers like : *Coccinia grandis, Dactyliandra welwitschii, Melothria maderaspatana* and *Momordica* spp. are fairly common on the hedges and woody species.

A stem parasite *Cuscuta reflexa* infecting the trees like *Acacia nilotica* ssp. *subalata* and *Salvadora* spp. is quite common in these habitats.

These undulating plains are also rich in grass species and make the area into grassland/savannah, which harbour the wild animals. The common grasses are : *Aristida* spp., *Bothriochloa annulatum, Cenchrus* spp., *Elynurus royleanus, Eragrostis* spp., *Oropetium thomaeum, Panicum* spp., *Melanocenchris jacquemontii, Stipagrostis hirtigluma, Schoenefeldia gracilis, Sehima nervosum, Setaria intermedia, Tragus roxburghii, Tetrapogon tenellus,* etc.

4. Marshy / Aquatic Habitats

Some tanks, dams, ponds and ephemeral rivers are present in LRK. Some of them are main source of drinking water. The common aquatic plants in the area are : *Vallisneria spiralis, Hydrilla verticillata, Monochoria hastata, Najas graminea, N. minor, Potamogeton pectinus, Zannichellia palustris,* etc.

The common plants of marshy habitats are : *Typha angustata, Alternanthera sessilis, Ammannia baccifera, Bacopa monnieri, Bergia ammannioides, Blumea mollis, Goniogyna hirta, Gnaphalium* spp., *Grangea maderaspatana, Juncus bufonius, Launaea fallax, Limeum indicum, Phyla nodiflora, Polygonum plebeium.*

The common sedges and grasses noted in the area are : *Cyperus laevigatus, C. pygmaeus, C. rotundus, Scirpus roylei, S. tuberosus, Arundo donax, Echnochloa colona, Eragrostis cilaris, Phragmites karka, Saccharum benghalensis, S. spontaneum.*

5. Weeds

Quite considerable area in LRK is also under cultivation, and some of the area is also gravelly to rocky and sandy hummocky plains, better to be called it as fringe area. This is the only area where vegetation is quite considerable due to better protection.

The weeds here grow in association with rainy season crops and in fallow and open wastelands of mixed habitats. The common rainy season weeds in this area are : *Acanthospermum hispidum, Achyranthes aspera, Alysicarpus vaginallis, Aristolochia bracteolata, Boerhavia diffusa, Borreria articulalris, Cleome gynandra, Celosia argentea, Commelina* spp., *Corchorus* spp., *Convolvulus prostratus, Digera muricata, Enicostema axillare, Euphorbia* spp., *Heliotropium* spp., *Gisekia pharnaceoides, Indigofera cordifolia, I. linnaei, Mollugo* spp., *Oligochaeta ramosa, Oldenlandia corymbosa, Pulicaria angustifolia, Polygala erioptera, Portulaca oleracea, Tribulus terrestris, Trichodesma indica, Triumfetta rotundifolia, Zaleya govindia.*

The common grasses and sedges competing with rainy season crops are : *Cyperus rotundus, Aristida* spp., *Chloris* spp., *Cynodon dactylon, Cenchrus* spp., *Dinebra retroflexa, Digitaria* spp., *Dactyloctenium* spp., *Desmostachya bipinnata, Dichanthium annulatum, D. foveolatum, Eragrostis* spp. and *Heteropogon contortus.*

The weedy species associated with winter season crops are : *Amaranthus* spp., *Argemone mexicana, Anagallis arvensis, Asphodelus tenuifolius, Chenopodium album, C. murale, Echinops echinatus, Fagonia schweinfurthii, Polycarpaea corymbosa, Pupalea lappacea, Tribulus terrestris.*

The common grasses associated with them are : *Dactyloctenium aegyptium, Eragrostis pilosa, E. tremula, Polypgon monspeliensis.*

In sandy habitats the following forests type can be recognized :

i. 6B/ISI – Desert Dune scrub

ii.6B/DSI – *Ziziphus* scrub forest

ECONOMIC POTENTIALITY OF PHYTODIVERSITY

The economic potentiality of phytodiversity determines its importance for existence and value for conservation, particularly to establish priorities. The flora of WAS in LRK is quite rich in economic plant resources and many of them may have potentiality to add to the economy of the State. Some of the common plants are classified according to their uses.

Medicinal Plants

The common plants used as medicinal in the sanctuary are : *Acacia nilotica* subsp. *indica, A. senegal, Achyranthes aspera, Aerva javanica, Aloe vera, Andrographis echioides, Aristolochia bracteolata, Argemone mexicana, Asparagus racemosus, Azadirachta indica, Balanites roxburghii, Barleria acanthoides, Blepharis linearifolia, Boerhavia diffusa, Cadaba fruticosa, Catharanthus pusillus, Chlorophytum teberosum, Cocculus hirsutus, Corchorus depressus, Cleome brachycarpa, C. viscosa, Commiphora wightii, Crotalaria burhia, Capparis decidua, Citrullus colocynthis, Calotropis procera* ssp. *hamiltonii, C. gigantea, Clerodendrum phlomidis, Coldenia procumbens, Convolvulus prostratus, Cynodon dactylon, Cyperus rotundus, Dactyloctenium aegyptium, D. scindicum, Datura metal, Desmostachya bipinnata, Dicoma tomentosa, Dicliptera verticillata, Dipcadi erythraeum, Dipteracanthus patulus* var. *alba, Eclipta prostrata, Echinops echinatus, Elytraria acaulis, Enicostema axillare, Ephedra ciliata, Euphorbia caducifolia, Evolvulus alsinoides* var. *alsinoides, Fagonia schweinfurthii, Ficus benghalense, F. religiosa, Glinus lotoides, Grewia tenax, Heliotropium bacciferum, H. europaeum* var. *lasiocarpum, Indigofera cordifolia, I. oblongifolia, Indoneesiella echioides, Justicia* spp., *Lepidagathis trinervis, Leptadenia reticulata, Leucas* spp., *Lycium barbarum, Maerua arenaria, Martynia annua, Melilotus alba, Momordica diocia, Mukia maderaspatana, Ocimum basilicum, Opuntia elatior, Pedalium murex, Pergularia daemia, Peristrophe paniculata, Phyllanthus* spp., *Portulaca oleracea, Prosopis cinerarea, Pulicaria crispa, Ricinus communis, Salvadora oleoides, S. persica, Senna auriculata, Sericostoma pauciflorum, Solanum nigrum, S. virgianum, Suaeda fruticosa, Tamarix indica, Tephrosia purpurea, Tecomella undulata, Tribulus terrestris, Trichodesma indica, Tridax procumbens, Urginia indica, Wattakaka volubilis, Withania somnifera, Xanthium strumarium, Ziziphus nummularia* and *Zygophyllum simplex.*

Timber yielding plants

Timber is most important and essential item for the economic development of an area and used variously by the local people in sanctuary area. The common timber yielding species are : *Acacia leucophloea, A. nilotica* subsp. *indica, A. nilotica* subsp. *subalata, A. senegal, Azadirachta indica, Capparis decidua, Prosopis cineraria, P. juliflora, Tecomella undulata and Ziziphus mauritiana.*

Gum and Resin yielding plants

The common plants species which yield gum and resin are : *Acacia senegal, A. nilotica* subsp. *indica, Avicennia marina, Commiphora wightii, Ficus* spp., *Tamarix indica,* and *Ziziphus mauritiana.*

Dye yielding plants

The common dye yielding plants in LRK are : *Abrus precatorius, Achyranthes aspera, Alhagi pseudoalhagi, Senna auriculata and Peganum harmala* var. *stenophyllum.*

Fibre yielding plants

The common fibre yielding species in the area are : *Abelmoschus esculentus, Abutilon indicum, Acacia leucophleoa, A. nilotica* subsp. *indica, Calotropis procera, C. gigentea, Senna auriculata,*

Corchorus olitorius, Crotalaria burhia, Desmostachya bipinnata, Gossypium spp. and *Leptadenia pyrotechnica.*

Plants used as famine food

The famines are the unusual and common phenomena in the entire Kachchh and Rann in particular. The common plant species their fruits and seeds can be used for the above purpose. The important fruits/seeds yielding species in the sanctuary area are : *Acacia senegal, Achyranthes aspera, Aerva javanica, Brachiaria ramosa, Capparis decidua, Citrullus colocynthis, C. lanatus* var. *lanatus, Cucumis melo* var. *culta, Cyperus rotundus, Cenchrus biflorus, C. setigerus, Dactyloctenium aegyptium, Fagonia schweinfurthii, Grewia tenax, Indigofera cordifolia, Panicum antidotale, Prosopis cineraria, Salvadora oleoides, S. persica, Tribulus terrestris, Ziziphus numularia.*

Edible fruit yielding plants

The common fruit yielding plants in the area are : *Capparis decidua, Citrullus lanatus, Cordia gharaf, Cucumis melo* var. *culta, Grewia tenax, Opunita elatior, Pithecellobium dulce, Phoenix sylvestris, Prosopis cineraria, Salvadora oleoides, S. persica, Tamarindus indica, Ziziphus mauritiana* and *Z. nummularia.*

Vegetable yielding plants

The common vegetable yielding plants in the LRK are : *Capparis decidua, Chenopodium album, Coccinia grandis, Euphorbia caducifolia, Momordica balsamina, Portulaca oleracea, Suaeda fruticosa and Trianthema portulacastrum.*

Fodder yielding plants

The fodder is most essential part of herbivores of the sanctuary. The common fodder yielding plants are: *Acacia nilotica* subsp. *indica, Aeluropus logopoides, Alhagi pseudoalhagi, Cynodon dactylon, Cenchrus biflorus, C. ciliaris, C. setigerus, Dichanthium aegyptium, D. scindicum, Eremopogon foveolatum, Medicago sativa, Panicum antidotale, Pithecellobium dulce, Sorghum halepense* and *Ochthochloa compressa.*

Oil yielding plants

Some of the plants yielding non-edible oil which can be used in medicines, varnishes, paints, lubricants, for soap making and in perfumery. The important species are : *Argemone mexicana, Azadirachata indica, Citrullus colocynthis* and *Ricinus cimmunis.*

Miscellaneous uses

The tender branches of *Acacia nilotica* subsp. *indica, A. nilotica* subsp. *subalata, Azadirachta indica, Senna auriculata, Ficus benghalensis, Salvadora oleoides, S. persica* are used as tooth brushes. *Balanites aegyptiaca* is used as substitute of soaps and detergent. *Phoenix sylvestris* and *Ziziphus nummularia* are used as beverages.

An analysis of economically important plants, their density, frequency and abundance in sanctuary revealed that some of them may be utilized on commercial scale and may provide a new source for revenue to the state. These plants may be called as "green coins" of the state. The common commercially important species in LRK and sanctuary are : *Calotropis procera* (seed floss as stuff and latex as medicinal), *Aerva javanica* (Inflorescence as stuffing material), *Saccharum benghalensis* (fibres), *Capparis decidua* (immature fruits as vegetable and pickles), *Acacia senegal* (gum), *Commiphora wightii* (resin as medicinal and perfume), *Citrullus colocynthis* (seeds non-edible oil), *Azadirachta indica* (seeds non-edible oil), *Citrullus lanatus* (seeds edible oil), *Balanites aegyptiaca* (fruit pulp as detergent and dry fruit power as family planning pills),

Azadirachta indica (oil as medicinal and leaves as insecticidal), *Avicennia marina* (tannin), *Cassia auriculata* (bark tannin), *Ziziphus mauritiana* (tannin).

WILD RELATIVES OF CROPS/CULTIVATED PLANTS

The wild relatives of cultivated plants are of considerable importance for their improvement of crops and for other useful cultivated plants and in providing basic information of species relationship (Arora & Nayar, 1985). The same has been given due consideration in biodiversity conservation.

The present study deals with 20 crop/cultivated plants along with their 24 wild relatives occuring in the sanctuary area **(Table 2)**. An analysis of the above table shows that highest domesticated diversity observed in vegetable type (8:11), leguminous crops (5:5) and fruits (3:3) with the result maximum numbers of wild relatives, while fourth place is being occupied by cereals/millets (1:1), oil-seed crops (1:2), fibre crops (1:2) and miscellaneous (1:1) respectively. The above analysis shows that 8 vegetable plants are having 11 wild relatives are present in "Wild Ass Sanctuary" in Little Rann of Kachchh and similarly other relatives need immediate conservation.

Table 2. Showing wild relatives of crop/cultivated species.

Crop/cultivated species	Wild relatives and related species
Cereals/millets :	
Pennisetum americanum	*P. purpureum*
Leguminous crops:	
Cicer arietinum	*C. mungo* var. *silvestris*
Medicago sativa	*M. polymorpha*
Trigonella foenum-graceum	*T. corniculata*
Vigna dalzellina	*V. aconitifolia*
V. radiata	*V. trilobata*
Fruit crops:	
Citrulllus lanatus	*C. colycynthis*
Phoenix dactylifera	*P. sylvestris*
Ziziphus mauritina	*Z. nummularia*
Vegetable crops:	
Abelmoschus esculentus	*A. tuberculatus*
Amaranthus caudatus	*A. hybridus*
	A. tricolor
Cucumis melo	*C. prophetarum*
C. sativus	*C. callosus*
Luffa acutangula var. *acutangula*	*L. acutangula* var. *amara*
Momordica charantia	*M. balsamina*
	M. dioica
Portulaca pilosa ssp. *grandiflora*	*P. oleracea*
Solanum melongena	*S. incanum*
	S. virginianum
Oil-seed crops:	
Brassica campestris var. *sarson*	*B. camestris* var. *oleifera*
Fiber crops:	
Corchorus capsularis	*C. olitorius*
	C. trilocularis
Miscellaneous:	
Physalis peruviana	*P. minima*

RARE AND THREATENED TAXA AND THEIR CONSERVATION

Pandey & Singh (1999) listed 16 species as endemic confined to Gujarat state. Recently Meena & Pandey (2004) also listed 16 taxa from Gujarat state. Out of these only 5 taxa are restricted to "Wild Ass Sanctuary" in Little Rann of Kachchh *viz. Viola cinerea* var. *stocksii, Tamarix passerinoides* var. *macrocarpa, T. kutchensis, Ziziphus truncata, Indigofera coerulea* var. *monosperma* etc. These taxa need immediate conservation measures, since any physical change in their ecosystem may finish the germplasm of these species forever. Since the endemic population in general are very poor in numbers, density and frequency, they all need '*in-situ*' conservation and multiplication through '*ex-situ*' method. The '*in-situ*' conservation method in the sanctuary may play important role in near future for their survival.

The floral diversity of the Wild Ass Sanctuary is facing different degree of threat due to heavy biotic pressure and high demand of natural produce and belong to threatened and rare categories. These are very susceptible to the effect of environmental damage, because they occur in small population or at scattered localities and are often confined to unique and localized habitats. The reasons may be inadequate reproductive mechanism, inviability of seeds, low range of adaption or habit destruction by way of Biotic interferences (*viz.* intensive invasion of *Prosopis juliflora* and salt industry). These species growing in Little Rann are : *Acacia nilotica* subsp. *subalata, Arthoenemum indicum, Asparagus africanus, Campylanthus ramosissimus, Cassia senna, Chloris quinquesetica, Cleome simplicifolia, Commiphora wightii, Dactyliandra welwitschii, Dalechampia scandens* var. *cordofana, Halopyrum mucronatum, Haloxylon recurvum, Ipomoea kotschyana, Limonium stocksii, Periploca aphylla, Schweinfurthii papilionacea, Stylosanthes fruticosa, Taverniera cuneifolia,Tecomella undulata* and *Urochndra setulosa.* To ensure the survival of germplasm in the sanctuary, necessary measures need to be taken for their protection, conservation and multiplication.

Besides above, the over exploitation of some of the economically important species *viz. Cassia senna, Commiphora wightii* and *Tecomella undulata* have also brought them on the doors of extinction. Thus maximum afforestation of such economic important species is therefore, necessary to balance the ecosystem. Recent available biotechnological method may also be applied for their multiplication. Further, the germplasm of depleting plant resources may also be preserved in seed banks, the habitats need to protected by establishing more Biosphere Reserves, National Parks and Wildlife Sanctuaries. The Gujarat State Forest Department presently make best efforts to establish 4 National Parks and 21 Wildlife Sanctuaries in the state, where the germplasm of rare and threatened flora and fauna can be conserved. Besides above conservation measures, the research alone cannot help to restore the biodiversity loss unless there is a political will, awareness and involvement of the local people in conservation programmes. In this direction the Government of Gujarat State is very particular on this subject - in creating awareness among the people and educating them on for reaching implication of Ecological degradation.

SYNOPSIS OF FLORA

The present work deals with 372 indigenous and naturalized plant species belonging to 224 genera under 72 families **(Table 3)**.

The present work is the result of 4 major Botanical explorations in the different seasons of the year. The specimens collected during the above explorations are deposited in the herbarium of Botanical Survey of India, Arid Zone Circle, Jodhpur (BSJO) and Central National Herbarium (CAL).

Table. 3. Statistical synopsis of flora in "Wild Ass Sanctuary" in Little Rann of Kachchh

Taxonomic groups	Families		Genera		Species	
	No.	%	No.	%	No.	%
Angiosperms						
(i) Dicotyledons	61	84.74	169	75.44	277	74.46
(ii) Monocotyledons	10	13.88	54	24.12	94	25.28
Gymnosperms	1	1.38	1	0.44	1	0.26
Total	**72**	**100.00**	**224**	**100.00**	**372**	**100.00**

A perusal of the above table reveals that Gymnosperms shows very limited diversity in the area and represented by a solitary species. Among Angiosperms, the dicotyledons maintain maximum diversity from specific level to family level. Further, the polypetalous dicots show rather more diversity as they consist 118 species (42.59%) under 71 genera (42.01%) and 31 families (50.81%) in comparison to gamopetalous group which maintains 111 species (40.07%) under 75 genera (44.37%) and 21 families (34.42%). Monochlamydeae shows minimum diversity among dicots as only 48 species (17.32%) belonging to 23 genera (13.6%) and 9 families (14.75%).

Except for Poaceae (58 species) and Cyperaceae (16 species), the monocotyledons are very poorly represented in the sanctuary area. The remaining 20 species belong to 13 different genera under 8 families.

Even if Leguminosae is cosidered *sensu lato* comprising 25 genera 46 species, yet the family Poaceae occupies the first place, the second and third positions are occupied by Leguminosae *s.l.* (46 species) and Asteraceae (28 species) respectively.

The ratio of Monocots to Dicots is 1:2.9 at species level, 1:3.1 at genus level and 1:6.7 at family level. The ratio of total number of genera to species 1:1.7 which is rather low in comparison to the corresponding ratio for whole of India which is estimated to be about 1:7, but it is more or less comparable to the ratio for Flora of Rajasthan Desert 1:2.01 (Shetty & Pandey, 1979), Gangetic Plain region 1:2.2 (Maheshwari, 1963) and for Gujarat State 1:2.4 (Shah, 1978). This also shows the small proportion of species to the number of genera and families in this region. It further confirms to the general rule that within the same floral regions, the smaller the flora, the smaller the species-genus ratio.

Fauna

As the Little Rann of Kachchh is well known for the Indian Wild Ass, and also rare and endangered species such as Chinkara, Blue Bull, Jungle Cat, Desert Cat, Wolf, Jackal, Common Fox, Desert Fox, Hyaena, Hare and Spiny-tailed Lizard etc. are found in this area. 11 species which are endangered and listed in Schedule I of the Indian Wildlife (Protection) Act of 1972 have been reported in this area.

The vast tract of WAS in LRK due to its unique geographical characteristics harbours a variety of Bird species, 307 bird species are reported in the sanctuary out of which 33 lesser florican, Shahin falcon etc. 80 of bird species breed inside the sanctuary where breeding colonies of Lesser flamingo, Caspian tern are unique of their kind in South Asia.

Management constraints

The following are the constraints which lead reverse effect on the sanctuary management. These are as follow :

(a) Settlement proceedings have not been completed.

(b) Salt manufacturing industries.

(c) Grazing of Wild Ass in crop fields.

(d) Inadequate staff in Forest Department.

(e) Army activities.

(f) Illiteracy and poverty.

(g) Invasion and fast spreading of *Prosopis juliflora.*

(h) Field firing.

Recommendations

The LRK in which large portion of WAS is located, is an internationally unique, incomparable and one of the most unusual areas of the World. It is Uniqueness of the area and its support to some of the rare and endangered species of flora and fauna have qualified the LRK as one of the first 13 wilderness areas selected for development as the Biosphere Reserves ('BR') in the country. So it is the right time to declare the LRK as 'BR' now.

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वन्य गर्दम अभयारण्य, गुजरात के विशेष संदर्भ में लघु कच्छ की खाड़ी की पादप विविधता का अध्ययन

आर.पी. पाण्डे

राष्ट्रीय उद्यान, वन्यजीव अभयारण्य, जीवमंडल रिजर्व आदि संरक्षित क्षेत्रों का वनस्पति जातीय अध्ययन जैव विविधता के प्रभावी अध्ययन हेतु महत्त्वपूर्ण है। इससे प्राप्त आंकडे सतत उपयोगी प्राकृतवास प्रबंधन एवं जैव विविधता संरक्षण हेतु रणनीति बनाने के लिए आधार प्रदान करते हैं। इस शोध पत्र में 72 कुलों के अंतर्गत 224 वंशों की 372 जातियों की वनस्पति, संवहनी पौधों की वनस्पतिजातीय संरचना का विवरण है। इसमें आर्थिक महत्त्व के पौधे भी शामिल हैं। 20 रोपित पौधों की सूची के साथ अभयारण्य में उनके 24 वन्य समवर्गी पौधों के भी उल्लेख हैं। इस क्षेत्र में विरल एवं दुर्लभ टैक्सा तथा उनके संरक्षण का विश्लेषण किया गया है। अंत में प्रबंधन हेतु कुछ सिफारिशें हैं।