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ECOLOGICAL STATUS AROUND SANGHIPURAM, ABDASA TALUKA, DISTRICT KUTCH BHUJ IN THE STATE OF GUJARAT

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Abstract: For present study, the baseline study was conducted for the evaluation of the floral and faunal biodiversity of the terrestrial as well as aquatic environment of the study area, it comprises of total 15 villages falls in taluka Abdasa, Dist-Bhuj, Gujarat.

Keywords: Chinkara, Reserve Forest, Wildlife Sanctuary, Kutch.

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INTRODUCTION

Ecology is the scientific study of the relations that living organisms have with respect to each other and their natural environment. Producer, consumer and decomposer govern whole cycle of ecology. Plant and animal both are interdependent to each other. Producer is necessary for each consumer. Plant plays their role in ecology as producer. Plant, animals and microorganism together with the environment in which they live make an independent unit called the Ecosystem. Mainly two types of Vegetation cover are on the earth surface. One is self-growing and another is cultivated. Plants are renewable resource and useful to living organism in many ways. It is the role of man in manipulating and changing vegetation population. Due to lack of awareness deforestation is occurring which in turn is responsible for imbalance of ecosystem. The main objective of the ecological survey is aimed to find out baseline status of flora and fauna of the study region. An ecological survey of the study area was conducted particularly with reference to listing of species and assessment of the existing baseline ecological conditions in the study area. Before detailing the study area, a

cursory understanding of the state scenario is important. Biodiversity of this region is largely related to the Thar Desert. Fossiliferous Limestone was found (Nummulites) which were mainly Marine deposits (coin-shaped) in this area. Due to unfavorable meteorological conditions and diverse habitat, a rapid snapshot survey for biological reconnaissance was conducted in this case. Secondly, the activity rhythms of different species differ on a diurnal scale. For instance the rodents dwelling in the sandy tracts of the buffer zone were seen despite being ubiquitous, but leave unmistakable sole imprints of the hind paws on the sand. Such indirect species specific evidences of the animals' occupancy of the habitat have been considered. With deserts conditions, coastal vicinity, open scrub forest and slight undulating terrain in this region provides a unique ecosystem. The adverse climate and edaphic conditions intermixed with saline open plains and mangrove forests along the coast have turned this desert into an ideal dwelling place for wildlife and birds. Though forest areas are open, scrubby and along the coast they are of saline nature, some of the most endangered and threatened species of animals and birds survive in this

area. As the district lies in poor rainfall area it lacks the richer mammalian life, but has the two form of wildlife are terrestrial and avifauna. There are no perennial water bodies within 500 m radius of the project site.

The primary objective of survey was to describe the floral and faunal communities within the study area along with marine ecological status. The sampling plots for floral inventory were selected randomly in the suitable habitats (Anderson, 1867; Jain and Rao, 1983; Dixit, 1984; Wilson and Reeder, 2005; Kumar, 2013; Kumar *et al.*, 2013). The methodology adopted for faunal survey involve random survey, opportunistic observations, diurnal bird observation, active search for reptiles, faunal habitat assessment, active search for scats and foot prints, animal call, and review of previous studies. The aim was to set baselines in order to monitor and identify trends after the commissioning of the clinker and cement production. Emphasis has been placed on presence of endemic species, threatened species if any present in the study area. The qualitative study has been carried out only. Desktop literature review was conducted to identify the representative spectrum of threatened species, population and ecological

communities listed by IUCN, WCMC, ZSI, BSI and Indian Wild life Protection Act, 1972 (Bentham and Hooker, 1862-1883; Hunter, 1879; Dixit, 1984; Ghosh *et al.*, 2004; Lushington, 1915; Wilson and Reeder, 1993; BirdLife International, 2000; BirdLife International, 2004a, b; Wilson and Reeder, 2005; BirdLife International, 2010; Kumar and Srivastava, 2012; Kumar, 2013; Kumar *et al.*, 2013; Kumar and Aggarwal, 2013a,b). The status of individual species was assessed using the revised IUCN/SSC category system (WCMC, 1988; IUCN, 1994; WCMC, 2000; IUCN, 2001, 2003, 2008, 2010).

METHODOLOGY

The baseline study was conducted for the evaluation of the floral and faunal biodiversity of the terrestrial as well as aquatic environment of the study area (10 km radius from the cement unit) and it comprises of total 20 hotspots study area.

Field Study Period: The ecological survey has been conducted for one season. The ground truthing has been conducted on 3rd July to 7th July, 2017.

Study area: 10 Km radius around the site.

Table 1. Mode of Data collection and Parameters considered during the Survey

#	Aspect/s	Data	Mode of Data Collection	Parameters Monitored	Remarks
1.	Terrestrial Ecology	Primary data collection	By Field Survey Hutto <i>et al.</i> , 1986; Welsh, 1987; Thommpson <i>et al.</i> , 1989; Welsh <i>et al.</i> , 1991; Allen <i>et al.</i> , 1996; Misra, 2013.	For Floral diversity, Vegetation measurements: Tree, Shrub, Herbs, Grasses, Climbers, Cultivated plants in the study area, Floristic composition of the study area, Medicinal plants of the study area, Status of the forest, their category in the study area, Rare and endangered flora in the study area. Endemic plants in the study area. For Fauna in the study	Random survey, opportunistic observations, diurnal bird observation, active search for reptiles, faunal habitat assessment, active search for microhabitat, scats, foot prints, animal call, pug marks, debarking sign, Nesting, Claws, Dung, etc. and information from local villagers.

				<p>area: -Reptiles, -Amphibians, -Birds, -Fresh water fishes -Mammals, -Butterflies. Rare and Endangered fauna in the study area, Endemic fauna in the study area, Wild life and their conservation importance in the study area.</p>	
2.		Secondary data collection	<ul style="list-style-type: none"> • Junagarh/Kutchh SF Division under SF Circle Bhuj. • Data of Fisheries department. • Literature like research papers, books published by research/academic Institutions. 	Interpretation of secondary data for Ecological Sensitive Areas such as national forests, wild life sanctuaries, lakes, ravines, hills, hillocks and reserve forest, vegetation, type, importance etc.	Bentham and Hooker, 1862-1883; Hunter, 1879; Dixit, 1984; Ghosh <i>et al.</i> , 2004; Lushington, 1915; Wilson and Reeder, 1993; BirdLife International, 2000; BirdLife International, 2004a, b; Wilson and Reeder, 2005; Bird Life International, 2010; Kumar and Srivastava, 2012; Kumar, 2013; Kumar <i>et al.</i> , 2013; Kumar and Aggarwal, 2013a,b). The status of individual species was assessed using the revised IUCN/SSC category system (WCMC, 1988; IUCN, 1994; WCMC, 2000; IUCN, 2001, 2003, 2008, 2010.
3.	Evaluation of Ecological sensitivity	Secondary	Review and Discussion	Wild life importance, Floral Endemicity, Faunal Endemicity, State of Terrestrial vegetation, State of wet land vegetation, Mangrove vegetation, Conservation importance, Legal status (National park, Wild life sanctuary, Reserve forest, Wetlands, Agricultural lands) Lakes /reservoirs/dam, Natural lakes and Swamps, Breeding ground of Migratory and Residential birds.	-

4.	Green Belt development	Primary	CPCB, 2000; 2007; Abhashi and Khan 2000.	List of trees, shrubs, ornamental, Budgetary outlay along with green belt map for 3 tier development.	-
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RESULTS AND DISCUSSION

Kutch bhuj district is forefront in agriculture field. The crops like groundnut, till, bajri etc. are taken in monsoon. The agriculture is rain dependent. No means of surface water or ground water available for crop irrigation. The area for the present biological baseline study

falls under 15 villages. The area falls under **agro-climatic zone XIII** as per IASRI http://www.iasri.res.in/agridata/12data/chapter1/db2012tb1_2.pdf. No forest land is to be acquired for the expansion project. There is no appreciable settlement around the project site, no vegetation, no trees to be cut.

Table 2. List of Villages/Spots of Survey

S.No.	Name of Village/HotSpots	Remarks
Core Area		
1.	Project Site	The existing cement plant in 95 ha. Area along with colony and gardens
2.	Hothiyay	A small village nearest to project site, about 25 families residing in the village, very few agriculture fields are there to grow the crops which are rain dependent.
3.	Ratipal RF	Mixed jungle of <i>Prosopis juliflora</i> , <i>Acacia nilotica</i> <i>Zizyphus</i> scrub and some grasses on lime stone in North.
4.	Maniyara RF	Open jungle of <i>Prosopis juliflora</i> and <i>Acacia nilotica</i> on SW with scattered agriculture fields.
Buffer Area		
5.	Bhurav	Small village practicing agriculture and milk
6.	Chherora	
7.	Golay	Small village near to Reserve forest
8.	Jadova	Small village practicing agriculture and milk
9.	Kherwanah	
10.	Khirsara	
11.	Lakhmiraru	A very small village of 25 families, some agriculture fields
12.	Motiber	
13.	Naniber	
14.	Narvawas	
15.	Patko	
16.	Piper	
17.	Rodasar	
18.	Rowara	
19.	Harodi Forest	Open jungle of <i>Prosopis juliflora</i> and <i>Acacia nilotica</i> on East with scattered agriculture fields.
20.	Mangrove Forest	Mangrove Forest in coastal area on SE direction.



Figure 1. River Drainage (May 2017)



Figure 2. Aerial View of Check dam



Figure 3. Discussion with Client at Site



Figure 4. Aquatic Habitat of the Study Area





Figure 5. Vegetable/Fruiting trees spotted in the study area



Figure 6. Nursery developed by Cement Industry



Figure 7. Nesting



Figure 8. Spotting of Mongoose



Figure 9. Spotting of Indian Monitor



Figure 10. Spotting of Camel



Figure 11. Spotting of Peacock





Figure 11. Quadrat Sampling





Figure 12. Glimpses of Local information and Confirmation from villagers

Floral Diversity of the Study Area

The objective of this floral inventory of the study area is to provide necessary information on floristic structure in the study area for formulating effective management and conservation measures. The climatic, edaphic and biotic variations with their complex interrelationship and composition of species, which are adapted to these variations, have resulted in different vegetation cover, characteristic of each region (Ohasi, 1975).

The tree species, herbs, shrubs, climbers and major crops, were documented during this base line study (Jain, 1968; 1991).

Trees: The dominant trees in the study area are *Azadirachta indica* (Neem), Khejari (*Prosopis cineraria*), Babool (*Acacia nilotica*), *Mangifera indica* (Aam). Total 33 species of trees belong to 17 families are enumerated from the study area listed in table 3.

Mangrove: Some part of the study area falls coastal area which is declared as mangrove

forest (10.68%), there is *Avecenia marina* was observed during the study. Four species of mangrove were encountered from the study area listed in table 4.

Shrubs: Total 21 shrub species belong to 15 families are enumerated from the study area. The dominant shrub community in this area was represented by *Prosopis juliflora* (Gando

Baval), *Calotropis procera*, (Akoda), etc. The shrubs observed in the study area are given in the table 5.

Herbs: Total 18 herbaceous species belongs to 10 family (agricultural crops not included) were recorded from the study area enlisted in table 6.

Table 3a. Plantation in the Study area

S.No.	Vernacular name	Common name	Scientific Name	Family	Habit	Core	Buffer
1.	Baval	Babool	<i>Acacia nilotica</i>	Mimosaceae	T	+	+
2.	Kalo Sarasdo	Albizia	<i>Albizia lebbek</i>	Mimosaceae	T	+	+
3.	Kala Sarasdo	-	<i>Albizia odoratissima</i>	Mimosaceae	T	+	-
4.	Safed Sarasdo	-	<i>Albizia procera</i>	Mimosaceae	T	+	+
5.	Ral kang		<i>Anacardium occidentale</i>	Anacardiaceae	T	+	-
6.	Limdo	Lemon	<i>Azadirachta indica</i>	Meliaceae	T	+	+
7.	Vaans	Bamboo	<i>Bambusa arundinaceae</i>	Poaceae	T	+	+
8.	Khakhro	Parrot Tree	<i>Butea superba</i>	Caesalpiniaceae	T	+	-
9.	Harit parn	Eucalyptus	<i>Eucalyptus sp.</i>	Myrtaceae	T	+	+
10.	Saru	Beach oak	<i>Casuarina equisetifolia</i>	Casuarinaceae	T	+	+
11.	Sandasado	Gulmohar	<i>Delonix regia</i>	Casuarinaceae	T	+	+
12.	Liso baval	Subabul	<i>Leucaena leucocephala</i>	Casuarinaceae	T	+	+
13.	Peru	Guava	<i>Psidium guajava</i>	Myrtaceae	T	+	+
14.	Keri	Mango	<i>Mangifera indica</i>	Anacardiaceae	T	+	+
15.	Chickoo	Chickoo	<i>Manilkara zapota</i>	Sapotaceae	T	+	+
16.	Amla	Gooseberry	<i>Phyllanthus emblica</i>	Phyllanthaceae	T	+	+
17.	Khajoor	Date Palm	<i>Phoenix dactylifera</i>	Arecaceae	T	+	+

Table 3b. Trees in the Study area (Natural Vegetation)

S.No.	Family and Scientific name	Vernacular name
1	Anacardiaceae	
1/1	<i>Mangifera indica L.</i>	Aam
2	Annonaceae	
2/1	<i>Polyalthia longifolia</i>	Asopalav
3	Verbenaceae	
3/1	<i>Avecenia marina</i>	Mangrove
4	Apocynaceae	
4/1	<i>Plumeria rubra L.</i>	Champa
5/2	<i>Tamarindus indica</i>	Imli
5	Casuarinaceae	
6/1	<i>Casuarina equisetifolia L.</i>	Sharu
6	Caricaceae	
7/1	<i>Carica papaya L.</i>	Papaya
7	Fabaceae	
8/1	<i>Dalbergia sisoo</i>	Sisso
9/2	<i>Delonix regia (Boj)</i>	Gulmohar
10/3	<i>Parkinsonia aculeate L.</i>	Rambaval
11/4	<i>Peltophorum pterocarpum (DC.)</i>	Tamrafal
12/5	<i>Albizia lebbek L.</i>	Siris
13/6	<i>Albizia procera</i>	Safed Siris
8	Leguminosae	
14/1	<i>Derris indica (Lam.)</i>	Karanj
	<i>Parkinsonia aculeata</i>	Vilayati Kikar
9	Lythraceae	
15/1	<i>Sonneratia apetala</i>	Blume Mangrove
16/2	<i>Sonneratia alba</i>	Mangrove Apple

9	Meliaceae	
17/1	<i>Azadirachta indica</i> A.Juss	Limdo
10	Mimosaceae	
18/1	<i>Acacia nilotica</i>	Desi Baval
19/2	<i>Leucaena leucocephala</i> (Lam.) De	Pardesi Baval
20/3	<i>Pithecellobium dulce</i> (Roxb.) Bth.	Jungle jalebi
21/4	<i>Prosopis cineraria</i> (L.)	Khejari
22/5	<i>Acacia senegal</i> (L.) Willd,	Baval
11	Moraceae	
23/1	<i>Ficus benghalensis</i> L.	Bargad
24/2	<i>Ficus religiosa</i> L.	Pipal
12	Moringaceae	
25/1	<i>Moringa oleifera</i> Lam	Sargavo
13	Myrtaceae	
26/1	<i>Eucalyptus citriodora</i> Hk.	Nilgari
27/2	<i>Syzygium cumini</i>	Jambu
14	Rhamnaceae	
28/1	<i>Zizyphus mauritiana</i>	Bor
29/2	<i>Zizyphus xylopyrus</i>	Jungli Bor
15	Salvadoraceae	
30/1	<i>Salvadora persica</i> L.	Piludo
31/2	<i>Salvadora oleoides</i> Decne.	Toothbrush Tree
16	Sapotaceae	
32/1	<i>Manilkara zapota</i> L. van Royen	Chikoo
17	Burseraceae	
33/1	<i>Commiphora wightii</i>	Guggal

Table 4. List of Mangrove/s encountered in the study area

S.No.	Scientific name	Common name	Family
Marine			
1.	<i>Avecenia marina</i>	Grey Mangrove	Verbenaceae
Terrestrial			
2.	<i>Salvadora persica</i>	Toothbrush Tree	Salvadoraceae
3.	<i>Salvadora oleoides</i> Decne.	Toothbrush Tree-Big	Salvadoraceae
4.	<i>Sonneratia apetala</i>	Blume Mangrove	Lythraceae
5.	<i>Sonneratia alba</i>	Mangrove Apple	Lythraceae

Table 5. List of Shrubs in the Study Area

S.No.	Family and Scientific name	Vernacular name
1.	Apocynaceae	
1/1	<i>Thevetia peruviana</i>	Pili Kaner
2.	Asclepiadaceae	
2/1	<i>Calotropis procera</i>	Akoda
3.	Bignoniaceae	
3/1	<i>Tecoma stans</i> (L.) H.B. & K.	Peilafol
4.	Cactaceae	
4/1	<i>Cereus peruvianus</i>	Cactus
5/2	<i>Opuntia elatior</i> Mill.	Fafdo thor
5.	Capparaceae	
6/1	<i>Capparis decidua</i> (Forsk) Edgew	Kerdo
6.	Compositae	
7/1	<i>Xanthium strumarium</i> L.	Gokhru
7.	Lythraceae	
8/1	<i>Lawsonia inermis</i>	Mehandi
8.	Euphorbiaceae	
9/1	<i>Ricinus communis</i> L.	Divel
10/2	<i>Euphorbia nivulia</i> Buch.-Ham	Thor
11/3	<i>Jatropha curcus</i> L.	Ratanjot

9.	Malvaceae	
12/1	<i>Abelmoschus manihot</i> L.	Jungli Bindi
13/2	<i>Hibiscus rosa sinensis</i> L.	Jasund
10.	Musaceae	
14/1	<i>Musa paradisiaca</i> L.	Kela
11.	Mimosaceae	
15/1	<i>Prosopis juliflora</i>	Gando baval
12.	Nyctaginaceae	
16/1	<i>Bougainvillea spectabilis</i> Willd.	Bougainvelia
13.	Rhamnaceae	
17/1	<i>Zizyphus nummularia</i>	Jharbera
18/2	<i>Zizyphus nummularia</i> (Burm.f.) W. &	Chanibor
14.	Punicaceae	
19/1	<i>Punica granatum</i>	Anar
15.	Rutaceae	
20/1	<i>Citrus limon</i>	Neebu

Table 6. List of Herbaceous species observed in the Study area

S.No.	Family and Scientific name	Vernacular name
1.	Asphodelaceae	
1/1	<i>Aloe barbensis</i> Mill.	Kunvarapato
2/2	<i>Aloe vera</i>	Kuwar Pathu
2.	Asteraceae	
3/1	<i>Tridax procumbens</i> L.	Bhangro
4/2	<i>Eclipta prostrata</i>	Bhangro
5/3	<i>Echinops echinatus</i> Roxb	Shulio
6/4	<i>Lacunae procumbens</i> (Roxb)	Moti Bhonpatri
3	Convolvulaceae	
7/1	<i>Cressa cretica</i> L.	Palio, Rudanti
8/2	<i>Ipomoea pes-carprae</i> (L)	Dariani vel
9/3	<i>Ipomoea aquatica</i> Forsk.	Nalini Bhaji
10/4	<i>Ipomoea obscura</i> Ker	Vad fudradi
4.	Lamiaceae (Labiatae)	
11/1	<i>Ocimum sanctum</i> L.	Tulsi
5.	Malvaceae	
12/1	<i>Abutilon indicum</i> L.	Khapat, Dabaliar
6.	Menyanthaceae	
13/1	<i>Nyphoides indicum</i> (Roxb.)	Kumudini
7.	Nyctaginaceae	
14/1	<i>Boerhavia diffusa</i> L.	Satodi
8.	Papilionaceae	
15/1	<i>Cortalaria medicaginea</i> Lam	Ran methi
9.	Solanaceae	
16/1	<i>Datura metel</i>	Dhatura
17/2	<i>Solanum nigrum</i> L.	Piludi
10.	Zygophyllaceae	
18/1	<i>Tribulus terrestris</i> L	Gokhru

Cultivated Plants in the Study Area

The prevalent cropping systems of this area are the cumulative results of past and present decisions by individuals; these decisions are usually based on experience, tradition, expected profit, personal preferences and resources, and so on. The crop occupying the highest percentage of the sown area of this

region is taken as the major crop and all other possible alternative crops which are sown in this region either as substitutes of the base crop in the same season or as the crops which fit in the rotation in the subsequent season, are considered as minor crop. It is observed that, the different parts of the study area were practicing different crop pattern based on the

season and availability of irrigation facility. The general crop patterns practiced in the study area were Juwar (*Sorghum vulgare*), Ground nut (*Arachis hypogaea*) and during monsoon, Wheat (*Triticum aestivum*) during winter and during summer only Ground nut (*Mumphali*) were practiced in this region.

Major Horticultural Crops: Plantation of Chikku (*Manilkara zapota*), Kela (*Musa sp.*) Papaya (*Carica papaya*), Amla (*Phyllanthus emblica*), Mango trees (*Mangifera indica*) and Dadam (*Punica granatum*) were observed at some localities. Mango trees (*Mangifera indica*) and Tamarindus trees (*Tamarindus indica*) were observed adjacent to the residential area and also along the road side at almost all villages. Chikku, Aam, Amla, Limboo and Papaiyo were developed by client in the premises.

Major Vegetable Corps: The major vegetables grown in the study area were:

- Bhindi (*Abelmoschus esculentus*),
- Brinjal, (*Ringana Solanum melongena*),
- Cabbage (*Brassica oeraceae*),
- Tomato (*Lycopersicon lycopersicum*),
- Guvar (*Cyamopsis tetragonoloba*),
- Val (*Lablab purpureus*),
- Turia (*Luffa acutangula*),
- Karela (*Momordica charantia*),
- Drum stick (*Sargva*) (*Moringa oleifera*),
- Amla (*Tamarindus indica*)
- Chloi (*Vigna unguilata*)

e. Pulses: The pulses cultivated in this region were Mag (*Vigna acontifolia*), Tuver (*Cajanus cajan*).

Rare and Endangered Flora

The IUCN Red List is the world's most comprehensive inventory of the global conservation status of plant and animal species. It uses a set of criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are relevant to all species and all regions of the world. With its strong scientific base, the IUCN Red List is recognized as the most authoritative guide to the status of biological diversity. Out of 17000 species of higher plants known to occur in India, nearly 614 higher plant species were evaluated by IUCN. Among them 247 species

are under threatened category (IUCN, 2008). Among the enumerated flora in the study area, none of them were assigned any threat category by Red data book of Indian Plants (Jain and Sastry, 1984; Nayar and Sastry, 1987; 1988; 1990; Oldfield *et al.*, 1998; Kholia and Bhakuni, 2009) and Red list of threatened Vascular plants (IUCN, 2010).

Among recorded plant species none can be assigned the status of rare/endangered plant of study area.

Forest and Their Category in Study Area

- i. Narayan Sarovar Wild Life Sanctuary 2.75 km NW
- ii. Golay Reserve Forest 3.0 km SW
- iii. Ratipal Reserve Forest 1.0 km N
- iv. Mniyara Reserve Forest 1.5 km SE
- v. West Mangrove Forest 6.5 km W

Narayan Sarovar Wildlife Sanctuary

Narayan Sarovar Wildlife Sanctuary or more popularly known as Narayan Sarovar Chinkara Sanctuary was notified as official in 1981 by state and central department of forest. The sanctuary has an exclusive eco system as it surrounds the site of Lakhpat taluka of Kutch district in the state of Gujarat. Set at an arid zone, the partial area of the sanctuary has a wetland and within around 15 endangered species thriving to prove their existence. The sanctuary has an area of around 765.79 square kilometer and has been centers of numerous activities as its strategic location has been subject of de notification and reduction of area for mining purpose are some of the major setbacks it had faced in past incidents. The predominant area of the sanctuary features northern and southern limits as northwest and western province has creeks of mangrove. The land of sanctuary is pretty flat and is set at the sea shore, a northeastern region has minor hills and surrounding area is curate by flow of small streams. The eastern part has a large formation of basalt rocks and then the southern area has limestone and shale, the entire area is rich in minerals and soils around are fertile in nature. The area of the sanctuary face tropical climate the summer is amazingly intense and season of winter is more mild and pleasant. The account of rainfall recorded in

average but during acute monsoon season it could be devastating and very uncertain.

Narayan Sarovar Wildlife Sanctuary falls under a separate biotic province of the country and represents a distinct gene pool of Indian arid region which possess abundant grass land, coastal areas with dense patches of mangrove forests, partial wetland due to the coast line and around 45 lentic wetlands of varying sizes and it provides home to many rare and threatened species like Chinkara, Caracal, Wolf, Leopard, Spiny-tailed Lizard, Desert Cat, Great Indian Bustard, Lesser Floricorn, Houbara Bustard, etc. the sanctuary area is relatively very rich in minerals, the major minerals being Lime Stone, Lignite, Bentonite and Bauxite; Kori-creek surrounds the sanctuary on the North West and mangrove forests on the West and no prominent land features are observed on Eastern, Northern and Southern sides. The peripheral area of about 22588.00 Hectare is proposed to be declared as Eco-sensitive Zone which includes the 28 villages of Lakhapat Taluka District Kutch and one village of Nakhatrana Taluka District Kutch and two villages of Abdasa Taluka, District Kutch and 8531.00 Hectare of forest land and 14057.00 Hectare of non-forest land. Eco-Sensitive Zone is divided in two sub zones within the buffer zone of 2.5 kilometer from the outer boundary of the sanctuary:

Sub Zone A: The area within the buffer zone of 2.5 km where the drainage lines towards the sanctuary area and the rock is relatively pervious; thus, on the one hand, this sub-zone will be a part of the catchments' area for various water courses or water bodies in the sanctuary and, on the other due, the relatively previous nature of rock, water borne pollutants will have more effect on the ground water.

Sub Zone B: The area where the drainage lines travel outwardly away from the sanctuary area. Moreover, the rocks in this area are relatively impervious. Applicable to-

Industrial Units

(a) No industrial development within 500 meter of the periphery of the Sanctuary shall be allowed;

(b) No polluting industries shall be allowed within the eco-sensitive zone, only non-polluting industries beyond the 500 m periphery in the eco-fragile area shall be considered with the provision of a minimum of 50 m wide green belt.

(c) Where the eco-fragile zone is limited to less than 2.5 km, the industry, if permitted, must ensure safe guards including 50 m wide monitoring strip and 200 meter wide greenbelt and 250 meter wide no activity zone shall be maintained in the 500 m eco-fragile zone.

Quarrying and Mining

(a) No mining shall be allowed in sub-zone A; if mining is done in this area then loose soils or mining pollutants would be following the drainage courses and may adversely affect the sanctuary area.

(b) The mining may be allowed with various control and mitigation measures in sub-zone B as loose soils or mining pollutants which would be following the drainage courses would flow away from the sanctuary and, therefore, are likely not to adversely affect the water bodies in the sanctuary and, therefore, it may not have adverse impact on the habitat of the wildlife sanctuary.

(c) The recommendations of Gujarat Ecological Education and Research (GEER) Foundation related to mining are appended to this notification which shall be adhered to while carrying out any mining activity in the zone.

Monitoring committee shall be the authority to grant special permission for limited quarrying of materials required for construction of local residential housing, construction and maintenance of roads, based on site requirement evaluation.

Trees: Felling of trees on forest should be as per the Working Plan or Management Plan approved by the Competent Authority and the felling of trees on private or revenue lands may be allowed in accordance with the State regulations.

Tourism: Tourism activities shall be as per as Tourism Master Plan which shall emphasize on ecotourism, eco-education and eco-development and be prepared by the Department of Environment and Forest in

collaboration with Department of Tourism which shall be a component of the Zonal Master Plan.

(5) Ground Water: Extraction of ground water shall be permitted only for the bona-fide agricultural and domestic consumption of the occupier of the plot and no extraction of ground water for commercial and industrial complexes shall be permitted except with the prior approval of the State Ground Water Board and all steps shall be taken to prevent contamination or pollution of water including from agriculture.

(6) Use of Plastics: No person shall use plastic carry bags within the Eco-sensitive zone area and the disposal of plastic articles shall be strictly regulated.

(7) Noise pollution: The Environment Department or the State Forest Department, Gujarat shall be the authority to draw up guidelines and regulations for the control of noise in the Ecosensitive Zone.

(8) Discharge of effluents: No untreated or industrial effluent shall be permitted to be discharged into any water body within the Eco-sensitive Zone and the treated effluent shall meet the provisions of the Water (Prevention and Control of Pollution) Act, 1974.

(9) Solid Wastes:

(a) The solid waste disposal shall be carried out in accordance with the provisions of the Municipal Solid Waste (Management and Handling) Rules, 2000 notified by the Central Government vide notification number S.O. 908 (E), dated the 25th September 2000, as amended from time to time.

(b) (i) the local authorities shall draw up plans for the segregation of solid wastes into biodegradable and non-biodegradable components;

(ii) The biodegradable material may be recycled preferably through composting or vermiculture,

(iii) The inorganic material may be disposed in an environmentally acceptable manner at site identified outside the Eco-sensitive Zone,

(iv) No burning or incineration of solid wastes shall be permitted in the Eco-sensitive Zone.

(10) Natural Springs: The catchment areas of all springs shall be identified and plans for their conservation and rejuvenation of those that have run dry, in their natural setting shall be incorporated in the Zonal Master Plan and the strict guidelines shall be drawn up by the State Government to ban development activities at or near these areas.

Tree community (Species-area) curves based on phytosociology fitted to the data may show unnatural shapes, with leveling-off or even decrease in sampling sizes higher than average. This distortion can be explained by the subjective, preferential method of field sampling used in phytosociology. When making relevés in species-poor vegetation, one probably tends to use larger plots in order to include more species. The reason for this may be that a higher number of species gives a higher probability of including presumed diagnostic species, so that the relevé can be more easily classified in the Braun-Blanquet classification system. This may have at least two consequences: in phytosociological data bases species-poor vegetation types are underrepresented or relevés are artificially biased towards higher species richness; the suitability of phytosociological data for species richness estimation is severely limited.

Faunal Biodiversity of Study Area

For the documentation of the faunal biodiversity of the study area with respect to birds, reptiles, amphibians, and butterfly species, a baseline survey had been conducted.

Birds: The sighting of bird species was very less during the study period. The most commonly spotted bird species of this area were; Cattle Egret, Intermediate Egret, Red-wattled Lapwing, Rock Pigeon, Eurasian Collared-Dove, Chestnut-headed Bee-eater, Bank Myna and Common Myna. Water birds are very common as creek and sea shore line is the major part falls under study area. The Indian Peafowl was observed which is listed as schedule –I as per IWPA, 1972 and others listed as schedule IV as per IWPA, 1972.

Total 1,224 bird species reliably recorded from India, together with their status

categories. In total there are 1219 extant native species including migrants and vagrants (but excluding 3 species now known to be extinct in the country and 2 introduced species). There are 923 breeding species (911 residents, plus 12 suspected residents). IUCN evaluated 1254 bird species from India and categorized 77 species as threatened (13 species as critically endangered, 10 species as Endangered and 54 species as

Vulnerable). No one sighted birds were evaluated as near threatened by IUCN, 2010 and BirdLife International, 2010. A taxon is Near Threatened, when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable categories, but is close to qualifying or is likely to qualify for a threatened category in the near future.

Table 7. Schedule –I Bird(s) of Study Area

Species	As IWPA 1972	IUCN	CITES
Indian Peafowl (<i>Pavo cristatus</i>)	Schedule I	Least Concern ver 3.1	Not listed

Table 8. Systematic Lists of Birds in the Study Area with Status

S.No.	Scientific Name	Local Name	Common Name	Schedule	Status
1.	<i>Accipiter badius</i>	Shakro	Shikra	Schedule IV	R
2.	<i>Acridotheres ginginianus</i>	Ghoda kabar	Bank Myna	Schedule IV	R
3.	<i>Actitis hypoleucos</i>	Nani tutwari	Sandpiper	Schedule IV	W
4.	<i>Apus apus</i>	Ababil	Common Swift	Schedule IV	R
5.	<i>Amaurornis phoenicurus</i>	Safed chatari	White-breasted Water hen	Schedule IV	R
6.	<i>Anthus campestris</i>	Pidi dhanchidi	Pipit	Schedule IV	R
7.	<i>Anthus spinoletta</i>	Panini Dhanchidi	Water Pipit	Schedule IV	W
8.	<i>Apus affinis</i>	Moto Ababil	Little Swift	Schedule IV	R
9.	<i>Anhinga melanogaster</i>	Jalbhi	Darter	Schedule IV	R
10.	<i>Athene noctua</i>	Nani ghuwad	Little Owl	Schedule IV	R
11.	<i>Bubulcus ibis</i>	Dhorbaglo	Cattle Egret	Schedule IV	R
12.	<i>Caprimulgus asiaticus</i>	Sonara	Nightjar	Schedule IV	R
13.	<i>Carduelis carduelis</i>	Tapusiyu	Goldfinch	Schedule IV	R
14.	<i>Centropus sinensis</i>	Hoco	Coucal	LC	R
15.	<i>Ciconia ciconia</i>	Badho	White Stork	Schedule IV	V
16.	<i>Columba livia</i>	Kabutar	Rock Pigeon	LC	R
17.	<i>Coracias benghalensis</i>	Deshi Neelkanth	Indian Roller	LC	R
18.	<i>Corvus splendens</i>	Kagdo	Crow	Schedule IV	R
19.	<i>Cursorius coromandelicus</i>	Rangodhlo	Courser	LC	R
20.	<i>Cyanistes caeruleus</i>	Chikyu	Blue Tit	Schedule IV	R
21.	<i>Dendrocygna bicolor</i>	Nani bawk	Duck	Schedule IV	R
22.	<i>Dicrurus macrocercus</i>	Kado kosi	Black drongo	Schedule IV	R
23.	<i>Egretta garzetta</i>	Baglo	Little Egret	Schedule IV	R
24.	<i>Elanus caeruleus</i>	Kapasi/Laudharo	Black-winged Kite	Schedule IV	R
25.	<i>Ephippiorhynchus asiaticus</i>	Dhonk	Black necked Stork	Schedule IV	R
26.	<i>Ficedula parva</i>	Chatki ma khimar	Red breasted Flycatcher	Schedule IV	R
27.	<i>Francolinus pondicerianus</i>	Titar	Gery Francolin	Schedule IV	R
28.	<i>Fulica atra</i>	Dasadi	Common Coot	Schedule IV	R
29.	<i>Gallinula chloropus</i>	Jalmurgi	Moorhen	LC	R
30.	<i>Grus grus</i>	Kunj	Crane	Schedule IV	R
31.	<i>Halcyon coromanda</i>	Kalkalio	Ruddy Kingfisher	Schedule IV	R
32.	<i>Halcyon smyrnensis</i>	Moto Kalkalio	White-throated Kingfisher	Schedule IV	R
33.	<i>Larus brunnicephalus</i>	Gull	Gull brown headed	LC	R
34.	<i>Limosa limosa</i>	Motagadero	Black Tailed Godwit	NT	R

35.	<i>Megalaima haemacephala</i>	Kansaro	Coppersmith	Schedule IV	R
36.	<i>Merops leschenaulti</i>	Tarklo	Chestnut-headed Bee-eater	LC	R
37.	<i>Mesophoyx intermedia</i>	Vachetdholo baqlo	Intermediate Egret	Schedule IV	R
38.	<i>Motacilla cinerea</i>	Diwaliyo	Grey Wagtail	Schedule IV	W
39.	<i>Motacilla flava</i>	Pilo Divaliyo	Yellow Wagtail	Schedule IV	SB
40.	<i>Muscicapa striata</i>	Nanu Chikyu	Spotted Flycatcher	Schedule IV	SB
41.	<i>Mycteria leucocephala</i>	Dhonk	Painted Stork	Schedule IV	R
42.	<i>Nectarinia asiatica</i>	Jāmbalī Sunbird	Purple Sunbird	Schedule IV	R
43.	<i>Nectarinia minima</i>	Motu Duriyu	Crimson-backed Sunbird	Schedule IV	R
44.	<i>Parus major</i>	Tikdi	Great Tit	Schedule IV	R
45.	<i>Passer domesticus</i>	Chakli	Sparrow	LC	R
46.	<i>Pavo cristatus</i>	Mor	Indian Peafowl	Schedule I	R
47.	<i>Pellomeum palustris</i>	Babbler	Marsh Babbler	Schedule IV	R
48.	<i>Phalacrocorax fuscicollis</i>	Pani Kagdo	Cormorant	Schedule IV	R
49.	<i>Philomachus pugnax</i>	Tilio	Ruff	LC	R
50.	<i>Phoenicopterus minor</i>	Nano Surkabh	Flamingo	Schedule IV	R
51.	<i>Picus viridis</i>	Lakkadhod	Green Woodpecker	Schedule IV	R
52.	<i>Platalea leucorodia</i>	Chamchichanch	Eurasian Spoonbill	Schedule IV	OP
53.	<i>Platalea ajaja</i>	Gulabi chamchichanch	Spoonbill	Schedule IV	O
54.	<i>Ploceus philippinus</i>	Sugari	Baya weaver	Schedule IV	R
55.	<i>Psittacula krameri</i>	Popat	Rose-ringed Parakeet	Schedule IV	V
56.	<i>Pterocies exustus</i>	Batumdi	Sandgrouse	Schedule IV	V
57.	<i>Pycnonotus cafer</i>	Bulbul	Bulbul	Schedule IV	R
58.	<i>Sterna albifrons</i>	Nana vabagli	Little Tern	LC	R
59.	<i>Streptopelia decaocto</i>	Holdi	Eurasian Collared-Dove	Schedule IV	R
60.	<i>Streptopelia orientaii</i>	Holdi	Rufous Turtle Dove	Schedule IV	R
61.	<i>Surniculus lugubris</i>	Kaliyakoshi	Drongo Cuckoo	Schedule IV	R
62.	<i>Tachybaptus ruficollis</i>	Dubki	Little Grebe	Schedule IV	R
63.	<i>Throskiornis melanocephalus</i>	Dhorikankansar	Black headed ibis	Schedule IV	R
64.	<i>Turdoides caudatus</i>	Lelu	Common Babbler	Schedule IV	R
65.	<i>Vanellus indicus</i>	Titodi	Lapwing	Schedule IV	R

Key to Status

R	Resident	VS	Vagrant summer
V	Vagrant	VP	Vagrant passage
S	Summer only	PB	Passage and breeds
W	Winter only	PW	Passage and winter
P	Spring or autumn passage	E	Escape
O	Occurs most years		

Due to presence of coastal area, some creeks and small water body (near the project site) in the study area; variety of birds were observed during the study area. Sighting of flamingo in the study area has been reported. There is a wild life sanctuary i.e. NS Wildlife Sanctuary reserved for Chinkara in the study area, no any other national park, tiger or elephant reserve, biosphere reserve. There is no marine national park in the study area. The listed faunal taxon has been crosschecked with Red Data Book of Indian Animals (Zoological Survey of India).

Butterflies from the study area: Butterflies from three families observed during the present study are documented in the table 9.

Herpetofauna: In amphibian group, the toads were sighted during the study period. The reptile, Common Garden Lizard, House Gecko and Fan-Throated Lizard, Common rat Snake and were observed in the region is given in the table 10.

Mammals: The wild mammals observed other than the domesticated ones are given in the table below. Chinkara is protected under

schedule –I as per WPA 1972, while Common Mongoose (*Herpestes edwardsii*), Jungle cat were observed which are protected under schedule II and Nilgai (*Boselaphus tragocamelus*) is Schedule-III animal as per Wildlife Protection Act 1972. The Squirrel,

Indian Porcupine, Hare etc. are protected under schedule IV. The Common House Rat (*Rattus rattus*) are protected under schedule V. List of mammals encountered in study area is given in table 11.

Table 9. Butterflies in the Study Area

Scientific Name and Family	Common Name	Relative Abundance
Family Asclepiadaceae		
<i>Danaus genutia</i> Cramer	Striped Tiger	Common
Family Papilionidae		
<i>Papilio polytes</i>	Common Mormon	Common
Family Pieridae		
<i>Eurema hecabe</i>	Common Grass yellow	Very Common
<i>Ixias Marianne</i>	White orange tip	Common
Family: Nymphalidae		
<i>Danaus chrysippus</i>	Plain Tiger	Common
<i>Phalantha phalantha</i>	Common Leopard	Fairy Common
<i>Hypolimanas misippus</i>	Danaid egg fly	Common
<i>Mycalesis perseus</i>	Common bush brown	Uncommon
<i>Cynthia cardui</i> Linnaeus	Painted Lady	Uncommon
<i>Junonia hierta</i> Fabricius	Yellow pansy	Common
<i>Junonia orithya</i> Linnaeus	Blue pansy	Fairy Common

Table 10. Reptiles and Amphibian in the Study Area

S.No.	Common Name	Scientific name	Schedule as IWPA, 1972
1.	Toad	<i>Bufo bufo</i>	Not listed
2.	Common Indian Krait*	<i>Bungarus caeruleus</i> (Schneider)	Schedule II
3.	Indian chameleon	<i>Chameleon calcaratus</i>	Schedule II
4.	Common Garden Lizard	<i>Calotes versicolor</i>	Not listed
5.	Fan-Throated Lizard	<i>Sitana ponticeriana</i>	Not listed
6.	House Gecko	<i>Hemidactylus flaviviridis</i>	Not listed
7.	Brahminy Skink	<i>Mabuya carinata</i> (Schneider)	Not listed
8.	Common Rat Snake	<i>Ptyas mucosus</i> (Linn)	Schedule II
9.	Indian Cobra*	<i>Naja naja</i> (L)	Schedule II
10.	Indian Monitor	<i>Varanus bengalensis</i>	Schedule II

*Not sighted but included as per the secondary information from the villagers.

Table 11. Mammals in Study Area

S.No.	Common Name	Scientific Name	Status as per IWPA 1972
1.	Chinkara	<i>Gazella bennettii</i>	Schedule I
2.	Common Mongoose	<i>Herpestes edwardsii</i>	Schedule II
3.	Jungle Cat	<i>Felis chaus</i>	Schedule II
5.	Nilgai (Blue Bull)	<i>Boselaphus tragocamelus</i>	Schedule-III
4.	Hare	<i>Lepus nigrigolisddayanus</i>	Schedule IV
6.	5 striped Palm Squirrel	<i>Funambulus pennanii</i>	Schedule IV
7.	Indian Porcupine	<i>Hystrix indica</i>	Schedule IV
8.	Common House Rat	<i>Rattus rattus</i>	Schedule V
9.	Grey Musk Shrew	<i>Suncus murinus</i>	-
10.	Camel	<i>Camelus dromedarius</i>	-

Domestic Animals: The domestic animals viz. Dog, cow, buffalo, goat, sheep and chicken observed in the study area.

Insect: There is no significant faunal assemblage here except for some insects like Honey Bees (*Apis sp.*) and Gum leaf Grasshopper (*Goniaea australasiae*).

Fisheries: Gujarat is the second largest fish producing States in the country only next to West Bengal. Among all the maritime States, Gujarat accounts for a significant share insofar as marine fish production in the country is concerned and stands as the largest marine

fish producer. Although, the study area have no major river or any lake, a very few fishes were observed. Some part of study area fall coastal zone, hence marine fishes reported, no fisher man or fishing activity found in the study area.

Table 12. List of Fishes reported from the Study area

S.No.	Common name	Scientific name
1.	Long Spine Sea-bream	<i>Argyrops spinifer</i>
2.	Indian Salmon	<i>Eleutheronema tetradactylum</i>
3.	Thread Fin	<i>Polynemus indicus</i>
4.	Mud Skipper	<i>Bolephthalmus</i>
5.	Indian shed (Chaksi)	<i>Hilsha ilisha</i>
6.	Seer fish (Chapri)	<i>Caranax atropus</i>

*not seen directly.

Rare and Endangered Fauna of Study Area

The IUCN Red List is the world's most comprehensive inventory of the global conservation status of plant and animal species. It uses a set of criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are relevant to all species and all regions of the world. With its strong scientific base, the IUCN Red List is recognized as the most authoritative guide to the status of biological diversity. IUCN, (2008) has evaluated 1976 animal species from India, among them 313 have in recognized as threatened species. Among them one species is considered as extinct, while 44 species are in critically endangered (CR) category, 88 is in endangered category (EN), while 181 is considered as vulnerable (VU). Wild Life (Protection) Act, 1972, amended on 17th January 2003, is an Act to provide for the protection of wild animals, birds and plants and for matters connected therewith or ancillary or incidental thereto with a view to

ensuring the ecological and environmental security of the country. Some of the sighted fauna was given protection by the Indian Wild Life (Protection) Act, 1972 by including them in different schedules. Among the birds in the study area, Pea fowl (*Pavo cristatus*) is included in schedule I of Wild life Protection Act (1972), while many other birds are included in schedule IV. Among the reptiles, Indian Cobra (*Naja naja*), Indian chameleon, Rat snake, Indian Krait and Indian Monitor are provided protection as per Schedule-II of Wild life Protection Act, (1972). Among mammals; there is a habitat for Chinkara in wild life sanctuary falls under study area and it is protected under schedule-I while Common Mongoose (*Herpestes edwardsi*), Indian Monitor, Jungle cat are a schedule-II animals. Nilgai (*Boselaphus tragocamelus*) is protected as Schedule-III animal and hares and 5 striped squirrels are included in schedule IV of Wild Life Protection act 1972.

Table 13. List of Schedule –I Fauna observed in the Study Area

S.No.	Scientific Name	Local Name	Schedule as per WPA, 1972	IUCN Category	CITES Listing
1.	<i>Pavo cristatus</i>	Indian Peafowl	Schedule - I	Least Concern ver 3.1	Not listed
2.	<i>Gazella bennettii</i>	Chinkara	Schedule - I	Least Concern ver 3.1	Appendix III

CONCLUSION

Flora: Floral diversity observed in the study area includes species like Babul (*Acacia nilotica*), Safed Siris (*Albizia procera*), Bargad (*Ficus benghalensis*), Imli (*Tamarindus indica*), Guggul (*Commiphora mukul*), Vilayati

Kikar (*Parkinsonia aculeate*), Neem (*Azadirachta indica*) etc.

Fauna: There is no significant faunal assemblage here except for some insects like Honey Bees (*Apis sp.*) and Gum leaf Grasshopper (*Goniaea australasiae*). Some of the Faunal species found in study area are

Little Cormorant (*Phalacrocorax niger*), Indian Pond Heron (*Ardeola grayii*), Little Egret (*Egretta garzetta*), Blue Rock Pigeon (*Columba livia*), Rose Ringed Parakeet (*Psittacula krameri*), Oriental Magpie (*Copsychus saularis*), Common Myna (*Acridotheres tristis*), Red-Vented Bulbul (*Pycnonotus cafer*), Bush Lark (*Mirafra javanica*), Common Crested Lark (*Galerida cristata*), House Sparrow (*Passer domesticus*) etc. Indian Peafowl (*Pavo cristatus*) and Chinkara (*Gazelle bennettii*) are the two schedule-I species found in the study area. These species need to conserve at their site and an urgent need to make aware the villagers about the importance of wildlife in the area. Also, it is suggested that the green cover/plantation/tree grove area should be increased to mitigate the impact on wildlife.

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