MANAGEMENT PLAN
OF
SUKHNA WILDLIFE SANCTUARY
CHANDIGARH
(UT)

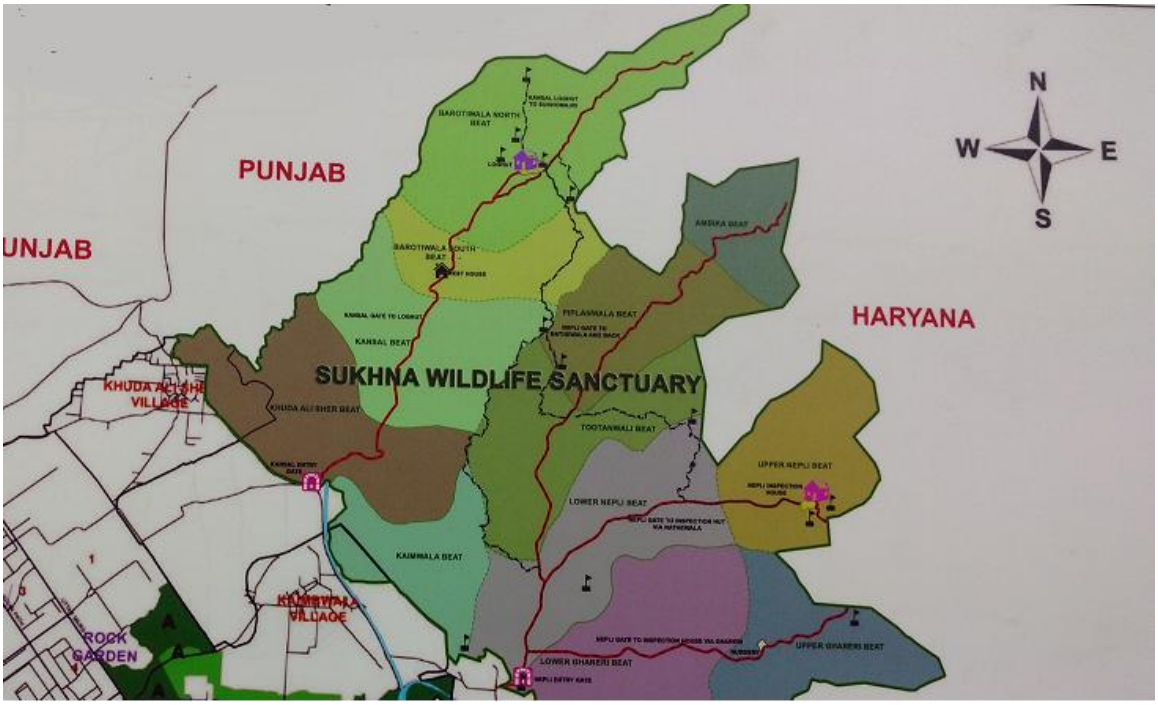
2018 - 19 to 2027 - 28

BY

SDFENR

Society for Development of Forests,
Environment & Natural Resources,
Chandigarh

Management Plan
of
Sukhna Wildlife Sanctuary
(2018-19 to 2027-28)



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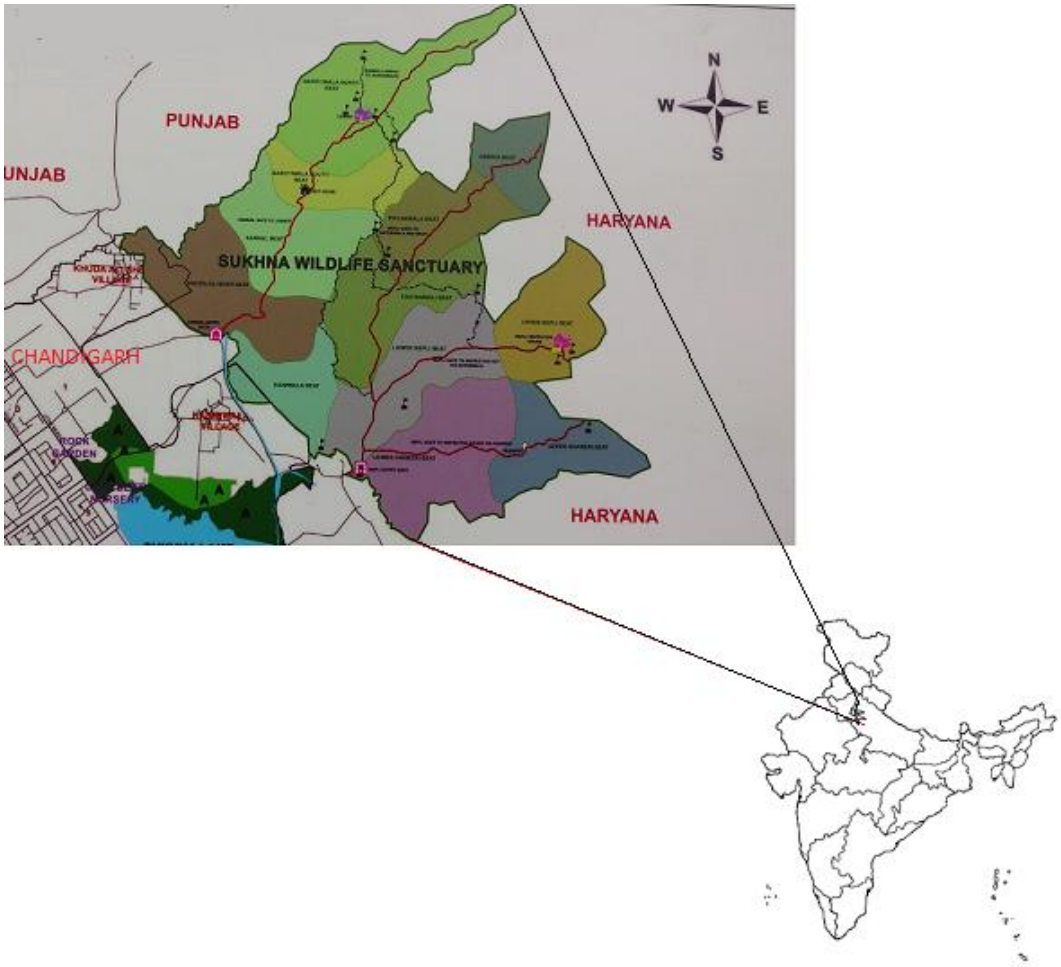
PUNJAB
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SUKHNA WILDLIFE SANCTUARY
CHANDIGARH
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LOCATION

ACKNOWLEDGEMENTS

We are thankful to Sh. Santosh Kumar, IFS, Chief Conservator of Forests – cum - Chief Wild Life Warden, Chandigarh (UT) for awarding us the work for revision of Management Plan for Sukhna Wild Life Sanctuary. His constant support, encouragement & cooperation were instrumental for completion of this laborious task over a period of 5 months.

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July, 2018

President,
SDFENR
(Society for Development of Forest, Environment & Natural Resources)
Chandigarh

Acronyms

Ac	Acre
BGZ	Bio-geographical Zone
CD	Check Dam
ET	Ecotone, Ecological Toning, Edge effect
Ha	Hectare
Km	kilo meter
m	meter
mm	milli meter
PA	Protected Area
SDD	Silt Detention Dam
TL	Trophic Level
TEZ	Tourism & Eco-tourism Zone
WLS	Wildlife Sanctuary
WZ	Wilderness Zone

Executive Summary

- **Sukhna WLS** lies between $30^0$17' N to $30^0$11' N Latitudes and $76^0$16' E to $76^0$29' E Longitudes. It came into existence w.e.f. 16.3.98 and is spread over an area of 2598.48 hectares or 25.98 sq km (equal to 6,420.99 acre as per notification) which was carved out from the hilly portion of the notified Reserved Forest Area of Chandigarh Administration. Sanctuary is in fact catchment of famous Sukhna lake, which is flanking the city's North-eastern edge.

- The **Shivalik hills are ecologically sensitive** and geographically unstable and thus highly prone to soil erosion during rains. Therefore, after initial years of construction of Sukhna lake, the rate of siltation was very high due to this soil erosion by surface run-off from its catchment area. During 1960-61, silt survey of the lake was carried out and found that on an average the lake was silting up at the rate of 500 acres feet per annum. The original storage capacity of the lake was 8,710 acre feet in 1958 which was found to be reduced to 2,970 acre feet (34% of original) in 1988. Thus in 30 years, 66% of the original water holding capacity of the Lake was lost due to siltation.
- This alarming rate of soil erosion and fast siltation of the lake forced the erstwhile Punjab Government to take various steps to reduce the silt inflow to the Lake from the catchment area. This led to the formation of Sukhna WLS for improving soil & moisture conservation regime of the area.
- **Sukhna WLS area** is the **catchment for 4 major seasonal streams** (Choe) viz. Kansal Choe, Nepli Choe, Nathewala choe and Ghareri Choe. The catchment area supports the water supply regime to Sukhna Lake at Chandigarh. The underground water regime supports a wide variety of flora and myriad fauna. Sukhna WLS falls under Indo-Gangetic BGZ and has been classified as Northern Tropical Dry Deciduous Forests by Champion & Seth (1968) due to extreme dryness of conglomerates during lean and summer seasons which support the forests. It has 40 tree species, 18 shrub varieties, 10 species of climbers, 28 kind of herbs and 16 species of grasses besides some bamboo and palms. It also harbours a wide variety of wild fauna and has more than 15 species of mammals, 133 species of birds including aquatic birds, 27 species of butterflies besides at least 7 species of reptiles reported.

- **During the preparation of current manuscript, the Transect walks were undertaken in all the four choes. Results of which have been summarized as below:**

- **Top of trophic level** has Leopard (*Panthera pardus*) at the apex, but the evidences were really scarce. **At level-III**, jungle cats, jackals, escaped-to-wild (feral) stray-dog packs, birds of prey are the main carnivores; jungle cat foot prints few, mainly packs of stray dogs (3 to 4 packs of 10-12 dogs), few

jackals. **At trophic level – II**, herbivores are the main prey base for higher trophic levels: grown up neel gai is too big for a leopard, only young ones and sub-adult females are preyed, also Sambar & Chital. Wild Boar is available in plenty in all valleys. **Small mammals** are in a decreasing order: Porcupine> Mongoose> small mongoose> civet cat> Pangolin. Porcupine is found every where. Special attention is required to be paid to Pangolin. **Trophic level-I** are autotrophs i.e. plants.

- **Current study has brought out number of issues & challenges for the management, which have been delineated as below:**

- **1. Augmenting catchment capabilities of the area: Prime objective** with which this area was set aside in 1950s is to conserve soil & moisture in the catchment area; thereby reducing siltation of lake below; **Continued de-siltation** till strata stabilizes with veg cover, **succession** of better plant species of next seral stages to replace dry deciduous vegetation akin to earlier seral stages of riverine succession.

- 2. **Restoring and conserving biodiversity of Bio-geographic zone (BGZ):** Existing vegetation pattern shows that roughly 66% area is under moderately dense canopy. Pebbly conglomerates greatly heated up during summers, leaving only xerophytic, shrubs & trees with deeper root systems to survive. Water conservation has increased moisture in soil - stage set for next seral stage or even climax vegetation of BGZ; also palatable grasses in the flood plains for enhanced fodder availability. Slopes require shade providing spp. through intervention, excessive regn. of *Prosopis* & *Leucinia* to be contained, *Adhatoda* & *Murraya* replacing available space after *Lantana* uprooting need to be curtailed & planted with suitable grasses

- 3. **Lay emphasis on maintaining a viable population of wild animals: Maintaining wild animal population** is dependent upon the available resources in the protected area. Dry deciduous forests have little to offer during lean seasons; **Past interventions** e.g. **uprooting of Lantana** in the area has resulted in somewhat enhanced availability of fodder, water but declined the shelter spp. of small animals as it has removed their shelter or niche; **Census:2011** in WLS have shown abundance of Sambar 1031+/-441 & Pea fowl 926+/-326. **Current study** Transect walks in 4 valleys, though does not quantify overall population but close to heuristic views of staff about 40 to 50 neel gai, 200 to 250 sambar, upto 100 chital and 200 to 250 wild boars.

- **4. Enhancing capacity building for effective management:** Wildlife management has now emerged as an elaborate concept where progress is being made at a fast pace. Without wildlife management training at appropriate levels for enhancement of skills, capacity building and knowing the progress made in the field, a scientific and effective management will be difficult; A **training programme** can be organized in collaboration with the Wildlife Institute of India, Dehradun.

- 5. **Promoting regulated tourism / eco-tourism: Low Sighting:** A visitor to a protected area expects to see some free ranging wild animals - gets passionate about wildlife conservation; **Lack of Grazing Grounds:** High population of herbivores in a WLS needs grazing grounds- prefer open grasslands or escape terrain; **Lack of Awareness:** Though **trekking has popularized** this WLS, the stakeholders like villagers of nearby area, students and people of Chandigarh, politicians, development departments, NGOs, are not fully well versed with the biological, ecological, landscape and environmental values of Sukhna WLS.

- 6. **Encouraging field research, inventorize to develop an adequate database, networking and develop a monitoring protocol**

- **Strategies to mitigate above mentioned issues:**

- **Ecological Boundaries:** During lean periods, animals venture out from WLS in search of greener pastures incld. Agri. fields or water. Stray cases when animals come in human inhabitations through nullahs i.e. Patiala-ki-Rao, Sukhna nullah etc. It **extends in adjoining forests** of Pb & Haryana upto ~5 km. This is Ecological Zone of Influence, where **signages** are required to be put up for public awareness and as to steps to be taken in the conflict situation.

- **Wilderness Zone:** Purpose of wilderness zone is to keep the area free from outside pressures for holistic biodiversity management, except management interventions where necessary; **Objectives :**

- 1) To manage the hydrological cycle in wake of soil & moisture conservation activities in the PA for detention of silt moving to Sukhna lake along with water.

- 2) To manipulate vegetative cover adapted to changing edaphic and climatic factors

- 3) Allow ecological processes to happen without interference.

- 4) Encourage healthy Prey – Predator ratio through scientific management practices

- 5) Protection of the sanctuary from theft, poaching and fire in perpetuity.

- 6) Relief & Rehabilitation

- **Eco Tourism Zone:** Clear delineation of Eco-Tourism zone and Wilderness zone is wanted. It is proposed to earmark tourist zone along South-West boundary of the sanctuary. It will have 2-3 Tracks laid down (proposed route depicted on Map). Tourism zone will cover 15-20 % of the sanctuary area. Remaining area will be wilderness zone with limited or no access to tourist. Development of Parking lots near the gates. Construction of a canteen cum souvenir shop & public conveniences in the Parking area near the gates.

Construction of hideouts and visits to watch towers for affording wildlife viewing. Involvement of the community of neighboring villages for nature guides, for cycling tours, for running facilities such as ticketing windows. Only guided/ attended tours to be allowed with Nature guides (on payment), in groups of 10-15 visitors . Institution of Nature Guides may be propagated. Youth from adjoining villages be encouraged, selected and trained as nature guides to augment their income as a self employment opportunity.

- **To enrich the experience** of visitors and improve their knowledge base, interpretation centre be developed providing life-size models of wild animals, method of identification of wild animal signs (pug marks, squat, sounds, others), ecosystem processes, displaying wildlife documentaries etc. A common place with canteen facilities, Souvenir shop and Interpretation Hall can be merged into one complex.

- **The Sanctuary is free from all rights** and concessions. There are no habitations inside the sanctuary area, as such there is no dependence on the sanctuary area for fuel, fodder, etc. from any quarters.

Statistical Data of Chandigarh

The Union territory of Chandigarh having a geographical area of 114 sq. km. constitutes 0.003% of the geographical area of the country. Physiographically the U T falls in the northern plains although it lies close to Shiwalik hills. The average annual rainfall varies from 400mm to 600mm and average annual temperature ranges between 1 °C to 45 °C. As per 2011 census Chandigarh comprises of single district, which is neither hill or tribal. The U T has a population of 1.06 million amounting to 0.09% of India's population. The rural and urban population constitutes 2.75% and 97.25 % respectively. The population density of U T is 9258 persons per sq. km. The 19th livestock census 2012 has reported livestock population of 24197 in Chandigarh.

Recorded Forest Area

Reserved Forest (R F)	31 sq.km
Protected Forest (P F)	0 sq.km
Unclassed forest (UF)	3 sq.km
Total	34 sq.km
Of UT's Geographical area	29.82%
Of country's geographical area	0.004%

Forest Cover within and outside green wash area

Forest Cover within green wash area (area in sq. km)

Very Dense Forest	1.13
Moderately Dense Foret	2.22
Open Forest	1.30
Total	4.65

Forest Cover outside green wash

Very dense Forest	0.23
Moderately dense Forest	11.60
Open Forest	5.08
Total	16.91
Total Forest Cover	21.56
Tree cover	10.0
Total Forest and Tree cover	31.56
Of U T's Geographical Area	27.68%
Of India's forest and Tree Cover	0.004%
Per capita Forest and Tree Cover	.003 ha

State of Forest Report 2017 (FSI)

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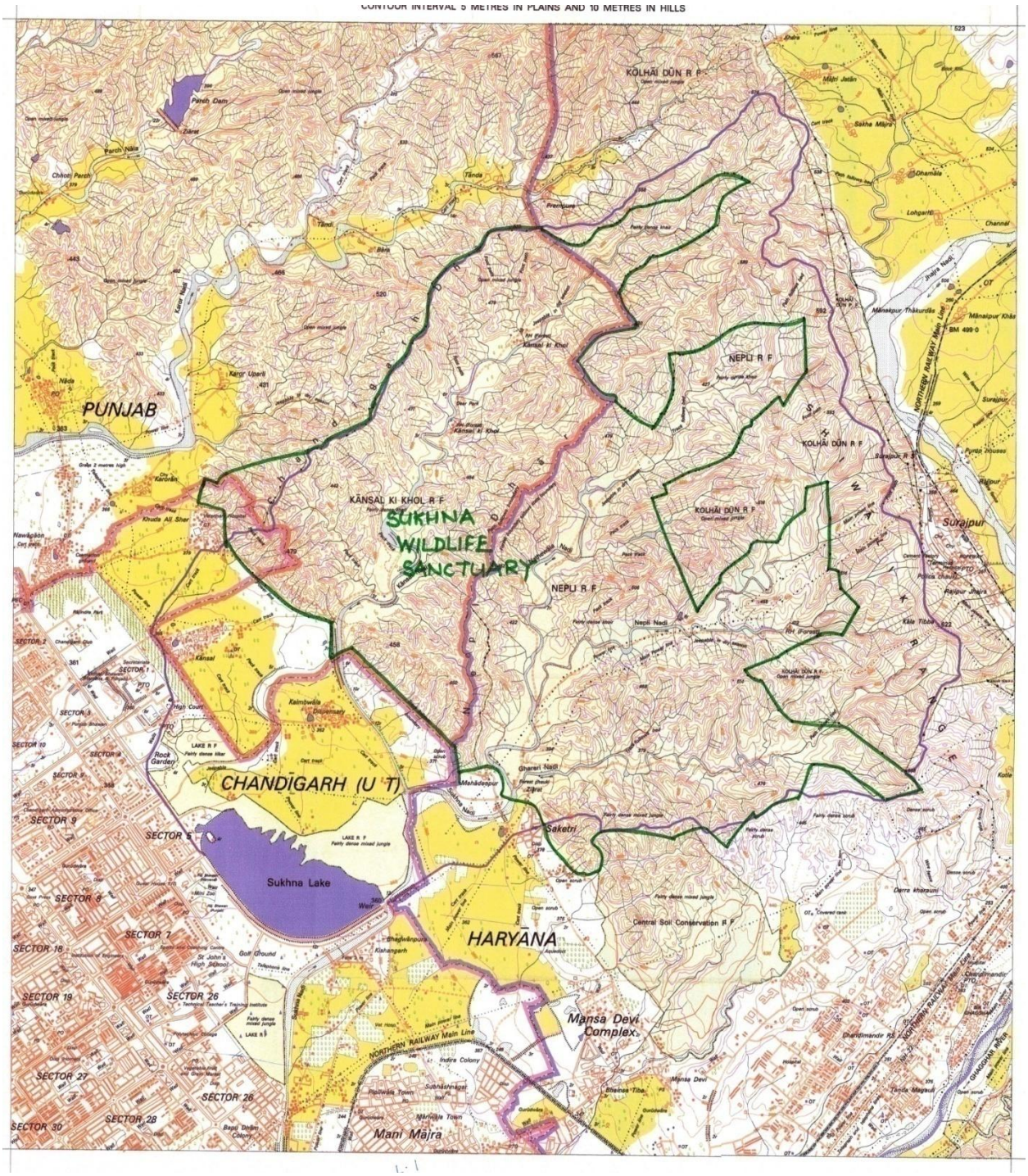
SUKHNA WILDLIFE SANCTUARY



CHAPTER – I

INTRODUCTION TO THE AREA

1.1 Name, Location, Constitution and Extent

1.1.1. Name

Sukhna Wildlife Sanctuary

1.1.2. Location

Sukhna Wildlife Sanctuary is part of the Union Territory of Chandigarh and is located north of suburbs Khuda Ali Sher, Kansal and Kampwala adjoining northern boundries of the city Chandigarh. The sanctuary lies between $30^0$17' N to $30^0$11' N Latitudes and $76^0$16' E to $76^0$29' E Longitudes. The sanctuary covers an area of 25.98 sq. km. Sanctuary is infact catchment of famous Sukhna lake, which is flanking the city's North-eastern edge. This lies in the outer most Shivalik Range and consists typically of conglomerates and loose strata which have been gullied by weathering into semblance of hills and nullahs geologically. Thus, there is an altitudinal variation between 346 m to 620 m from Mean Sea Level (MSL).

The area of Sukhna WLS is therefore, somewhat hilly and is contiguous to Punjab part of Shivalik Range in the North and North-western aspects. It is continued as Haryana Shivaliks in the East, East-southern & partly Southern aspects. City Chandigarh and the Sukhna lake are flanking it on the South-western & partly Southern sides respectively.

The Headquarter of Sukhna WLS is situated in Chandigarh. The Shivalik Hills, in the north-eastern part of the "Inter-State Chandigarh Region" (ISCR), constitutes the "Naturally Hilly Ecosystem" (NHE) and mainly consists of a chain of low lying hills. Since Sukhna WLS falls in these Shivalik Hills, which are ecologically sensitive and geologically unstable, it is highly prone to soil erosion during rains and represents a fragile eco-system.

The sanctuary is under the charge of Deputy Conservator of Forests (Hqrs), Chandigarh. The Chandigarh Forest Department is headed by the Chief Conservator of Forests, who is also the Chief Wild Life Warden (CWLW) Chandigarh and functions under the administrative control of the Secretary, Forest and Wildlife, U.T. Administration, Chandigarh. The Secretary (Home), UT Administration, Chandigarh is the administrative secretary of the department of forest and wildlife.

1.1.3. Extent and constitution of Sukhna WLS:

1) **Reserve forest area** – 7,548.43 acre notified as R.F. area by Secretary, Forest and Environment, Chandigarh Administration vide notification No.18/11/24-H II(4)-98/3442 dated 17.2.98 (Annexure -2)

i)	Sukhna Choe –	866.56 acre
ii)	Lake Area –	260.88 acre
iii)	Hilly Area –	6420.99 acre
	Total :	7548.43 acre or 3054.74 ha or 30.5474 sq km.

2) **Sukhna WLS** – 6,420.99 acre from within the above R.F. area, notified as Sanctuary vide Secretary, Environment and Forest, Chandigarh Administration notification No.694-H II(4)-98/4519 dated 6.3.98 (Annexue-1) . Hilly Area – 6,420.99 acre or 2598.48 hactare

Thus Sukhna WLS came into existence w.e.f. 16.3.98 and is spread over an area of 2598.48 hectares or 25.98 sq km (equal to 6,420.99 acre as per notification) which was carved out from the hilly portion of the notified Reserved Forest Area of Chandigarh Administration. The total area declared as Sanctuary as per notification was 6420.99 acres which is equal to 2598.48 Hectares and so it has been referred as 2600 Hectares instead, in some records, for the sake of convenience.

Sukhna WLS Area = 2600 ha. or 26.0 sq km.

The exact areas declared as Reserved Forests on 17.2.98 including their Khasra numbers is shown in Table .1.1 The actual area comprising of hilly catchment area from these RF areas which was declared as Sukhna WLS on 6.3.98 is shown in Table 1.2

Table 1.1: R.F. Areas Notified as per Section 20 of Indian Forest Act, 1927

Name of Forest Area Reserved	Area (acres)	SN	Name and Khasra No. of Land Reserved	Area (acres)
Sukhna Choe	866.56	1	Raipur Khurd (232)	77.85

		2	Raipur Kalan (371)	1.74
		3	Behlana (231)	53.46
		4	Hallomajra (219)	235.02
		5	DelhariRajputtan (218)	274.17
		6	Dariya (374)	20.14
		7	Manimajra (375)	177.13
		8	Hamiragarh (216)City Area	27.05
Hilly Area	6420.99	9	Suketri (376)Hilly Area	2452.07
		10	Dara Khurani (390)	557.84
		11	Dhamala (122)	198.95
		12	Kuran Wala (105)	461.00
		13	Manak Pur (104)	346.45
		14	Kansal (354)Hilly Area	2296.68
		15	Khuda Alisher (353)	108.00
Lake Area	260.88	16	Between rock garden and lake	122.68
		17	Kaimbwala (355)(Lake area)	72.76
		18	Suketri (376)(Lake area)	65.44
Total	7548.43		Total	7548.43
or 3,054.74 hectares or 30.54 sq km				

Table 1.2: Sanctuary Area Notified Under Clause (b) of Sub-Section (1) of Section 26 – A of Wildlife (Protection) Act, 1972

Name of R.F. Area	**Area (acres)**	**Name and Khasra no. Of Land Reserved**	**Area (acres)**
Hilly Area	6420.99	Suketri (376)Hilly Area	2452.07
		Dara Khurani (390)	557.84
		Dhamala (122)	198.95
		Kuran Wala (105)	461.00
		Manak Pur (104)	346.45
		Kansal (354)Hilly Area	2296.68
		Khuda Alisher (353)	108.00
Total			**6420.99**
or 2598.48 ha or 25.98 sq km			

The Map showing present forest cover in Chandigarh is at Annexure – 3. The Forest Area details have been shown in Table 1.3 below:-

Table 1.3: The Forest Area Details of Chandigarh Administration

S.N	Particulars	Reserved forest area (acres)	Additional* area (acres)	Diverted area (acres)	Total area (acres)	Total area (ha)
1	Hilly Forest	6420.99	30.73	--	6451.72	2610.975

2	Lake R.F.	260.88	69.423	(-) 6.5160	323.787	131.035
3	Sukhna Choe	866.56	111.785	(-) 23.775	954.570	386.309
4	Patiala Ki Rao	56.87	(+) 279.67	--	336.54	136.196
	Total	7605.30	491.608	30.291	8066.617	3264.515

***** Patiala Ki Rao includes shooting range 43.73 acre and P.G.I. area of nearly 292 acres and its legal status is not clearly defined as yet.

The boundary description of Sukhna WLS has not been given in the Sanctuary notification dated 6.3.98. Since it was carved out from the R.F. areas, the boundary description for R.F. in the notification dated 17.2.98 states “as demarcated by boundary pillars”. Therefore, the last Management Plan suggested that proper boundary description of the sanctuary was required to be written. However, this remained to be accomplished during the last Plan period.

The external and internal boundaries, as already defined, have been modified for description purposes and are given as below.

1.2 External Boundaries

The sanctuary is bounded by the hills of Haryana in the EAST and North East and hills of Punjab in the North.The plains of Punjab and Haryana surround the sanctuary in the north West.,south and south west.Pinjor and Mohali forest division lie in the east and south of the wildlife sanctuary respectively while mohali forest division lies to the north and west.

The Sukhna Wildlife Sanctuary was created out from the Reserved Forests of Chandigarh UT. The notification of declaring Sukhna WLS dated 6-3-1998 mentions the names of areas falling in the R.F which has been converted to Sanctuary. The boundaries of RF areas mentioned in the notification states as demarcated in the field. So there is no clear cut boundary description of the WLS although boundary pillars have been erected. Therefore boundary description through pillars with specific marking and number and natural features where necessary needs to be carried out. The boundary pillars should be erected at every 100 metres.

1.3 Internal Boundaries

Internal boundaries of the WLS, though originally demarcated with clear lines and pillars, have not been maintained. Presently internal boundaries comprise of range, block and beat boundaries and the management unit is being considered as beat. However, the compartment remains the basic management unit and hence the compartments with well defined and demarcated boundaries need to be formed.

The internal boundary of the range should be clearly demarcated by natural features on the ground. The block boundary should be demarcated by painting black rings at 2 meter height of 2 inch width on tree trunks falling at the edge of the block boundaries. The beat boundaries and the compartment boundaries can be demarcated by clearing undergrowth inline up to 3 and 2metres width, respectively but retaining the trees. Such internal boundaries by clearing the undergrowth shall also act as fire lines and inspection path respectively. The 2600 hectare of Sukhana WLS is presently divided into 2 ranges, 3 blocks and 12 beats (map 1.2).

1.4 Compartments:

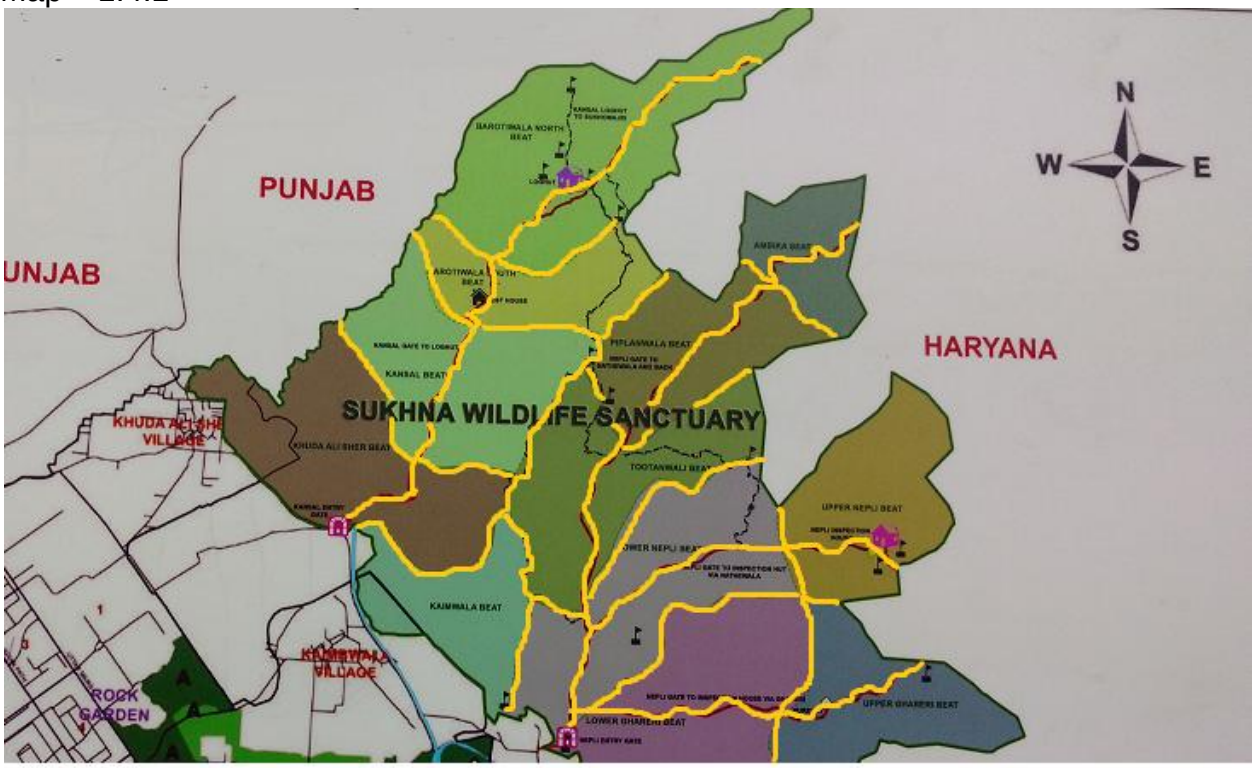
The basic unit of management is a compartment. However, the compartments have not been demarcated in the field probably due to the small size of the sanctuary which is just ~26 sq km. The last Management Plan suggested that the Compartments be demarcated. This remained to be accomplished during the last Management Plan implementation period. This being a wildlife sanctuary, where forest working according to prescription of yields and regulations for rotation of crops are *sensustrictu* not required, but the compartments can be defined along the natural boundaries more for working and reference convenience with respect to the forestry or wildlife operations of manipulation of canopy, firelines, incidences of fire, references wrt small fauna distinctive areas, etc. Accordingly, 12 existing administrative beats have been retained over 24 compartments / sub- compartments. The details of the Beats, Compartments Reference Number allotted, Area of each compartment or sub-compartment are tabulated as below (Table 1.4) and Map at 1.4.1:-

Table 1.4: Details of Compartments Reference Number allotted & Area of each compartment/ sub-compartment

S.No.	Block	Beat	Comptt. / Sub-comptt. Ref No.	Area (in Ha.)
1	Barotiwala	Barotiwala North	1A	216.00
2		Barotiwala North	1B	88.00
3		Barotiwala South	2A	42.94
4		Barotiwala South	2B	97.06
5	Kansal	Kansal	3A	87.86
6		Kansal	3B	127.14
7		Khuda Ali Sher	4A	219.78
8		Khuda Ali Sher	4B	100.22
9		Kaimbwala	5	154.00
10	Nathewala	Ambika	6A	77.97
11		Ambika	6B	52.03
12		Piplanwali	7A	65.97
13		Piplanwali	7B	44.03
14		Tootanwali	8A	137.20
15		Tootanwali	8B	120.80
16	Nepli	Lower Nepli	9A	119.46
17		Lower Nepli	9B	107.03
18		Lower Nepli	9C	53.51
19		Upper Nepli	10A	214.58
20		Upper Nepli	10B	50.40
21	Ghareri	Lower Ghareri	11A	129.20
22		Lower Ghareri	11B	105.80
23		Upper ghareri	12A	64.00
24		Upper ghareri	12B	136.00

(Grid method has been used to segregate areas of Compartments / sub-compartments)

Map – 1.4.1



Compartments in Sukhna WLS

The Compartment History file Performae have been prepared (Annexure 15). Data may be incorporated by respective field staff and updated annually.

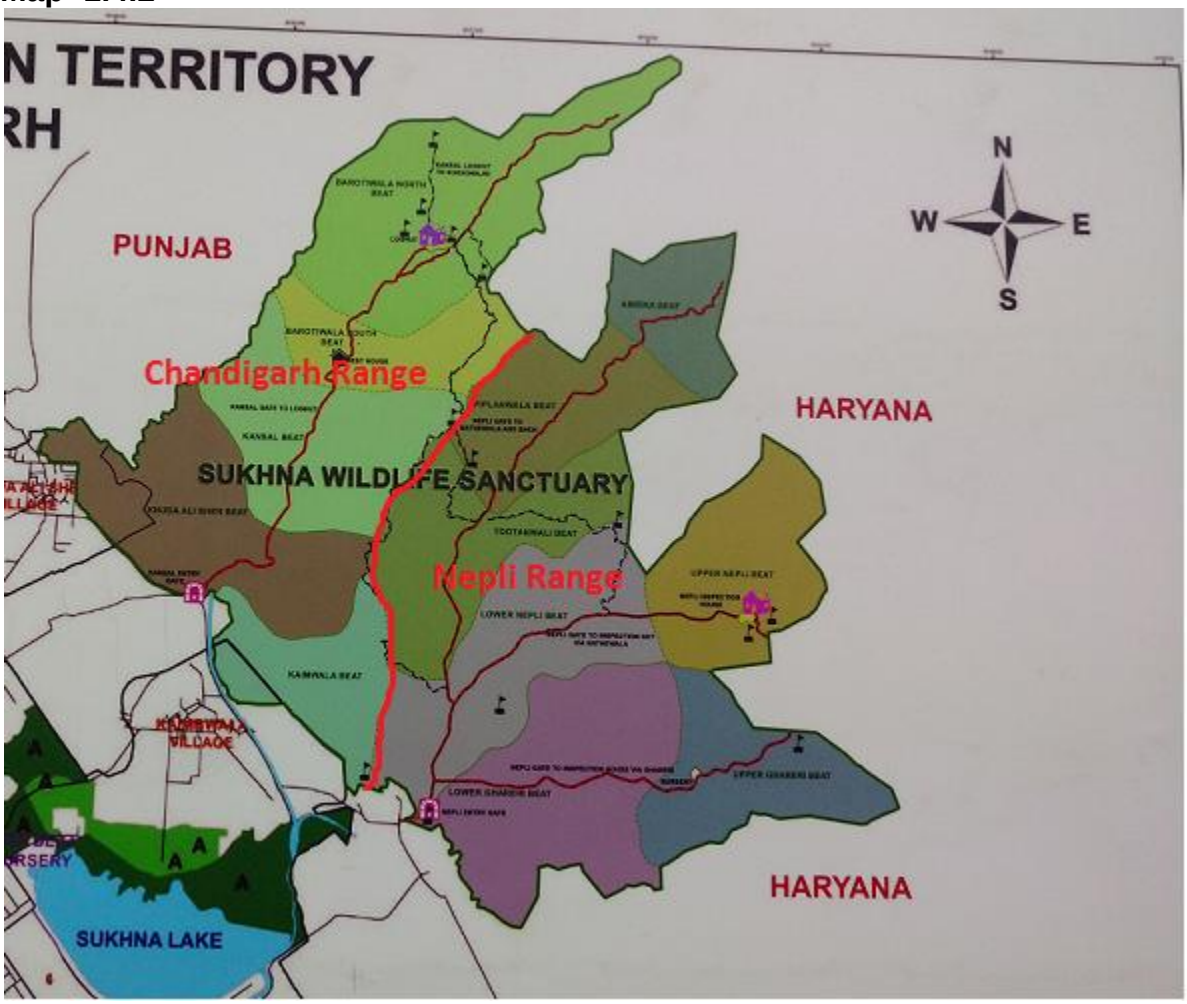
The 2,600 ha area of Sukhna WLS is presently divided into 2 Ranges, 5 Blocks and 12 Beats. The Range wise area detail is shown in Table 1.5. The map showing the details of Ranges, Blocks and Beats is at Map 1.4.2.

Table 1.5: The Range wise Area details of Sukhna WLS

S.No.	Range		Block		Beat	
	Name	Area (ha)	Name	Area (ha)	Name	Area (ha)
1.	Nepli	1,477.98	Nepli	544.98	Upper Nepli	264.98
					Lower Nepli	280
			Ghareri	435	Upper Ghareri	200
					Lower Ghareri	235
			Nathewala	498	Ambika	130
					Piplanwali	210
					Tootanwali	258

2.	Chandigarh	1133	Kansal	689	Kansal	215
					Khuda Ali Sher	320
					Kaimbwala	154
			Barotiwala	444	Barotiwala (N)	304
					Barotiwala (S)	140
	Total	2610.98		2610.98		
Or say 2600 ha.						

Map- 1.4.2



1.5 Genesis of Sukhna WLS

Chandigarh is a modern city housing the capital of the two states of Punjab and Haryana and the seat of Union Territory Administration. It was designed by the famous French Architect Le Carbusier and is famous for its unique architecture and well planned landscaping.

Bounded on 2 sides by two seasonal rivulets, the northern edge of the city is the capital complex against the panoramic backdrop of Shivalik Hills. Presently the city

proudly boasts of a harmonious blend of buildings and trees, well-wooded forests along the periphery of the city, green belts running across the length and breadth of city and a Sukhna Wild Life Sanctuary on its periphery which augment the ecological, environmental and aesthetic richness of the city.

To bring delight to the Chandigarh denizens and to further enhance the aesthetic appeal of the city, a man-made lake was conceptualized as a major tourist attraction. Thus Sukhna Lake was constructed in 1958 across Sukhna Choe, a seasonal stream flowing down the Shivalik hills, below the confluence of Nepli and Kansalchoe with an earthen dam of 3 km length and 14 m height. The total catchment area of this lake is 4,207 hectare of which the hilly catchment area is 3,312 ha and the catchment area under agricultural use including habitations is 895 ha. The Table 1.6 shows the catchment area details along with the respective jurisdictions in which they fall:

Table1.6: Catchment Area details of Sukhna Lake

S. N	Type of Catchment Area	Punjab (ha)	Haryana (ha)	Chandigarh (ha)	Total (ha)
1	Hilly Catchment Area	--	770	2,542	3,312
2	Under Agricultural Use	277	252	366	895
3	Total	277	1,022	2,908	4,207

The Shivalik hills are ecologically sensitive and geographically unstable and thus highly prone to soil erosion during rains. Therefore, after initial years of construction of lake, the rate of siltation was very high due to the soil erosion by surface run-off from its catchment area. During 1960-61, silt survey of the lake was carried out and found that on an average the lake was silting up at the rate of 500 acres feet per annum. Poor vegetation and excessive biotic interference in the catchment area further accelerated soil erosion and huge quantity of silt slipped into the lake between 1958 to 1962. In fact the original storage capacity of the lake was 8,710 acre feet in 1958 which was found to be reduced to 2,970 acre feet (34% of original) in 1988. Thus in 30 years, 66% of the original water holding capacity of the lake lost due to siltation (Anon, 2004a). The Table 1.7 shows other parameters which also got drastically altered due to this siltation.

Table 1.7: Change in siltation parameters of Sukhna Lake

S. N.	**Siltation Parameters**	**1958**	**1988**	**Loss (%)**
1	Storage capacity (acre feet)	8,710	2,970	66
2	Average depth (feet)	15.4	8.6	44
3	Surface area of lake (acres)	565	332.56	41

This alarming rate of soil erosion and fast siltation of the Lake forced the erstwhile Punjab Government to take various steps to reduce the silt inflow to the lake from the catchment area. One such measure was to acquire the hilly catchment area of the lake, measuring 2,542 ha, during 1962-63 itself, in order to carry out intensive soil conservation works on watershed basis as well as afforestation works. This acquired area now vests with the Union as per Section 48(5) of the Punjab Reorganisation Act, 1966.

The hilly catchment area of Sukhna lake measuring 2,542 ha (25.42 sq km) acquired for soil conservation works has now been declared as Sukhna Wild Life Sanctuary. The restoration initiatives like silt retention dams, afforestation, gully plugging, etc. has considerably reduced the silt inflow to the lake presently.

1.6. Approach and access

The headquarter of Sukhna WLS is Chandigarh which is approachable by road, rail and air. Chandigarh is reachable by road from Delhi (250 km); Shimla in Himachal Pradesh (110 km); Ambala in Haryana (55 km); Ludhiana in Punjab (100 Km); or from Dehradun in Uttaranchal (180 km). The nearest broad gauge railway station at Chandigarh is hardly 4 Km from the sanctuary.

There are 2 entry gates to Sukhna WLS. They are Kansal Gate and Nepli Gate. The route to Kansal gate is via village Khuda Alisher or through village Kaimbwala of U.T. Chandigarh, at a distance of 3 Km from Chandigarh, either way. The route to Nepli gate is via village Suketri of Haryana which is at a distance of about 3 Km from Chandigarh. The sanctuary has a road network inside. It is also possible to enter from one gate and come out from the other through an eight km nature trail after completing the visit to the sanctuary, **but not by driving.**

The nearest airport is Chandigarh and there are regular flights from Delhi, Bombay & other major destinations in India. Now the airport has been declared International airport with the start of flights for Dubai as well as Bangkok (Thailand). Delhi, the national capital of the country, is a mere 250 km from Chandigarh by road and takes 4 hours of rational driving on a well maintained stretch of NH – 1 which is more convenient than traveling by air.

1.7. Statement of significance

Sukhna Wild Life Sanctuary represents Champion & Seth's Type 5B/C1 Northern Tropical Dry Mixed Deciduous Forests & 5/DS1 Dry Deciduous Scrub over Shivalik Hills and its adjoining alluvial plains, which form an ecologically fragile ecosystem, yet it is rich in terms of diversity of its flora and fauna. This being the only sanctuary in the

vicinity of Chandigarh, which in geological terms hoards immense value as the area was once inhabited by mammoth elephants, gigantic turtles, members of Dinosaurus class & extinct gymnospermous tree stems of late Pliocene now calcified; as is evident from the **neighboring area excavations** in **village Masol& village Karoran**. The fossils collected can be seen in Govt. Museum & Art Gallery, sector 10, Chandigarh, Museum at Deptt.of Geology of Panjab University; or in the Archeology Museum & Fossil Park at Kala Amb (HP). Some fossils have also been collected by Punjab FD in the neighbouring area of Siswan. The biological significance of current vegetation has been delineated as below:-

1) Sukhna WLS is situated in Shivalik Hills which comprises *Naturally Hilly Ecosystem* and represents a very fragile ecosystem being located on conglomerates and thereby very loose soil devoid of humous and very high run off rate of soil. It falls in the **Western Himalayas** and **Lower Gangetic Plains bio-geographical zones**; contiguous to the forests of Haryana and Punjab in the region.

2) The Sanctuary supports a significant population of Sambhar, Nilgai, Jungle Cat, Jackals, stray dogs, , Wild Boar, Porcupine, Mongoose, small Mongoose, Indian Palm Civet, Pangolin, Common Langur, Rhesus Monkey, Peacock, Grey Partridge, Kingfisher, Parrots, Doves, Jacanas besides sizeable population of snakes and butterflies. The seasonal choes are also believed to harbor small population of fish, frog & toads.

3) The area represents typical **Northern dry mixed deciduous forest** and **dry deciduousscrub** (Champion & Seth's Classification - **Type 5B/C1 & 5/DS1** respectively) and supports a rich bio-diversity comprising of large variety of trees, shrubs and herbs like Khair, Semul, Kikar, Neem, Shishum, Dhak, Lasura, Kendu, Ber, Karipatta, Nirgundi, Karaunda, Vasaka, Moonj, Rati etc. Bamboo also exists in some patches. The area in river beds is covered by grasses such as *Saccharum munja, Eulaliopsisbinnata* and elsewhere including ridges by *Apludamutica, Heteropogoncontortus, Cymbopogon parkeri*, etc.

4) Sukhna WLS area is the catchment for 4 major seasonal streams (Choe) viz. Kansal, Nathewala, Nepli and Ghareri Choe(s). The catchment area supports the continuous water supply regime to Sukhna lake at Chandigarh, which is a major local & tourist attraction.

5) Sukhna WLS acts as a 'Green Lung' to the heavily congested and over populated capital of 2 states of Haryana and Punjab and the seat of U.T. Administration.

6) Sukhna WLS provides opportunity for environmental education to the young minds and nature interpretation to the nature lovers.

7) Sukhna Lake attracts huge flock of migratory birds each year; the vicinity of Wildlife Sanctuary provides breeding ground to some.

8) Sukhna WLS can serve as a good example of ideally managed Wild Life Sanctuary and provide a nature laboratory to researchers for studying population dynamics of flora as well as fauna, environmental economics, habitat management, etc.

CHAPTER 2

HISTORY OF MANAGEMENT PLAN AND PRESENT PRACTICES

2.1. General

Union Territory of Chandigarh, houses capital of the states of Punjab and Haryana. It is one of the first planned city of India and was designed by the famous French Architect Le Carbusier.

To provide water supply, as also a tourist attraction, a man-made lake was conceptualized. Thus SukhnaLake was constructed in 1958 across Sukhna Choe, a seasonal stream flowing down the Shivalik hills, below the confluence of Nepli and Kansalchoe with an earthen dam of 3 km length and 14 m height. The total catchment area of this lake is 4,207 hectare of which the hilly catchment area is 3,312 ha and the catchment area under agricultural use including habitations is 895 ha.

The Shivalik hills are ecologically sensitive and geographically unstable and thus highly prone to soil erosion during rains. Therefore, after initial years of construction of lake, the rate of siltation was very high due to this soil erosion by surface run-off from its catchment area. During 1960-61, silt survey of the lake was carried out and found that on an average the lake was silting up at the rate of 500 acres feet per annum. The original storage capacity of the lake was 8,710 acre feet in 1958 which was found to be reduced to 2,970 acre feet (34% of original) in 1988. Thus in 30 years, 66% of the original water holding capacity of the Lake was lost due to siltation.

This alarming rate of soil erosion and fast siltation of the lake forced the erstwhile Punjab Government to take various steps to reduce the silt inflow to the Lake from the catchment area. The total catchment area of Sukhna lake was 4,207 hectares. Out of this, 3,312 ha constituted Shivalik hills while the remaining 895 ha fall in 3 villages of Kaimbwala (U.T. Chandigarh); Kansal (Punjab) and Suketri (Haryana). The present land use pattern of the area is shown in Table 2.1below. The Punjab government acquired the hilly catchment area of the lake, measuring 2,542 ha, during 1962-63, to put the area under permanent vegetative cover and to carry out intensive soil conservation works on watershed basis. This acquired area now vests with the Union as per Section 48(5) of the Punjab Reorganisation Act, 1966

Table 2.1: Catchment Area details of Sukhna Lake

SN	Type of Land	Punjab (ha)	Haryana (ha)	Chandigarh (ha)	Total Catchment Area (Ha)

1	Hilly catchment area	--	770	2,542	3,312
2	Under agricultural use	277	252	366	895
	Total	**277**	**1022**	**2,908**	**4,207**

Thereafter the Department of Forest and Wildlife, Chandigarh Administration issued a preliminary notification expressing its intent to declare the 7,548.43 acres of land as ReservedForest on 9.5.91. The entire area of 7,548.43 acres was finally declared as R.F. by Secretary, Forest and Environment, Chandigarh Administration on 17.2.98 and included the following areas (Annexure -2).

(i) Sukhna Choe – 866.56 acre
(ii) Lake area – 260.88 acre
(iii) Hilly area – 6420.99 acre
Total: 7,548.43 acre or
3054.74 ha or
30.5474 sq km.

However the hilly catchment area was found to be an area of adequate ecological, faunal, floral, geomorphological, natural and zoological significance. Therefore, the area of 6,420.99 acre consisting of the hilly catchment area of SukhnaLake was declared as Sukhna WLS on 6.3.98 for the purpose of protecting, propagating and developing wildlife and its environment.

Sukhna WLS – 6,420.99 acre from within the above R.F. area, notified as Sanctuary vide Secretary, Environment and Forest, Chandigarh Administration notification No.694-H II(4)-98/4519 dated 6.3.98 (Annexure -1).

i) Hilly area – 6420.99 acre
or 2598.48 ha
or 25.98 sq km

Thus Sukhna WLS came into existence from 6.3.98. The restoration initiatives like silt retention dams, afforestation, gully plugging etc. has considerably reduced the silt inflow to the lake presently. It is also the abode of myriad flora and provide ideal habitat for a wide variety of fauna. It is also vitally important for preservation of green lungs of Chandigarh city.

2.2. Timber operations including bamboo and firewood harvest

2.2.1. Silvicultural system and tending operations

No felling has been done previously in sanctuary area as it is a protected area. However, eradication of lantana weed has been carried out to supplement the

regeneration and to protect the young saplings and trees from being suppressed by lantana. Even dry and uprooted trees have been left in the forest.

A three-pronged strategy was taken up by the Forest Department of Chandigarh for physical removal/ suppression of lantana weed *(Anon 2005a).*

(i) Removal of the cause of weed infestation: - Heavy forest working like thinning, planting or clear cutting is almost nil and no grazing of domestic livestock is allowed. Weeds are removed before fruiting and seeding stage so that seed dispersal does not take place.

(ii) Physical removal of lantana:- The work of physical removal of lantana started in 2001-02 and lantana has already been removed from 1930 hectare of forests in the sanctuary upto 2005-06. Manual uprooting was also undertaken in isolated patches of relatively smaller area (5 – 10 Ha). Eradication of lantana has been envisaged in a phased manner to avoid loss to wildlife habitat. The management proposes to free the entire sanctuary area from lantana by March, 2007.

(iii) Encouraging natural regeneration and afforestation of non weed indigenous species:- While removing lantana physically, care was taken to retain indigenous species of herbs, shrubs and trees. These plants acted as seed source for regeneration which speeded up the process of natural succession by diverse flora. To supplement natural regeneration, planting of *Dendrocalamusstrictus*(bamboo), *Holoptelia integrifolia* (papri), *Azadirachta indica* (Neem) and *Leucaena leucocephala*etc. were carried out in patches vacated by lantana.

About 20% lantana reappeared after first year of removal which necessitated successive removal in second year also. But in the third year resurfacing of weed was almost negligible as the forest floor was already covered by natural regeneration. Now the natural regeneration of indigenous species like *Adhatodavasica*(Vansa), *MurayaKoenigii (*Kari patta*), Butea monosperma*(Dhak), *Tinospora cordifolia* (giloe), *Abrusprecatorius*(Ratti) etc. have covered the land vacated by the removal of lantana and is preventing further infestation by the weed. To stop reappearance of lantana along choe banks, *Arundo-donex*(Nada) was planted which has now successfully out-competed lantana after just first removal.

2.2.2 Even-aged and Uneven-aged Forests

The crop is almost even-aged having mixed species of Eucalyptus, Khair, Shisham, *Prosopis* etc. Later on Amla, Papdi, bamboo etc. were planted. In natural forest, *Anogeissus latifolia* is found profusely all over the sanctuary. However, no Eucalyptus has been planted in the last 20 years or so.

2.2.3 Bamboo working

Bamboo plantation is negligible in the sanctuary area. *Dendrocalamusstrictus* is planted near the forest rest house and along the roads.

2.2.4 Firewood harvest and collection

Firewood harvesting and collection is totally banned in the sanctuary as it is a protected area. The sanctuary boundary near local villages has been fenced by using wire mesh fencing so the villagers cannot enter inside the sanctuary to collect any firewood. The labor and staff working inside the sanctuary area occasionally collects firewood for their personal use.

2.3 Non wood forest produce (NWFP) collection

No collection of anynon wood forest produce is allowed inside the sanctuary area being protected forest.

2.4Leases

No lease is sanctioned in the sanctuary area.

2.5 Legal status

The forest of Sukhna WLS was taken over by the forest department in the year 1966 after the formation of Chandigarh under UnionTerritory and prior to that these used to be villages. The final notification declaring the area as R.F. was issued vide Chandigarh Administration's notification no.18/11/24-HII(4)-98 dated 17.2.1998 for an area of 7548.43 acre. Sukhna WLS was declared vide Notification No.694-HII(4)-98/4519 dated 6.3.1998 covering an area of 6420.99 acre under clause (b) of Sub-Section (1) of Section 26 – A of the Wildlife (Protection) Act, 1972. Presently, there is no confusion as to its legal status.

2.6 Past System of Management in the Sanctuary

The forest of Sukhna WLS used to be managed under a system of selection felling. Only dry, uprooted and fallen trees were removed from the forest. However, now after imposition of ban by the Hon'ble Supreme Court of India in the year 2000 for removal of even dry, uprooted and fallen trees & grasses from the Protected Areas, nothing is removed from the sanctuary. The crop was allowed to regenerate naturally, assisted by artificial regeneration. Plantations of Eucalyptus, Amla, Papri, Su-babul etc have been raised. The plantation work is carried out by contract laborers. The works were carried out on the basis of Annual Plan of Operations.

2.6.1. Eco-Restoration Works

Following activities have been carried out

- Planting of bamboo, fruit and fodder trees
- Maintenance of old plantations
- Eradication of *Lantana camera*
- Raising of indigenous fodder plantations and its maintenance
- Maintenance of glades and saltlicks
- Maintenance of water bodies
- Soil conservation and choe training works
- Improvement of fire lines
- Habitat restoration through decongestion of plantation
- Raising of miscellaneous plantations in the degraded areas.

2.6.2 Protection works

The hilly catchment area of SukhnaLake measuring 2542 Ha (25.42 Sq Km) acquired for soil conservation works was declared as Sukhna Wild Life Sanctuary. The restoration initiatives like silt retention dams, Afforestation, gully plugging etc. have considerably reduced the silt inflow to the Lake presently. A two pronged strategy was adopted to conserve the soil and moisture in the area.

a) Vegetative methods: Massive afforestation including direct seed sowing in contour trenches had been carried out on hill slopes on sustained basis to conserve soil. Soil conserving species like *Arundo-donex* was planted along choe banks to train the choe and to stabilize the choe bank. Special emphasis was laid to plant indigenous species of trees, shrubs and grasses.

b) Engineering methods: 175 silt retention dams, , spurs, revetments and brushwood structures had been constructed to conserve the soil and to retain the silt in the water-bodies created behind silt retention dams. 150 silt retention dams have been fully silted up. These water bodies had been desilted on regular basis to revive its silt retention capacity. The silt taken out from silted up water bodies has been spread at appropriate locations in the sanctuary itself and soil conserving grasses, herbs and shrubs were planted over it before onset of Monsoon every year.

The aforementioned soil and moisture conservation measures have led to a remarkable improvement in the underground water regime. Due to series of water-bodies in these seasonal nallahs (choes), there is continuous flow of seepage water

throughout the year in few nallahs. The availability of moisture is responsible for good plantations in the sanctuary.

The following activities were also carried out for protection works:

- Construction and improvement of roads, patrolling path and fire lines
- Construction of watch towers and maintenance
- Construction of culverts and check dams
- Erection of wire mash fencing as a barrier from straying of wild animals
- Maintenance of communication sets/ mobile phones.
- Maintenance of two rescue centers for care of rescued and captured animals

2.6.3. Tourism

Wildlife tourism is restricted to only permit holders. One can visit the sanctuary from sunrise to sunset. No visitor is allowed to stay inside the sanctuary during night. The sanctuary remains open on Saturday and Sundays also.

2.6.4 Research, Monitoring and Training

At present the research in the sanctuary is limited to inventorisation of the flora and fauna found inside Sukhna WLS. The species of birds, butterflies and mammals have been recorded for both winter and summer survey by the scientists from FRI, Dehradun. The qualitative analysis of flora of Sukhna WLS has been done during this study. Three sediment monitoring stations also exist near KansalKhol and Suketri.

2.6.4.1Training

The field staff mainly comprising of forest guards and foresters are formally trained in forestry. Wildlife trainings of short durations also need to be imparted for wild animal estimates, animal health, habitat manipulation etc.

2.7 Present wildlife conservation strategies and their evaluation

2.7.1 Plantations: - Large areas inside Sukhna WLS have been taken up for plantation of indigenous species. Massive afforestation including direct seed sowing in contour trenches has been carried out on hill slopes on sustained basis. The plantation work is carried out on contract basis and there are no permanent laborers in the department. Details are as given below in Table 2.2:

Table 2.2: Details of plantation raised by the department.

Year	**No. of plants Planted** Neem/Jungle Jalebi/ Khair/ Shisham/ Pipal/Mango/ Guava/ Kikar /Kachnar/ Bamboo/ Amaltas/ Semul	**Shrub Cuttings** Arundo donax/ Ipomea/ Kaner	**Patch Sowing (Seeds) (Lakhs.)** Neem/ Jungle Jalebi/ Khair/ Shisham/ Jamun/ Pipal/ Mango/ Guava
1989 - 90	1,45,000		--
1990 - 91	2,07,013		--
1991 - 92	2,28,900		--
1992 - 93	3,19,907		--
1993 - 94	2,50,000		--
1994 - 95	2,75,150		--
1995 - 96	70,000		--
1996 - 97	50,000		--
1997 - 98	40,000		2.0
1998 - 99	59,030		2.0
1999- 2000	49,970		2.0
2000 - 01	49,600		2.0
2001 - 02	41,100		2.0
2002 - 03	12,000		3.60
2003 - 04	21,170		4.0
2004 - 05	28,790		4.0
2005 - 06	23,800		4.0
2006 - 07	20,000		4.0
2008-09	90,000	90,000	6.0
2009-10	19000	1,00,000	1.5
20010-11	55000	1,00,000	3.0
2011-12	68000	1,00,000	3.0
2012-13	40000	1,00,000	3.0
2013-14	30000	1,00,000	3.0
2014-15	30900	1,00,000	3.0
2015-16	20000	1,00,000	3.0
2016-17	23000	1,00,000	3.0
2017-18	56000	225000	3.0

(Note: Source office of DCF/RO Chandigarh)

2.7.1.1. Vegetative measures of soil conservation are in the form of planting live hedges of *Arundo-donex*, *Ipomoea* and Kana along choe banks, bhabbar grass plantation on exposed slopes and brushwood structures on steep slopes.

2.7.1.2. Massive plantations of endemic species like Khair, Kikar, Neem, Peepal, Papri, Karonda, Jungle Jalebi, Jamun, Gullar, Kejri, Shishum etc. in lower hills have been raised.

2.7.1.3. Contour trenching and direct seed sowing of seeds of Jungle jalebi, Kikar, Khair, Neem etc. in higher reaches of the hills has been done.

This way the erosion prone areas have been effectively treated and silt inflow to the lake has reduced considerably.

2.7.2 Lantana Removal

More than 50% of the forest area in Sukhna Wildlife Sanctuary was highly infested with lantana weed. It is a very hardy weed and grows fast in comparison to the indigenous plant species in wildlife sanctuary and other forest area. Wild growth of lantana had choked the natural regeneration in the forests It also eliminated all kind of undergrowth and was damaging the trees as well. Therefore Lantana was posing a serious threat to the 'Biodiversity' of our forests.

Considering the adverse impact of 'Lantana' on the ecology of Sukhna Wildlife Sanctuary and other forest area, the Forest Department of Chandigarh Administration chalked out a 5 year schedule in March, 2001 to make the sanctuary and other forests of U.T. Chandigarh free from 'Lantana'. About 80% of Wildlife Sanctuary and other forest area have already been freed from lantana. By March, 2007, the entire forest area including Wildlife Sanctuary of U.T. is expected to be free from lantana. The department has ensured that lantana does not appear again on the site already cleared of it. This has been a very successful project and good results are visible on the ground. The regeneration of indigenous species like Bansa, Ratti, Karipatta, Giloe, Karaunda and other tree species is appreciable. For the last two years, there has been good flowering and fruiting in trees like Ber, Dhak (Palas), Karaunda etc. Good grazing grounds for wildlife have also been developed after removal of lantana and thus, there is overall improvement in the wildlife habitat of the sanctuary. Lantana removal has thus proved to be a great boon to the restoration of floral and faunal biodiversity of Sukhna Wildlife Sanctuary. 'Forest fire' threat to the forests has also been reduced due to removal of lantana. The year wise details of the area from which lantana has been removed is mentioned in Table 9 below**:**

Table 2.3: Removal of lantana from Sukhna WLS (Hilly catchment area)

Range	Total Area	Lantana removed Upto 31.3.2006	Lantana to be removed in 2006-07
Chandigarh	1133 ha	878 ha	255 ha
Nepli	1478 ha	1052 ha	426 ha
	Total	1930 ha	681 ha

Thus Lantana removal has helped in restoration of floral and faunal diversity besides reducing fire threat in the area.

2.7.3. Water Bodies/ Silt Retention Dams

SukhnaLake is a man made lake conceptualized as a major tourist attraction and to enhance the aesthetic appeal of Chandigarh city. It was constructed in 1958 across Sukhna Choe, a seasonal stream flowing down the Shivalik hills, below the confluence of Nepli and Kansalchoe with an earthen dam of 3 Km. length and 14 Mtr. height. The total catchment area of this Lake is 4207 Hectare of which the hilly catchment area is 3312 Ha and the catchment area under agricultural use including habitations is 895 Ha. Till date 175 silt retention dams have been constructed out of which 150 dams have silted/ partially silted while 25 dams are having perennial water bodies/ water holes/ reservoirs behind them. These water bodies act as good water holes to the wildlife.

As a result of sustained efforts by the Chandigarh Administration, soil erosion in the Chandigarh area has considerably controlled. This has been mainly possible due to the soil conservation measures and afforestation works. The following Tables 2.4 & 2.5 is indicative of the masonry/ earthen structures, which have been provided upto March 2006 in the catchment area falling under the jurisdiction of the Union Territory of Chandigarh.

Table 2.4: Detail of works carried out in U.T. Sukhna Catchment (Hilly) Area upto 31.3.2017.

S.N.	Description	Unit	Total
1	Construction of Silt retention dam	Nos.	175
2	Repair, raising & strengthening of dams	Nos.	39
3	Raising of waterholes	Nos.	51
4	De-siltation of dams	Nos.	41
5	Construction of Check dams (small 3-5 m. ht)	Nos.	59

Table 2.5: Detail of Silt Retention Dams as on 31.3.2017.

S.N.	Name of Rivulet	No. of Dams	Silted
1	Kansalchoe	63	55

2	Nathewalachoe	42	34
3	Neplichoe	28	24
4	Gharerichoe	42	37
	Total	175	150

2.7.3.1. To minimize soil erosion, retention of silt and train the course of streams a number of masonry spurs, revetments, grade stabilizers, retaining walls, crate wire structures and small loose stone structures have been constructed at selected locations.

The aforementioned soil and moisture conservation measures have led to a remarkable improvement in the underground water regime and good vegetation cover in the sanctuary.

2.7.4. WatchTowers

Traditional watchtowers and signages camouflaged in forests are constructed along the nature trails, which add beauty to the trails. A breathtaking view of Shivalik hills is afforded from the watchtowers. These watchtowers also help in detecting/spotting forest fire, illegal felling and poaching.

There are presently 12 watch towers situated in both the ranges. They may be assigned names or locations identified by number for easy identification since they can also serve as fire watch towers.

2.7.5. Rest Houses

There are 3 Rest houses inside Sukhna WLS. They act as inspection bungalow as well as tourist rest houses. Provision of Boating is also kept in water bodies near ‘KansalLoghut’ and ‘Nepli Inspection hut’. Their locations are also shown in the map at Annexure -18d. They are:

i. Kansal Log Hut
ii. Kansal Rest House
iii. Nepli Rest House

2.7.6. Nature Trails

With a view to promote Eco-tourism and to educate and create awareness among masses about our rich floral and faunal heritage, the Department of Forests and Wildlife, Chandigarh Administration has created 'Nature Trails' throughout the length and breadth of the sanctuary. These Nature trails are passing through the woods, hill-slopes and water bodies and the gradient is varying from gentle to steep. While trekking through different kind of trees, shrubs, herbs, grasses and climbers on these Nature trails, we get close interaction with variety of Mammals, birds, reptiles, butterflies and insects. There are eight such nature trails of 2½ to 8 km in length. They are:

i. Nepli Inspection Hut to Kansal Log Hut 8 km
ii. Nepli gate to Nepli Inspection hut via Ghareri 5 km
iii. Nepli gate to Nathewala and back 6 km
iv. Nepli gate to Nepli Inspection hut via Nathewala 6 km
v. KansalLoghut to Nepli gate 6½ km
vi. KansalLoghut to Sukhomajri 5 km
vii. KansalLoghut to KansalLoghut (towards Bhagwanpura) 5 km
viii. KansalLoghut to KansalLoghut (towards Nepli) 2½ km

2.8. Communication

The details under various categories are mentioned below:

2.8.1 Road Communication

S.N.	Category	Range	Surface	Name or Number	Length (Km)	Cross drainage Works/ bridges
1.	Forest road	Kansal	Earth	1	6	Causeway
2.	-do-	Nepli	-do-	3	6+4+4	Masonry

2.8.2 Vehicle Communication

S.N.	Kind of Vehicle	Number	Hqtr	Use
1	Jeep (Qualis)	1	Chandigarh	Management
2	Utility	1	Chandigarh	Patrolling
3	M/Cycle	6	Chandigarh	Patrolling
4	Boat (paddle)	2	Kansal&Nepli	Tourism

2.8.3 Mobile Communication

S.N.	Range	Facility	Location	Number	Remarks
1	Kansal	Mobile	Chandigarh	7	Mobile sets purchased
2	Nepli	-do-	-do-	8	Charges reimbursed
3	DCF	Telephone	-do-	3	Functional

2.9 Securing Boundaries

S.N.	Category of Construction	Range	Location	Length (km)	Numbers	Specification
1	Chain link Fence	Kansal/ Nepli	Lower Periphery	8.2	2,734 (angle iron at 3 mtr. spacing	Chain Link (2.4 mtr height)
2	Enclosures	Kansal/ Nepli	Kansal/ Nepli		1 1	Chain Link (2.4 mtr height)

2.10. Administrative Set Up

The overall head of Chandigarh Forest Department including Sukhna WLS is now the Chief Conservator of Forests, Chandigarh with headquarters at Chandigarh who is also the Chief Wild Life Warden. Earlier this set up was headed by the DCF. The 2,600 ha area of Sukhna WLS is presently divided into 2 Ranges, 5 Blocks and 12 Beats. The sanctioned strength of staff under the division is shown below in Table 2.6.

TABLE 2.6: Sanctioned Staff Strength

SN	Category of Post	Sanctioned Strength	Status		Scale of Pay
			Existing	Vacant	
1	**2**	**3**	**4**	**5**	**6**
1	CCF	1	1	--	Level 14
2	CF	1	1		Level 13 A
3	DCF(Hq) & BG& NR	2	1	1	Level 12
4	SDSCO	2	-	02	10300-34800/ 5400 GP
5	RO/ FR	2	1	1	10300-34800/ 4800 GP
6	Draftsman	1	1	-	10300-34800/ 4600 GP
4	Dy.FR	1	1	--	10300-34800/ 4600 GP
5	Forester	12	7	5	10300-34800/ 4400 GP
6	Forest Guard	15	10	5	10300-34800/ 3200 GP
7	O/Supdt.	1	-	1	10300-34800/ 4800 GP
8	Accountant	1	-	1	10300-34800/ 4400 GP
9	Junior Asstt.	1	1	--	10300-34800/ 3600 GP
10	Clerk	3	3	--	10300-34800/ 3200 GP
12	Driver	2	1	1	5910-20200/ 2400 GP
13	Mali	2	2	--	4900- 10680/ 1650 GP
14	Chowkidar	1	1	--	4900- 10680/ 1650 GP
15	Peon	4	4	--	4900- 10680/ 1650 GP
	Total	52	35	17	

Source: UT Forest Department

CHAPTER 3

Profile of Sukhna Wildlife Sanctuary

Sukhna wildlife sanctuary is located in the Sivalik foothills of Chandigarh city near Sukhna lake and is spread over an area of 2600 hectares. The Shivalik region along with the adjoining plains have come under heavy thrust of human pressure due to commercial, industrial and economic activities.

3.1 Geology,Rock and Soil

The Shivalik Hills is a mountain range of outer Himalayas, extending over a length of 2,400 km and a width of 10 to 50 km, their average elevation is 1500 to 2000 m. It represents the most fragile ecosystem of Himalayan mountainous region. Most of the hills are represented by eroded ravines and barren slopes leading to enormous quantity of soil being eroded which, in turn, result in rise of riverbeds and siltation of tanks, reservoirs and water bodies. The Shivaliks thus present a highly dissected badland topography created by ephemeral streams of various genetic types. Weathering and denudation have produced a variety of erosional land form features such as rills, gullies, scarps and variously shaped ridges and amphitheatrical basins.

On the basis of lithology and fossil content, the Shivaliks have been broadly divided into 3 divisions i.e Lower, Middle and Upper, ranging in age from Middle Miocene to Upper Pliocene. The Lower Shivalik is composed of well indurate sandstones and the sediments bear shallow water feature like ripple marks, mud cracks etc. The Middle Shivalik is essentially a sandstone formation, moderately indurate and show shallow water features besides the presence of slump structures. The Upper Shivalik sequence is composed of poorly indurate pebbly sandstone and convolute laminations, slump structures and pockets of sand and sandy clays are frequently noticed. The salient textural characteristics of the sediments of the Lower, the Middle and the Upper Shivalik formations of western Himalaya do not show any contrasting pattern but a gradual change is noticed from the Lower Shivalik to the Upper Shivalik sequence (Mittal *et al*,2000)

The Shivalik hills run NW-SE direction. The rocks are made up of stone, grits, conglomerates, clay and silt. The seasonal streams, commonly called ***choes,*** run from NE to SW and descend into the valleys. Here they broaden and form *choe*terraces and flood plains scroll of fertile alluvium (Mittal et al, 2000).

The Shivaliks of Chandigarh region are soft and friable. The composition of deposits show that they are alluvial detritus from subarial wastes of the inner mountainous ranges, swept down by their numerous rivers and streams and deposited at the foot (Sohal, 2000). These hills composed mainly of clay sand, sand rocks, poorly bedded sandstones and conglomerates are more or less homogeneous along their entire length and are believed to be deposited contemporaneously. The hills conform in characters to recent alluvial deposits except that they are compact, having undergone immense folding and faulting by *Post-Tertiary orogenic movements* (*Singh Y*). The soil is varying widely in its characteristics. The soil depth varies from shallow to deep, Texture from sand to clay loam, organic carbon from 0.1 to 1.1% and pH from 5.3 to 8.4 (*Sidhu et al, 2000*). The area had been severely affected by soil erosion in the past. The shallow soil depth, stoniness, rapid run-off resulting in low water storage, low available water capacity and low nutrient status had been the main causes of soil erosion. The

area needed intensive soil conservation measures along with introduction of erosion resistant varieties of grasses like “bhabbar grass”. Some of the soils were well suited for raising fruit trees, protected pastures, forestry and recreational activities. Therefore, the department took up treatment of the area by adopting suitable soil conservation measures to minimize the soil erosion losses.

3.2 Geography/Terrain

The Shivalik hills run parallel to the NW Himalayan range on the southern side and generally dip to the south and south west. These are flanked by the rolling plains on the southern sloping side with conspicuous longitudinal value, Pinjore-Nalagarh dun on the North Eastern side. These hills present a highly dissected bad land topography created by ephemeral streams of various genetic types. Weathering and erosion in the semi arid region has produced a variety of erosional land form features as rills gullies, scarps, spurs and variously shaped ridges and amphi-theatrical basins. Depositional features likes choe terraces and flood plains scrolls are formed subsequent to erosion of surrounding land forms.

The ares of Sukhna wildlife sanctuary lies in the Shivalik hills with the higher regions more susceptible to erosion. The track is undulating with some moderate hills and the general inclination is from east to west. The northern portion of the track is rugged, precipitous and cut up by various spurs.

3.3 Climate

The Shivalik hills of the century, experience Koeppen’s CWG category climate based on annual and monthly means of temperature and rainfalls. This is categorized by humid tropical weather and dry winter. For general vegetation there are 2 major growth periods-Feb to march (spring and rainy months of july and august). Leaf fall for non ever green vegetation is experienced during feb to march. The area lies in the dry deciduous zone.The sanctuary remains humid during June to September and the relative humidity varies from 60-70 %.

3.3.1 Rainfall pattern and distribution

The meteorological data for last 8 years 2010-2017 were collected from Meteorological department Chandigarh administration are enclosed at Annexures 8 & 9 for ready reference which shows the following details.

1. Monthly rainfall

2. Mean-Min temperature (in celcius)

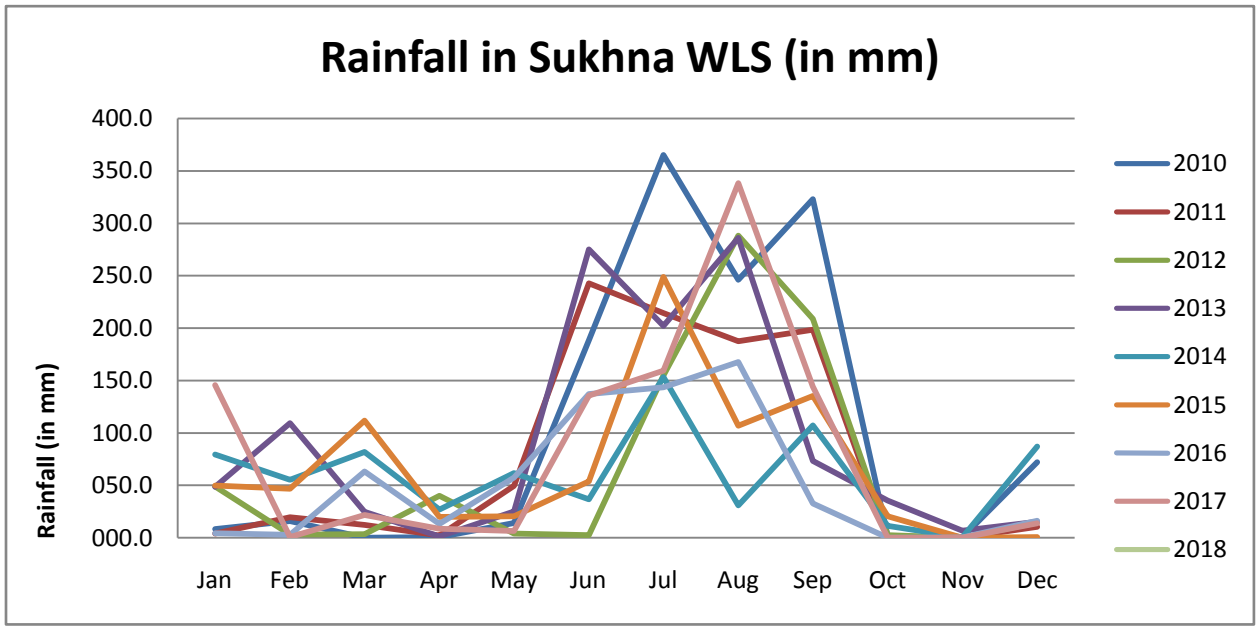
3. Mean – Max temperature

4. Average wind velocity

5. Relative Humidity

The South- East monsoon is the main source of rainfall. The Sanctuary receives the maximum rainfall from mid June to September. The average rainfall is more than 1000mm (Annexure - 8). Winter rain occurs during December and January causing severe cold in sanctuary areas. Abrupt rainfall during monsoon can cause soil erosion resulting in silt deposition in the earthen dams. This is evident from the Fig. 3.1 below. There has almost nil rainfall during winter months from 2010 to 2012. From 2013 to 2017, there is a distinct change in trend with early onset of rainfall from end November or early December to January, low in February and again some from March to May. However, from mid June to mid September the rainfall has been consistently high.Though Sukhna WLS has been effectively treated with vegetation and engineering methods and so even heavy rainfall in not likely to cause much damage to habitation or wildlife, the process requires to be continued further.

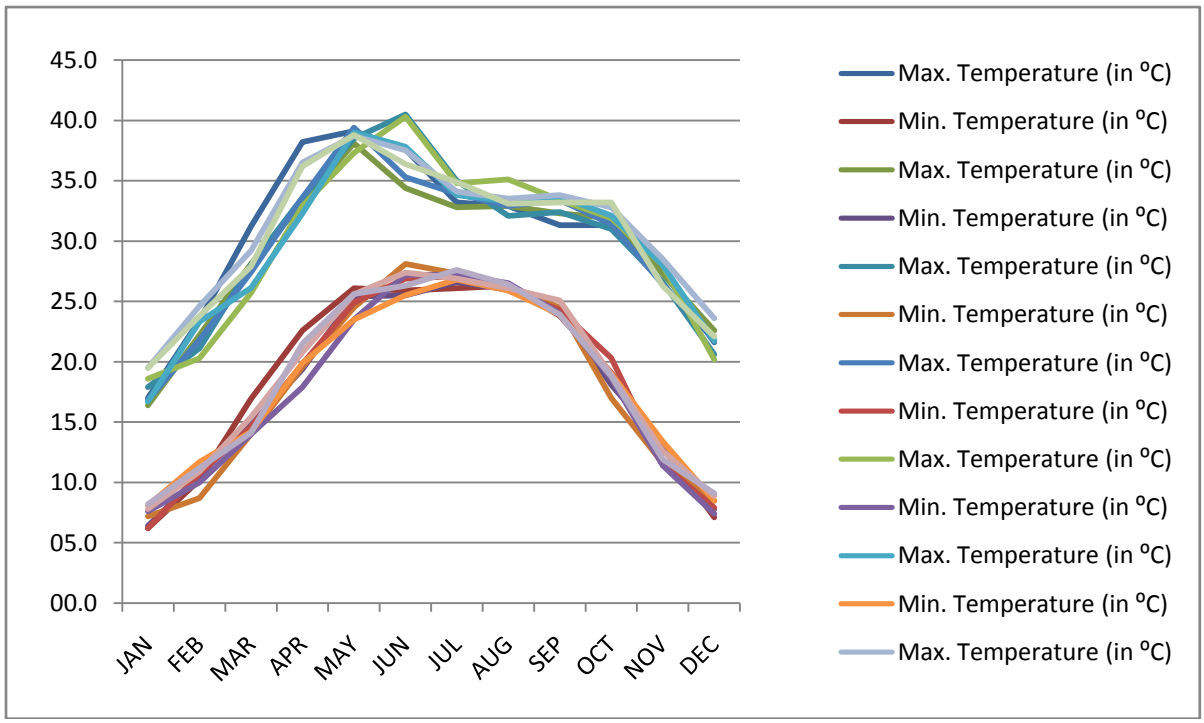
Fig. 3.1 showing pattern of rainfall in Sukhna WLS for the past 8 years



3.3.2 Temperature: Summary of Pattern

Temperature increases rapidly from 15th April. The months of May and June are generally the hottest months in the year with the mean daily temperature ranging from 21° to 27° C. the heat during summer season is intense. The decrease in the temperature is rapid from November. Usually the Jan is coldest month with the mean daily maximum temperature of 21°C and mean daily temperature of 7°C. During the winter season, cold waves sweep in the district in the wake of passing western disturbances and minimum temperature drops down to 4°C. On such occasions frost is also likely phenomenon in the Sanctuary. The data pertaining to the temperature of the Sanctuary area have been presented in Annexure- 8 and Fig. 3.2 below:

Fig. 3.2 showing pattern of mean max. & mean min temperature in Sukhna WLS for the past 8 years



3.3.3 Frost

Frost generally occurs in the valley. Although no damage is seen in the well stocked forest but damage to young saplings is seen in open area.

3.3.4 Dew

During winter, dew formation takes place but its contribution to available moisture is insignificant.

3.3.5 Hail and Storm

Hail and storm are not known in this area.

3.3.6 Humidity:Summary of Pattern

The relative humidity is maximum during monsoon and minimum during dry months of April, May and June. Annexure -9 shows the % of relative humidity recorded at Chandigarh in the last 8 years.

3.3.7 Wind Speed

During summer, dry and hot winds cause drought like conditions. Although dust storms occur during hot weather but they are hardly any consequence. Uprooting of trees and breaking of branches of large size trees take place only if very strong winds follow the rains. During winters the northerly winds create a cold spell. The annual wind velocity for the last 8 year is given in annexure 8.

3.3.8 Drought and its periodicity

Drought like condition prevails during summer season for mid April to June. Hot winds uproot the tree and cause damage to young seedling and the regeneration. The mortality due to excessive evapo-transpiration among young plants is maximum in May and June.

3.4 Water Sources

Forest track is intercepted by numerous choes of varying sizes which are rain fed. They rise and fall with great rapidity but due to choe training works undertaken by the department, they do not change their course very often. Water table is usually up to 10-15 metre deep during the summer months. The wildlife depends on the numerous Water Harvesting structures distributed throughout the sanctuary area. The earthen dams constructed for siltation purpose also serve as reservoir/ water holes for wild life.

Siltation dams in existence 175

Dams already silted up 150

Dams with storage capacity 25

Sukhna WLS area is the catchment for 4 major seasonal streams(choe) wiz Kansalchoe, Naplichoe, Nathawalchoe and Gharerichoe. The catchment area supports the water supply regime to sukhna lake at Chandigarh which is a major tourist attraction.

The underground water regime supports a wide variety of flora and myriad fauna. Sukhna WLS has 40 tree species, 18 shrub varieties, 1 species of climbers, 28 kind of herbs and 16 species of grasses beside some bamboo and palms. It also harbors a wide variety of wild fauna and has more than 15 species of mammal, 133 species of birds including aquatic birds, 27 species of butterfly besides at least 7 species of reptiles.

3.5 Range of wildlife, Status, Distribution and Habitats

3.5.1 Vegetation (Flora)

Sukhna WLS is bestowed with a wide variety of trees, shrubs, herbs, grasses and climbers. It has 40 tree species, 18 shrub varieties, 10 species of climbers, 28 kinds of herb and 16 species of grasses besides some bamboo and palms. The detailed list is enclosed at Annexure -10. Some of the prominent ones among them are:

- *Acacia arabica* (Kikar)
- *A. leucophloea* (Raeru)
- *A. modesta* (Phulai)
- *A. catechu* (Khair)
- *Abrusprecatorious* (Rati)
- *Adhatoda vasica* (Vasaka)
- *Anogeissus latifolia* (Chhal)
- *Azadirachta indica* (Neem)
- *Bauhinia racemosa* (Kachnar)
- *Bombax ceiba* (Semal)
- *Butea frondosa* (Dhak)
- *Carissa spinarum* (Karaunda)
- *Cassia fistula* (Amaltas)
- *Dalbergia sissoo* (Shisham)
- *Diospyros montana* (Kendu)
- *Emblica officinalis* (Amla)
- *Lannea grandis* (Jhingan)
- *Lantana camara* (Panchfali)
- *Morus alba* (Tut)
- *Murrayakoenigii* (Kari patta)
- *Prosopis juliflora* (Musket)
- *Saccharum spp.*(Moonj)
- *Tinospora cordifolia* (Giloe)
- *Vitex negundo* (Bana or nirgundi)
- *Zizyphus jujuba* (Ber)

3.5.1.1 The Physiographic Classification

The sanctuary lies in the physiographic zone of Northern Plains (Anon 2003b).

3.5.1.2 The Forest Types, Cover and Food for Wild Animals

The Sukhna Wildlife Sanctuary is a forest of multi-tier vegetational assemblage. The forest of the sanctuary can be classified as **Type 5B/C1 Northern Tropical Dry Mixed Deciduous Forests & 5/DS1 Dry Deciduous Scrub**according toChampion & Seth's classification (1968). As the total area of the sanctuary is small and entirely lies in shivalik hills so there is no marked difference in the forest types and the vegetative cover is almost similar all over the sanctuary.

The history of the vegetation of Shivalik Hills clearly shows that the tree canopy had been severely broken by human activities in the past. There is no trace of *chir (Pinus roxburghii)* and *sal (Shorearobusta)* in the Chandigarh Shivalik Hills. Scattered trees of other species grow in small groups except for the closed forests where the trees are in abundance. Now these hills are characterized by tropical dry deciduous forest with abundance of thorny species. The trees are low in height with xerophytes predominating in the area. Tree canopy is more or less broken with tree height not

exceeding 10 meters. The least disturbed patches of vegetation are on the northern flanks. Throughout the range, thorny species dominate. The common ones are *Capparis sepiaria, Flacourtia indica, Rhamnus persicus, Zizyphus. nummularia, Acacia nilotica, A. catechu, A. leucophloea, A. modesta, Prosopis spicigera* and *Diospyros cordifolia*. Of course, scrubby thorny *Carissa spinarum* is abundant all through the hillsides.

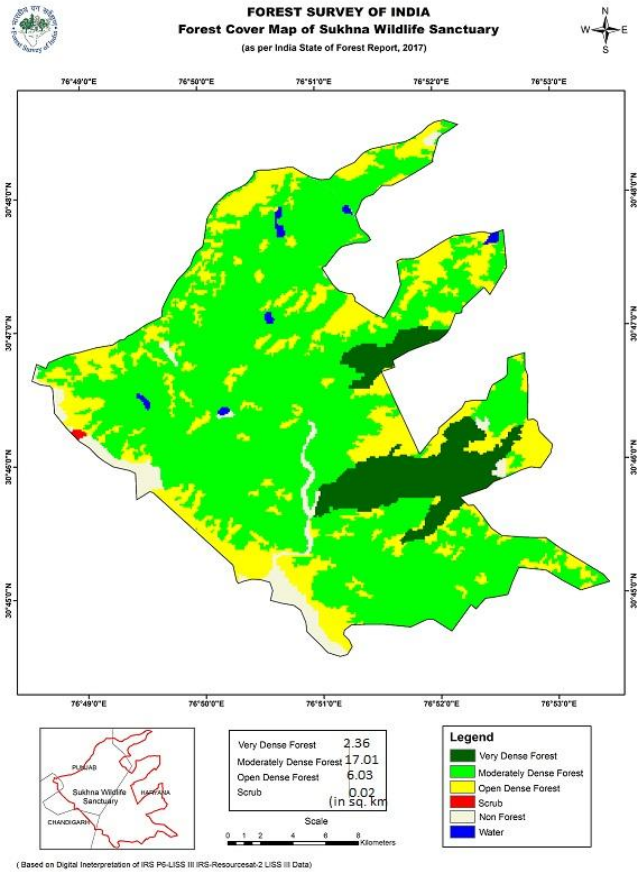
Zizyphussepiaria, Z. nummularia and C. spinarum at places form impenetrable scrub vegetation. In the hill-foot plain areas occasionally highly lopped trees of *Butea monosperma* are seen just outside the PA jurisdiction. Species such as *Anogeissus latifolia, Bauhinia recemosa, Cassia fistula, Lanneacoromandalica, Woodfordia floribunda, Nyctanthusarbortristis (Harshingar)* are not rare. On dry exposed slopes, *Dodonia viscose* and *Adhatodavasica* form conspicuous shrubby elements. In the valleysand near choes,*Butea monosperma, Aegle marmelos* and *Dalbergia sissoo* are occasionally found. Where the vegetation is thick and protected, *Bauhinia vahlii* and *Pueraria tuberosa* grow as conspicuous climber and few clumps of *Dendrocalamusstrictus* may also be seen. Plantation of *Eucalyptus* is common along the roadsides which was done in early 80's.

Near habitation in valleys, *Melia azadarach* and *Ficus religiosa* are often planted. Common perennial grasses are *Eulaliopsisbinnata*, *Heteropogoncontortus* and *Arundinellanepalensis*.

According to the Canopy Density, the forests in the Sukhna Wild Life Sanctuary area can be classified into following categories based on FSI Vegetation Map (Map No 3.3):-

Type	**Area** (in sq. km.)	**%**
Very Dense Forests	2.36	9.08
Moderately Dense Forests	17.01	65.47
Open Forests	6.03	23.21
Deciduous scrub	0.02	0.077
Non Forest area	0.56	2.155
Total	25.98	99.99

FSI Vegetation map of the sanctuary is placed below:



Map 3.3 – Vegetation Map of Sukhna Wildlife Sanctuary (FSI)

A. TREES

Acacia catechu (Katha)*, A. leucophloea, A. modesta, A. nilotica*(kikar)*, Adina cordifolia, Aegle marmelose*(bel)*, Anogeissus latifolia, Azadiracta indica* (neem)*, Bauhinia variegata*(kachnar)*, B.purpurea, Bombax ceiba* (semal)*, Butea monosperma*(dhak)*, Cassia fistula* (amaltas)*, Cidrella toona* (tun)*, Dalbergia sissoo* (shisham)*, Diospyros cordifolia, Ehretia aspera, Eucalyptus tereticornis*(safeda)*, Syzigiumcumini*(jamun)*, Ficus bengalensis* (barh)*, F. glomerata* (gular),*F.religiosa*(peepal),*Flacourtia indica, Grewia oppositifolia, Lagerstroemia parviflora, Mallotusphillipinsis, Melia azedirach, Morus alba* (Shahtoot),*Nyctanthusarbortristis*(Harshingar), *Prosopis juliflora, P.spicigera, Sizygyiumcuminii*(Jamun), *Terminalia arjuna, Trewianudiflora, Vitex negundo, Zizyphusmauritiana*(ber)*, Z.numularia*(jungliber)etc.

B. SHRUBS

Adhatodavasica (busuta), Calotropis procera (desi ak), Capparis sepiaria, Carissa spinarum, Dodonia viscose, Euphorbia nivulea (thor), Ipomoea fistulosa (walaitiak), Lantana indica, Mimosa aspericaulis, Murrayakoengii (curry patta), Woodfordia floribunda (fruticosa).

C. CLIMBERS

Abrus precatorius (ratti plant), Bauhinia racemosa, B.vahlii, Cisampelos pareira, Pueraria tuberosa, Tinospora cordifolia, Cryptolaepis buchanani, Ipomea purpurea (Morning glory).

D. GRASSES AND HEDGES

Arundinella nepalensis, Cynadon dactylon (dub), *Cenchrus ciliaris, Dendrocalamus strictus, Eulaliopsis binnata* (bhabhar), *Heteropogon contortus, Imperata cylindrical, Saccharum benghalense* (munj), *S. spontaneum* (kahi), *Cyperus niveus, C. rotundus, Scirpus tuberosa.*

The extent of this forest ranges from plain up to an elevation of 620 m in the Siwalik hills. There is sufficient food available for the wild life such as Amla, Bel, Kachnar etc. The limiting factors for flora are erosion, parasites, weeds, fire, etc.

3.5.1.3 Species and Communities of Conservation Importance and Key areas:

For the conservation of wild life in the sanctuary area, fruit bearing shade trees have been planted. Plantation of Papdi*(Holoptelia integrifolia)* and Amla *(Emblica officinalis)* etc. show good results. As the sanctuary area is fenced near the habitations so no grazing and firewood collection is allowed. The area itself is showing changes in the density of the crop. Forests around the earthen dams are helping in conservation of bio-diversity due to presence of water bodies. The micro-climate of the sanctuary is different than outside of the sanctuary due to presence of these large number of water holes located all over the sanctuary area. Both the thorny species and broad leaved species are visible in the sanctuary. Due to eradication of Lantana weed, other species such as *M. koenighii* and *Adhatodavasica* etc. has occupied vast stretches in Nepli and Kansal Ranges of the sanctuary area. Presence of bhabar grass on the sloppy hillock helps in binding the soil. During summer, the scarcity of palatable grasses may create problem for the wild animals to graze. Therefore more fodder trees and palatable grasses on dams are required to be planted to compensate for the scarcity of grasses during pinch period. Lantana which afforded a good cover to the wild animals earlier has been removed. Similarly *Parthenium hystosporus*, another exotic weed which invades new soils, abandoned land, roadsides, forests etc, is a major biological pollutant of the environment. The management has taken a three-pronged strategy for physical removal/ suppression of both these weeds in a phased manner in order to reintroduce indigenous varieties of plants, conserve biodiversity and develop an ideal natural habitat. Therefore tall grasses, herbs and shrubs also need to be planted to provide shelter and escape terrain to the herbivores which are usually shy and docile animals.

3.5.2 Animals (Fauna)

Sukhna Wildlife Sanctuary is an abode of wide variety of mammals, birds, reptiles, butterflies insects, etc. The detailed list is enclosed at Annexure -11. Some of the prominent and most common ones among them are mentioned below:

3.5.2.1Vertebrates, their Distribution, Status and Habitats:

i) **Fishes: -** In small and large water bodies there are about a dozen types of fishes, of which mahaseer (*Tor putifora*), thail (*Catlacatla*) and rohu (*Labeorohita*) are very common in Sukhna Lake *(Singh Yadvinder).*

ii) **Frogs and Toads (Amphibian) -**The common frog is *Rana tigrina* and the common toad of the region is *Bufo melanostictus*.

iii) **Reptiles -** There are varieties of reptiles including snakes like Indian Cobra, Rat Snake, Common Krait, Russell's viper, Indian Python etc. Two types of tortoises, Common Monitor Lizard (Gho), are also foundand 3-4 types of lizards have been observed. One of these has brilliant vermilion colour during mating season.

iv) **Birds -** There are more than 120 varieties of birds including aquatic birds. The resident population may consist of over 100 different kinds. There are also migratory birds visiting during winter from far off lands as Siberia. These primarily visit Sukhna Lake. The estimate about the number of visitor birds varies from 200-500 types depending upon estimates for different years *(Singh Yadvinder).* The forest of Sukhna WLS is very rich in avifauna. Prominent ones are Peacock, Red vented fowl, Grey partridge, Cuckoos, Night jars, Golden Oriole, Kingfishers, Swifts, Hoopoes, Hornbills, Barbets, Woodpeckers, Rollers, Barn owls, Parrots, Doves, Jacanas, Plovers, Coots, Hawks, Geese, Swan, Ducks, Grebes, Black Drongo, Tree pie, Jungle crow, Bulbul, hill myna, Koel, Bee-eater, Common Myna etc.

v) **Mammals** - Along with plant biodiversity Sukhna WLS harbors a wide range of faunal biodiversity. The main herbivores of this sanctuary are Sambar (*Cervus unicolor*), Chital (*Axis axis*), Wild boar (*Suscrofacristratus*), Porcupine (*Hystrix indica*), Hare (Caprolagushispidus), Rhesus macaque, Hanuman Langur, Fire-striped Palm Squirrel, Pangolin (ant eater), etc. Among carnivores Leopard *(Panthera pardus)* is the only large cat found in the sanctuary. However, Jackal, Small Indian Civet, Jungle Cat, Porcupine, Common-Mongoose, Common rat, Squirrel etc. are also present. As no census has been carried out so no data on the exact number is available for the record.

3.5.2.2. Invertebrates, their Distribution, Status and Habitats

Insects: - Wide variety of Butterflies, Moth, Honey-bee and other insects are in abundance. At least 30 varieties of butterfly have been identified during summer and winter survey in the sanctuary (Annexure -11). However, a separate inventory of total invertebrates found in Sukhna WLS does not exist as yet.

3.5.2.3 Species of Conservation Priority (Birds)

At least five species of birds recorded during the survey of the sanctuary and adjoining Sukhna Lake have been listed in IUCN Red List of globally threatened animals. These species are mainly inhabiting grassland and aquatic habitats besides some are scavengers (carrion feeders) (Singh Arun P, 2005).

1. Grey-crowned Prinia, *Priniacinereocapilla* (Vulnerable) – A resident species that is endemic to the Indian-Subcontinent and has a restricted range in India as it is found only at the base of the Himalayan foothills (terai and duns) and the adjoining Shivaliks (between 300-1600 m) from Margana hill in Pakistan up to Assam in India. It was recorded once during

summer survey in Kansal range at Sukhna. Its habitat in Sukhna includes open, undisturbed grassy areas adjoining the reservoirs. Very rare, Insectivorous.

2. Cinereous Vulture, *Aerypiusmonachus* (Near Threatened) – Winter migrant to India from the Palae artic region. An individual was recorded flying over the sanctuary during winter survey. Feeds on carrion.

3. Red headed Vulture, *Sarcogyps calvus* (Near Threatened) – A resident species in India. 1-2 individuals recorded flying over the sanctuary on several occasions in Napli range. Feeds on carrion.

4. Ferrugionus Pochard, *Aythya nyroca* (Near Threatened). A rare winter migrant to India from the Palae-artic region. Prefers secluded areas with large reservoirs inside the sanctuary. Three individuals observed in Kansal range. Feeds on aquatic fresh water fauna (fishes).

5. Darter, *Anhinga melanogaster* (Near Threatened) A resident species to India. Two recorded at Sukhna Lake during summer surveys. Feeds on aquatic fresh water fauna fishes.

3.5.2.4 Threats to wildlife and their habitats in the sanctuary

1. For grassland species, care should be taken against summer fires, grass cutting, grazing invasion by exotic weeds.

2. For aquatic species precaution should be taken against drying of reservoirs during summer, pollution by chemical discharge/ waste and usage of chlorine, etc. for purifying water, siltation, fishing and disturbance caused due to boating at Sukhna lake.

3. Further fragmentation of forest habitats in the area adjacent to Sukhna Wildlife Sanctuary should be checked for its isolation.
4. Firing from adjoining army firing range should also be checked from the eastern side along with noise pollution.

5. Usage of Declofenac (anti-inflammatory drug) given to sick cattle in the area should be checked as this drug persists in the animals body even when it dies and causes rental failure to vultures that feed on the Caracas of the animals treated with this drug e.g. Whire-rumped vulture, *Gyps benghalensis*.

6. The population of feral cattle although less at present should be checked now before it rises to unmanageable levels and competes with the wild herbivores for

food besides this cattle is also susceptible to air borne and water borne diseases that can be transmitted to wildlife.

7. Checking the small population of stay dogs in the sanctuary that chase the wild animals (ungulates) and can also prey upon their young ones.

8. Planting of more fruiting and flowering trees (figs, jamun, ber, mango, guava, etc.) should be encouraged in the sanctuary to attract more species of birds.

9. Spotted Deer has already been successfully re-introduced in the sanctuary. But Barking Deer *(Muntiacusmuntjak)* and Ghoral*(Nemorhaedus goral)* are potential herbivores that occur widely in the adjoining areas {West Himalayan foothills and the Shivaliks – (Moorni hills and Kalesar in Haryana and Nalagarh, Solan, Nahan, Kalaamb in Himachal Pradesh)} but are absent from the sanctuary. These species can also be introduced in the area provided they do not exceed the carrying capacity of the P.A.

3.5.3 Fauna: Census 2011

Through no systemic census has ever been conducted in the past in this PA, an attempt to quantify available large herbivores was made in the year 2010 with the backstopping from Wildlife Institute of India, Dehradun,(9^{th} – 11^{th} December, 2010) and active support from Yuvasatta, Chandigarh; People for Animal, Chandigarh; Avian Habitat & Wetland Society, Chandigarh; Punjab University, Chandigarh (Botany & Zoology Departments); St. Kabir School, Chandigarh. [1]However, data could only be procured for **Sambar** and **Peacock**. Line transect method was adopted. 8 groups so constituted walked on the line transects in the then existing 8 beats in the PA (now reorganized into 12 beats). The results brought out following, in nutshell, from the several observations made:-

i) **Sambarpopulation** in Sukhna WLS was estimated at 1031 +/- 441 (abundance +/- SE). On the line transacts, 21 groups of Sambar were observed with an average of 4.7 individuals as group size. Maximum range of Sambar groups varied between 3.39 to 10.07 (Highest for any PA in India).

ii) The **peafowl population** was estimated at 920 +/- 326 (abundance +/- SE).

iii) The **recommendations***inter alia* include that the exercise needs to be repeated in different seasons to refine the estimates as there is large variation in population estimation in different species.

3.5.4 Current studies:

Line transects in stream/ (nallahs) valleys were walked during this exercise, the results of which are presented as below under the caption: Spatial distribution of Fauna.

Spatial Distribution Of Fauna In Sukhna WLS

To study spatial distribution of wild animals in Sukhna WLS, transect method was followed. Sukhna WLS has four major seasonal streams flowing through it. Being Dry deciduous tropical forest located over the outermost Shivalik Range formed of

[1]Wildlife Census of Sukhna Wildlife Sanctuary, Chandigarh (December, 2010)

conglomerates, water tends to reduce drastically in the lean, dry season as summer approaches. Thus, movement of animals can be gauged along the water streams and other water bodies in the sanctuary. There are roughly 200 water bodies created in the sanctuary by human interventions; mainly to check erosion through the streams / nullahs. Thus, majority of these are check dams, which get filled with the run-off from their respective water shedding slopes. Additionally, some slopes have smaller natural and artificially created waterholes. The visibility is hindered in most of the plains along nullahs by tall grasses such as *Arundo donax, Saccharum munja, Eulaliopsisbinnata*, etc. and slopes by thorny bushes of various species of *Carissa, Flacourtia, Lantana, Acacia, Prosopis* and thick tree cover on northern slopes and sparse on southern slopes. The 4 nullahs viz., Kansal, Ghareri, Nepli&Nathewala cover roughly 30 km. in length.

Under the circumstance explained above, transect walks along nullahs appear to be most effective method to look for signs of nocturnal or temporally segregated species and for sighting of others. Therefore, walks of 3 teams were planned in all 4 nullahs to walk parallel to the streams, one on either side 100 metres apart from mid-stream bed and a third team in the steam bed or along its banks where filled with water. Since the exercise ranged in February & March of 2018 (10.2.2018, 23.2.2018 & 7.3.2018), the streams were partly dried up due to delayed and sparse winter rains (Fig.). A pamphlet used for identification of droppings and other signs of animals is placed at Annexure.16.

RESULTS

Results of the transect walks (figure 3.1) have been shown in figure 3.2. For small mammals, Wildlife distribution map is shown at Annexure -18f. Distribution of animals mainly based on pug & hoof marks and to a lesser extent on droppings (poops, antlers, spines) and carcass depicted on the map help to mark zones where different species are visiting the water holes / streams. Reference material for field identification of wildlife used during the transect walks is given in Annexure -16.

As far as top of trophic level is concerned, it is Leopard (*Panthera pardus*) but the evidences were really scarce. Only in Kansal and Nathewala valleys evidences were seen. In the former, clear foot prints seen on parapet (photo) and in the latter, a sambar carcass of the kill supposedly made by leopard, as previous night's rainfall had washed out pug marks.

A level below, jungle cats, jackals, escaped-to-wild stray-dogs packs, birds of prey are the main carnivores. While only few foot prints of Jungle cat were seen in all valleys, signs of stray-dogs were present through-out in all valleys. The stray-dogs have taken dangerous proportions as pack size is up to 10 to 12 dogs in each pack and there could be 3 to 4 such packs in the WLS. Management interventions may be required to tackle with packs of stray-dogs, lest depletion of large carnivore prey-base may get undue acceleration. Jackal foot prints are similar to stray dogs except for prominent nails and behavior-wise attacking small mammals or scavenging on carcasses only.

At trophic level – II, herbivores are the main prey base for higher trophic levels. Neel gai (Blue bull, *Boselaphustragocamelus*) inhabits extreme areas in all valleys, where it could move to adjoining agricultural areas with ease. They are large enough and can't be hunted easily by a leopard (Tigers are not found in this part of the country), only smaller females and fawns are most likely preys. Sambar and chital form main prey base, both for leopards and pack of stray-dogs. The chital base appears to be narrow

due to lesser foot prints seen through-out the valleys. Clear visibility is lacking in grassy meadows along watercourses as soil stabilizing grass *Arundo donax* has made thickets, not really affording open view. Wild Boars (*Sus scrofa*) are forming considerable population in all valleys and female and young ones gregarious.

Small mammal require separate GIS layer for their restricted movement near their niches. They are seen at night. Porcupine appears to be omnipresent in valleys and feeds on *Arundo donax* rhizomes at water edge. Palm civets are few and live in couples, found almost in all valleys but sparsely located. Approximate locations around old disused buildings as well as Rest Houses are easily located. Mongoose and small mongoose are seen in all valleys which are less predominant than porcupines but more than civet cats. Hares have been seen away from the water edges in all valleys. Pangolins evidences are very few and far between. However, some are depicted on the map for zoning.(Annexure 18 f)

The first trophic level or autotrophs (flora) earlier in the chapter have been discussed separately in a section on flora & vegetation shown in maps (Map 3.3 above)

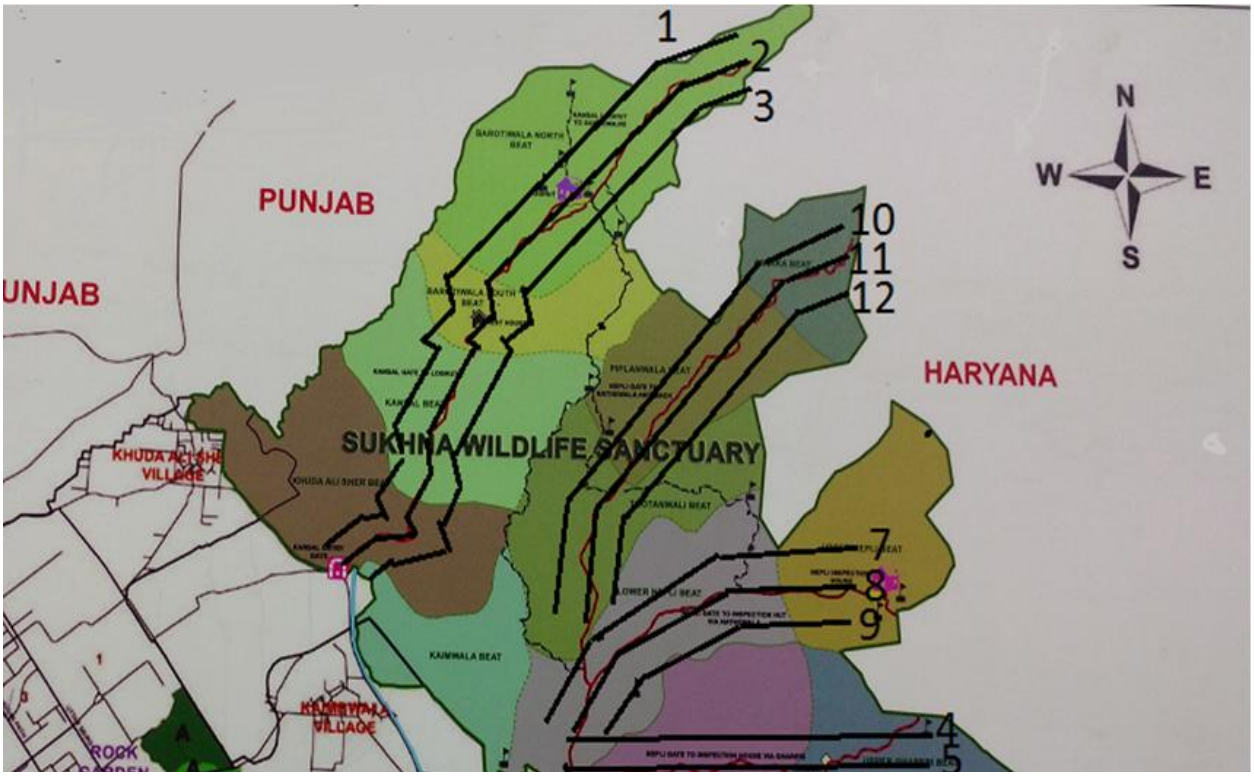


Fig.3.4 : Transects in various riverine valleys of Sukhna WLS

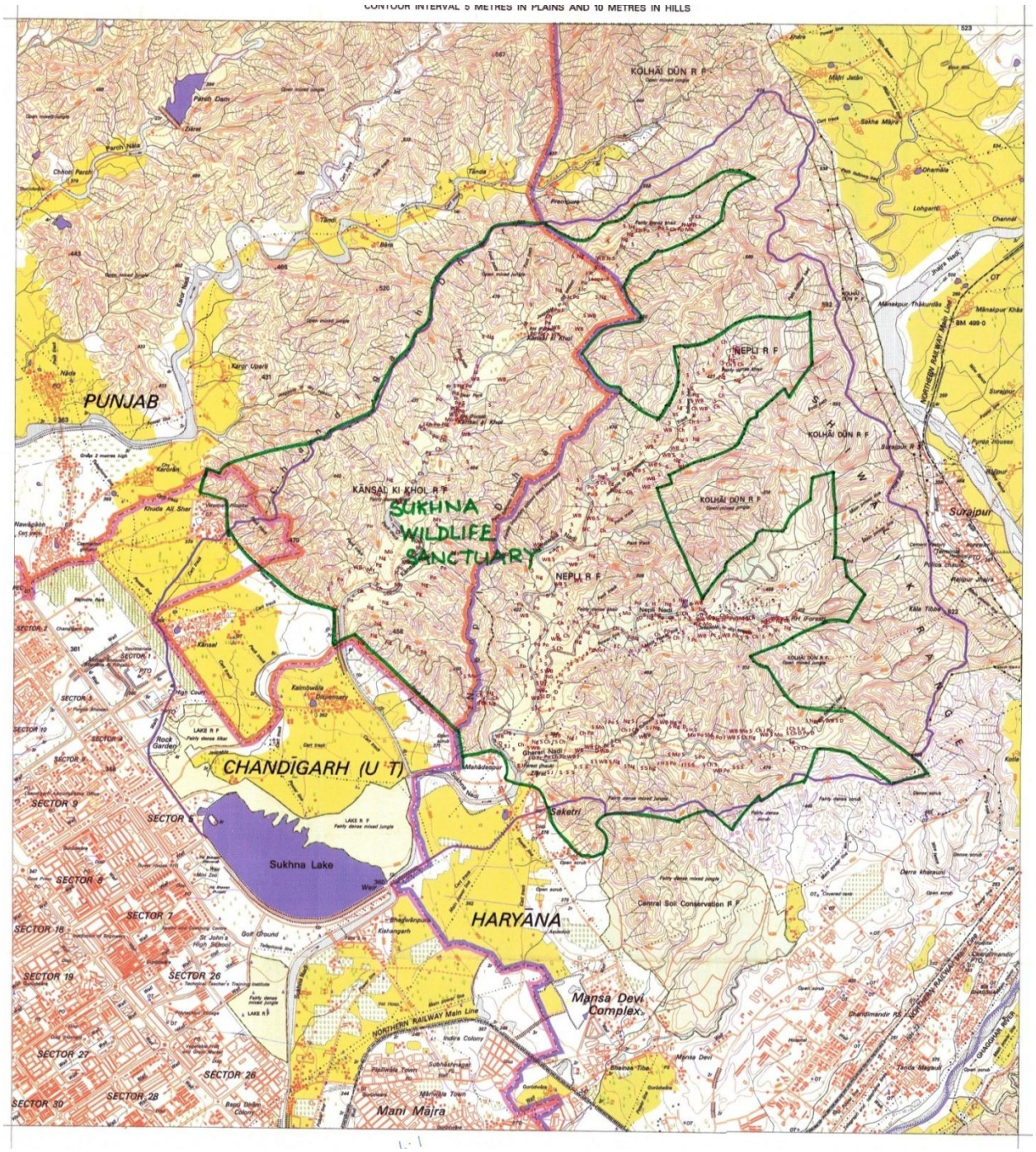


Fig. 3.5 : SPATIAL DISTRIBUTION OF FAUNA IN SUKHNA WLS
(Acronyms: S: Sambar, Ch: Chital, Ng: Neel gai, L: Leopard, Lg: Langur, J: Jackal, Jc: Jungle Cat, B: Wild Boar, Po: Porcupine, Mo: Mongoose, sm: small mongoose, Pc: Palm civet cat, D: stray Dog, Fc: Feral cow, Pg: Pangolin, My: Monkey)

PART – II

PROPOSED MANAGEMENT

CHAPTER 4

ISSUES & CHALLENGES

A 26 sq.km. patch in outermost Shivaliks has been named as **Sukhna** WLS with its declaration as a **wildlife sanctuary** in 1998. Located in foothills of Himalayas in North India, this area is significant for being the catchment of Sukhna lake (thus deriving its name) adjoining the Chandigarh City. For recharging streams those feed the Sukhna lake throughout the year, it in fact requires to be under dense vegetative cover and hence a protected area.

Sukhna WLS falls in the bio-geographic zones of Western Himalayas and Lower Gangetic plains. Thus, its limited variety of flora and fauna is largely due to edaphic and climatic factors supporting only Tropical Dry Deciduous forests & scrub in outer Shivaliks. Sum total of locality factors pose a variety of issues and challenges to the managers of the Protected Area. These have been delineated *a priori* as below:

4.1 To augment the catchment capabilities of the area by reducing soil erosion and moisture regime.

4.2 To restore and conserve the representative biodiversity of the area

4.3 To lay emphasis on maintaining a viable population of wild animals.

4.4 To enhance capacity building for effective management.

4.5 To promote regulated tourism / eco-tourism for aesthetics & leisure, conservation education/ Training, building mass support through environmental awareness, opportunities for self employment and enhance visitor experience.

4.6 To encourage field research, inventorization to develop an adequate database, networking and develop a monitoring protocol.

4.7 Other issues

Description of various issues & challenges is given here under.-

4.1 Augmenting catchment capabilities of the area:

The **prime objective** with which this area was set aside in 1950s was to improve soil & moisture conservation regime. This has been adequately explained in the previous chapters. After the formation of Sukhna lake, resultant havoc caused by the run-off from the adjoining conglomerates and loose-soil hills devoid of green cover, started silting the lake at a very fast rate. This led to the soil conservation works to create check dams and silt detention dams on the seasonal streams (choe). The enormity of work extended 175 silt detention dams and other vegetative means for creating green cover, before declaring the area a wildlife sanctuary.

Geological formation is posing a challenge even to this date, albeit to a lesser extent. Years of efforts have fructified in terms of detention of silt to a greater extent and provide water in the streams even during lean seasons. The removal of silt from the filled dams has to be a tireless continued effort year after year till substantial decrease in siltation poses lesser danger of choking the dams. This also requires continued efforts for improving the green cover. This is possible with succession of better plant species of next seral stages to replace dry deciduous vegetation akin to earlier seral stages of riverine succession in and along the streams as well as removal of silt and stabilizing muck & land sliding slopes.

4.2 Restoring and conserving the representative biodiversity of Bio-geographic zones (BGZ):

These hills were devoid of stored water i.e. water bodies, since time immemorial. The rising temperatures during Northern summers, soil being pebbly is greatly heated up. Thus plants with shallow root systems tend to dry up, leaving only xerophytic vegetation and shrubs and trees with deeper roots alive. The formation of contour trenches, check dams, silt detention dams, vegetative bunds have changed the trend. Stored water seeps down slowly and devoid of run-off clay / silt. Along the water courses, greener grass starts to be available even during hottest periods. Planting various species along the water courses, provided shade and lowered temperatures under the canopy. While southern & western hill slopes continued to be dominant xerophytic, northern slopes have better moisture retention.

The trend is now required to bring in next seral stage or even climax vegetation of the BGZ along the watercourses, preferably trees which can produce more cooling impact on the soil for the under growth to survive the summer. Also to bring in palatable grass species covering plains near water courses.

The slopes require species planting through interventions, which provide better shade so as to effectively deal with **poor regeneration** on slopes. Past plantations have greatly enhaced regeneration now in valley parts as seen in Ghareri nullah in respect of **Khair, *Prosopis*&shisham,** in Kansal,**shisham, *Leucinia*&*Prosopis***and in Nathewala, **shisham&*Prosopis***. ***Lantana*** has been greatly reduced in the sanctuary by the earlier efforts probably continued during the last plan period. Relapses of *Lantana* have been seen in Ghareri and Nathewala riverine valleys to a lesser extent. Now care has to be placed on regeneration by those species which lead the future of sanctuary to a desired direction.

Discussions with the staff as well as observations in all the valleys suggest disproportionate enhancement of species like *Prosopis juliflora* and *Leucinialeucocephala* due to excessive regeneration, suppressing other desired species for maintaining herbivore population, which now pose a challenge. On the other hand, Lantana removed plains along streams are either covered on edges by *Arundo donax*once planted but now greatly increased or by *Adhatoda vesica* and *Murrayakoenighii* which are little edible by wild animals. Considering their usefulness, levels need to be set for retention of each species until unless management practices warrant retention of specific species e.g. plantation of *Jatropha curcas* in sanctuary area is of no consequence. *Parthenium hystosporus* has invaded Ghareri, Nepli& other valleys basically along the roads, which needs to be removed prior to fructification each year.

Fire is undesirable and has no reason to occur in PA except escaped from neighboring villages, accidental or deliberate human activity, yet several incidents occurred over the years have been reported as below.

Fire Damage & Control: No major fires have broken out in the sanctuary area. However, minor fire incidents occur in which ground fire has damaged small plants, bushes. No damage to wildlife has been reported. Forest fire fighting equipment – Tool kit, Search lights, Nylon Tents, Extra tool handling rod are kept for safety. Necessary help of Fire Department is taken in case of fire. Fire lines have been created and maintained regularly. Road network is strengthened regularly and maintained. Intensive monitoring is carried out during fire season. Details of fire incidences in the last 9 years in given here under-

Table 4.1: Fire affected area of PA

S. No	Year	Area Burnt (Ha)	Location of Fire Incidence	Type of Fire	Damage	Remarks
1	2009	93	Upper Nepli- Lower Nepli- Tootawali-Piplawala	Ground	Nil	High Tension wire passing through area. Fire coming from Morni Hills area of Haryana
2	2010	5	Nepli	Ground	Nil	
3	2011	8	Nepli	Ground	Nil	
4	2012	15	Upper & Lower Nepli	Ground	Nil	
5	2013	1	Nepli	Ground	Nil	
6	2014					
7	2015	80	Upper Nepli- Lower Nepli- Tootawali-Piplawala	Ground	Nil	
8	2016					
9	2017					

[Source: Office of DCF/ RO, Chandigarh]

4.3 Lay emphasis on maintaining a viable population of wild animals

Maintaining wild animal population is dependent upon the available resources in the protected area. Dry deciduous forests and scrub provide little for maintaining healthy populations of wild animals as herbivores which require desired forage plants, fruits, roots, rhizomatous parts, water and shelter or ecotones for survival. Past interventions in the area has resulted in somewhat enhanced availability of food, water

but declined the shelter as uprooting of weeds like Lantana has removed their shelter or niche for smaller animals. If Lantana retention augments niche availability, it interferes with the food availability by posing threat for growth of wanted plant species.

Spatial distribution studied of fauna in all rivulets has been presented in Chapter 2. A **heuristic knowledge** is nowhere close to a census in its authentication, but no **census** has ever been carried out in this wildlife area, even use of **camera traps** has not been employed. Therefore, basing on available information sources, the levels of herbivores present in the protected area are presently not appear to maintain a resident top carnivore for its continued survival. Gathered information from the staff, it appears there is a population of about 40 to 50 neel gai, 200 to 250 sambar, upto 100 chital and 200 to 250 wild boars. There is no authentication of these figures. Animals are hardly visible during day time except for 2 to 3 sambars in at least 4 visits. Carrying capacity far exceeding the limits has been feared in the last plan for lack of large carnivore species which did not discount stray dog packs (3 to 4 packs of up to 10 dogs) which are certainly deleterious to chital and young ones of two other species mentioned as well, not to speak of recorded 2 sambar kills by leopard seen in a valley.

Canopy manipulation can only enhance their number with plantation of desired species of grasses and other forage/ fruit species.

4.4 Enhancing capacity building for effective management

All front line staff have usually undertaken the basic forestry training just once in which wildlife management was one of the subjects. But wildlife management is now emerging as an elaborate concept where progress is being made at a fast pace. Without wildlife management training at appropriate levels for enhancement of skills, capacity building and knowing the progress made in the field, a scientific and effective management will be difficult except in exceptional circumstances where either the P.A. manager himself or a comparatively senior devoted official takes upon himself to train the frontline staff. The forester on his routine inspection of the area may be witness to certain animal behaviors that are still not known. But he has to be properly trained to take notice of such event and record the observations. A training programme can be organized in collaboration with the Wildlife Institute of India, Dehradun. The Forest Research Institute, Dehradun can also be associated for dealing with matters related to forestry.

4.5 Promoting regulated tourism / eco-tourism

4.5.1 Low Sighting

A visitor to a protected area expects to see some free ranging wild animals and consequently gets passionate about wildlife conservation. If the visitor is not able to sight free ranging animals in the wild, he is disappointed. He not only does not take up the cause of conservation strongly but also does not have a word of praise for the management who take utmost precaution in managing the protected area.

4.5.2 VVIP Guests

Chandigarh is the capital of two adjoining states of Haryana and Punjab besides being the seat of U.T. Administration. Naturally the incidence of visits by politicians, bureaucrats, judges and the elites of the society will be fairly high. The high incidence of the VVIP visitors may also deter the general tourists from visiting the protected area, as also cause disturbance to the wildlife.

4.5.3 Lack of Grazing Grounds

The relatively high population of herbivores in the sanctuary need grazing grounds. They prefer open grasslands or escape terrain.

4.5.4 Lack of Awareness

The stakeholders like villagers of nearby area, students and people of Chandigarh, politicians, development departments, NGOs, are not fully well versed with the biological, ecological, landscape and environmental values of Sukhna WLS.

4.6 Encouraging field research, inventorize to develop an adequate database, networking and develop a monitoring protocol

Some research has been undertaken as far as the enhancement of silt retention capacity in the catchment area is concerned. But no research has been taken up in Sukhna WLS keeping the management needs in mind which include the habitat requirements of the faunal species. A target oriented research in areas which are accorded priority by the management and a proper documentation of earlier researches to avoid in-fructuous exercises is essential.

The monitoring standards of activities are not quantifiable in most cases except silt deposition in Sukhna Lake. The success depends on appropriate feedback based on which required modifications where needed can be introduced. Such mechanisms are required which can assess the success of works undertaken and check the quality etc. through verifiable indicators in the field e.g. if regeneration is better on a Lantana eradicated patch it should be recorded.

4.7 Other Issues

4.7.1 Discussion with staff brought out following additional issues:

- **Staff Shortage**: There is an acute shortage of staff. Against Sanctioned posts of 12 Forester; 15 FG (as per the version of staff), 2 Forester (BO) and 2 FG are working and 1 Block Officer.
- **Water Scarcity**: There is shortage of potable water for use by staff and labour in the Sanctuary area. Also, plantations/ Nurseries need better irrigation facilities. Urgent need to augment water supply with installation of Tube wells. However, there is sufficient water available for wildlife in the sanctuary, throughout the year.
- **Number of visitors** entering and traversing the sanctuary during organized monthly trek are too many, causing disturbance to wildlife. Tourist zone passes through the middle of the sanctuary.
- There are number of **feral cattle** in the sanctuary which puts pressure on fodder availability and are potential carriers of disease.
- **Stray Dogs** have increased over the period and have disturbed the ecology of the sanctuary. They hunt in packs of 6 -10 animals and are threat to populations of Chital and Sāmbar.
- **Vegetation of Leucinia** (*Leucinialeucocephalla*) and *Prosopis juliflora* (**muscat)** has increased disproportionately (like weed) and needs to be checked. It is hindering grasses and other fodder sp.

CHAPTER - 5

THE STRATEGIES TO OVERCOME THE CHALLENGES

The issues and challenges brought out in the previous chapter need to be mitigated through adopted interventions. Due care has been taken that none of the known biological or ecological principles are violated for chalking out the strategy.
Following broader issues have been classified

1. Boundary issues – External, Internal & Ecological.
2. Wilderness Zone issues
3. Tourism & Eco-tourism Zone issues

5.1. Boundaries

Sukhna WLS has been carved out of Reserve Forest, having an area of 2598.48 hectares, which has a long boundary line along the natural features of constituent hilly terrain having ridges, valleys & nullahs. This has been explained as below:

5.1.1. External Boundaries

The boundaries of R.F. areas mentioned in the Sukhna WLS notification dated 17.2.98 (copy enclosed at **Annexure -2)** states“ as demarcated in the field”. So there is no clear-cut boundary description of the WLS in words although Khasra numbers have been given and boundary pillars have been erected at some places. Therefore, boundary description through pillars with specific marking (GPS Coordinates) and number and natural features or forward & backward bearings, where necessary, needs to be done and record maintained in the Boundary pillar register.

The southern part of sanctuary jurisdiction is demarcated by chain-link fencing (approx. 10 Km) along the village boundaries. Boundary wall (100 metre- 10 ft high) has also been constructed in some portion of the southern boundary along the village **Mahadev**, interlinked chain fencing existed prior to wall, which was prone to encroachment. Wall should replace the existing interlinked chain fence along the common boundary with villages **Suketri, Kaimbwala and Khuda Alisher** also.

In the nallahs at the boundary of sanctuary, special structures made of steel embedded in cement concrete are required to be erected to restrain the animals within bounds of protected area.

5.1.2. Internal Boundaries

Internal boundaries of the WLS, though originally demarcated with clear lines and pillars, have to be maintained. Presently internal boundaries comprise of range, block and beat boundaries and the management unit is being considered as beat. However, the compartment remains the basic management unit. This being a PA, compartment does not essentially restrict to a single operational unit or species specific but can be a tool more for ease of workability and referencing. Thus, this management plan proposed

compartmentalization along natural features consisting of 24 compartments / sub-compartments in 12 beats & their area worked out in Table No 1.5 (Map 1.1) in chapter-1.
The internal boundary of the range should be clearly demarcated by natural features on the ground. The block boundary should be demarcated by painting black rings at 2 metres height of 2 inch width on tree trunks falling at the edge of the block boundary. The beat boundary and compartment boundary can be demarcated by clearing undergrowth in lines up to 3 and 2 metres width, respectively but retaining the trees. Such internal boundaries by clearing the undergrowth shall also act as fire lines and inspection path, respectively. The ~2,600 hectare of Sukhna WLS is presently divided into 2 Ranges, 5 Blocks and 12 Beats.

5.1.3. Ecological Boundaries

During lean periods, animals are likely to venture out from the sanctuary in search of greener pastures including agricultural fields or water. There are stray cases when animals come in human inhabitations through nullahs such as Patiala ki Rao, Sukhna nullah etc. Patiala ki Rao has its own resident faunal population too in the forest patches along the stream such as on the western side of Panjab University and up to vill. Daria along nullah or railways tract on the eastern side. However, mostly animals confine to nullahs, waste land or forested land only.

Therefore, above areas constitute the ecological boundary for wildlife of this PA. Last plan had described this zone along with some forests of Punjab (SAS Nagar FD) and Haryana (Morni FD) which formed part of a radius of 5 km. and termed it as a **Zone Of Influence**.
Extended boundaries of Ecological influence Zone should be shared with FD of Punjab and Haryana. Signages may be put up at prominent places for awareness of public. Help may also be rendered to these departments in case of man animal conflict adjoining such zones.

Accordingly, adjoining part of Chandigarh city, Sukhna nullah and Patiala Ki Rao will also form the zone of influence of this PA in UT. Additionally, adjoining forested and agricultural areas of Punjab & Haryana also form part of ZOI. Their forested areas fall under Mohali (SAS Nagar) FD and Morni FD respectively. However, southern part of sanctuary jurisdiction is demarcated by chain link fencing and brick wall along the village boundaries, so there is no zonal influence in those areas.

5.2. Wilderness Zone

The purpose of creation of wilderness zone is to keep the area for holistic biodiversity management without much outside interference, except management interventions where utmost necessary. Highly eroded/ landslide areas of this zone as well as that of ecotourism zone are to be treated by using vegetative & engineering measures.

5.2.1 Objectives

5.2.1.1 To manage the hydrological cycle for soil & moisture retention in the Sukhna Catchment Area.
5.2.1.2 To manipulate vegetative cover adapted to changing edaphic and climatic factors (micro-climatic factors)
5.2.1.3 Allow ecological processes to happen without much interference.
5.2.1.4 Encourage healthy Prey – Predator ratio through scientific management practices
5.2.1.5 Protection of the sanctuary from theft, poaching and fire in perpetuity.
5.2.1.6 Relief & Rehabilitation

5.2.2 Strategy

To achieve the above objectives, following tenets are suggested:-

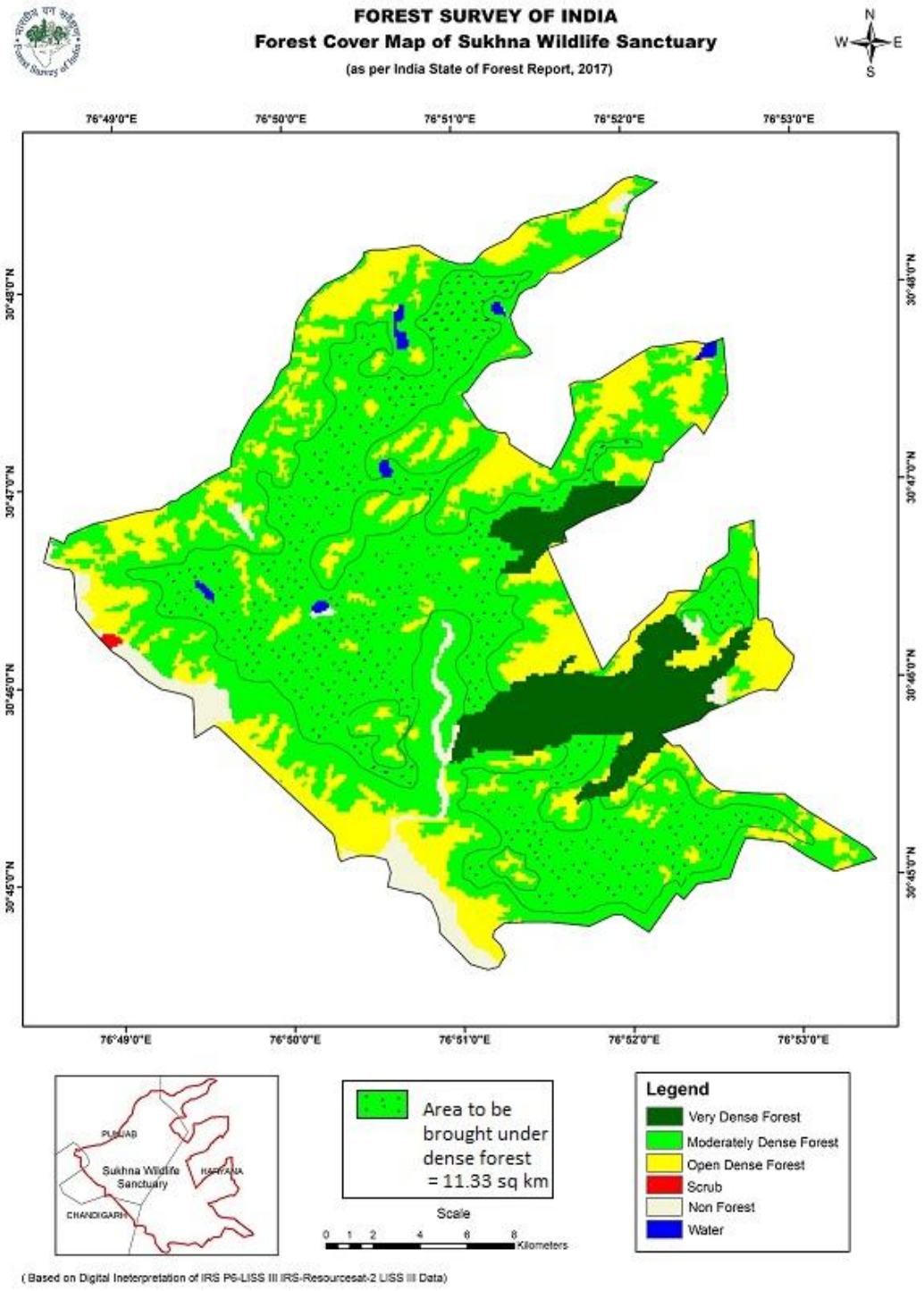
i. The area has to be kept free from biotic interferences.
ii. No rights and concessions are to be allowed.
iii. Collection and harvesting of Timber & Non Timber Forest Products incl. fuel wood should not be allowed.
iv. Strict vigilance be kept to prohibit unauthorized public entry.
v. Following management interventions are proposed:
- All round vigil by the staff
- Use of modern technology for watch & Ward, like Solar powered CCTV Cameras at strategic points to keep a watch on poachers and intruders.
- Infrastructure for support of feld staff.
- Maintenance of waterholes.
- Maintenance of silt retention dams by desilting and cleaning.
- Plantation of Pilkhan, Gular, Ber, Triveni on open spaces along submergence area. Moderately dense forests planted with climax vegetation to form top canopy in moderately dense forests to convert into Dense Forests for 1200 ha. Area (Map). This will add to enhanced Ecotones & visual Diversity to sanctuary area as also moisture in the forest floor.
- Plantation of soil binders like*Arundo donax*at appropriate locations.
- Removal of *Lantana* and replacement by appropriate species such as *Indigofera heterantha, Sesbania, Desmodium, Morus serrata,Ulmusvillosa.*
- Maintenance of roads
- Maintenance of protection camps and watch towers.
- Mairtenance of fire lines.

vi. No part of the area to be transferred to other zones.
vii. Survey for plant or tree diseases such as wood rot fungus affecting Khair in Nathewala valley.
viii. Effective survey to detect animal diseases.
ix. Inventorisation of resources and scientific study to be allowed.
x. Monitoring through periodic annual census operations and vegetative plots to be done.

Point wise delineated objectives are discussed as below:

5.2.1.1Management of Hydrological Cycle:

a) Existing Silt detention Structures, which were constructed over a longer period of time (50 years), have partially silted up and exhausted their storage capacity. These structures were initially constructed by the Soil Conservation Deptt., to check silt flow into the Sukhna lake, (prior to the notification of Wildlife Sanctuary in 1998). To rejuvenate these structures, either desilting operations are required (stabilizing silt properly behind dykes and planting up with grasses and shrubs), or Height of the structures be increased, depending on budget and site suitability. Desilting operations have been taken up in the last Plan period as also formation of dykes, retaining walls, etc. These Silt detention Structures and water bodies have served a useful purpose of soil and moisture conservation. However, above maintenance works are insufficient to meet out the excessive silt flow during monsoon. Therefore, it is suggested that further smaller silt detention structures/ dams and Gully plugs be carried out all over the PA ie. Higher numbers with lesser silt & water storage. Water conservation measures taken inside the PA, also helps in raising the water table in the immediate vicinity (down stream), outside the PA helping in agriculture and drinking water availability.
b) Fragile, steeper slopes need to be treated with suitable vegetative structures. And by retaining walls where required.
c) Gentle slopes to be contour trenched, improving water regime. (Use of grass slips on rims & berms of contour trenches recommended to stabilize them. Trenches should be planted with shade bearing trees).
d) Fresh gully formations to be checked with brushwood dams and gully plugs.
e) Banks of streams/ nallahs to be stabilized with Arundo donax or other similar local grasses/ shrubs.
f) Slopes of several water reservoirs/ Dams are too steep to be negotiated by wild animals to use them for drinking purposes; hence water of these reservoirs is not always available to these animals. Necessary modifications are to be made by providing ‘ladders’ (gentle slopes upto water edge) at least one on each water body.
g) Construction of Breast walls/ retaining wall are required to prevent landslides and flow of debris to the water streams.
h) Rejuvenation of Old Wells: The PA is interspersed with several old wells, majority of which are non-functional, as on date. These Wells can be made functional with little effort and expenditure. These Wells will the serve purposes of drinking, irrigation to the nurseries/ plantations and supplement Waterholes for Wildlife.



(Map 5.1- Showing Areas to be brought under Dense Forest)

5.2.1.2 Manipulation of Vegetative Cover :

(i) Along the water streams in the valleys:

- a) Water regime in the sanctuary has improved over the last 50 years or so, with creation of number of Dams, other water bodies, and soil and water conservation activities. As a result, area surrounding such water bodies, now is supporting mesophytic vegetation and has improved the survival of existing vegetation considerably. This warrants change in vegetation to next seral stage. Above **Map**(Map No 5.1)is showing areas which can be brought under **Dense forests** with plantation of 100 trees per hectare with tall climax species over a period of next 10 years.Therefore, it is required that vegetation **around water bodies along streams**, following species be brought in:-

Top Canopy- Selection should be made from following species: *Sterculia alata; Pterospermumacerifolium, Shorearobusta, Adina cordifolia, Bischoffiajavanica, Alstoniascholaris.*
Middle canopy- *Cordia myxa, Acer oblongum, Saracaasoca, Craetiva religiosa, Schleicheraoleosa, Mitragyna parviflora, Holoptelia integrifolia, Schizygiumcuminii, Mangifera indica, Cordia myxa.*
Shrubs- Edible shrubs like, *Indigofera heterantha, Sesbania sesban, Morus serrata, Ulmusvillosa, Zizyphus jujube, Carissa carandas (Karonda), Artocarpus heterophyllus, Grewia oppositifolia.*
Grasses- *Arundo donax* along water courses for stabilization; *Setaria glauca, Pespellum sp., Oplis manus, Chlorophytum, Cymbopogon* spp*, Imperatacylendrica, Bothriochloapertusa, Vetiveriazizanoides, Legumes* like clover*, Medicago falcata, Trifolium alexandrinum, Desmodium* spp.
These grasses are required to be planted in the plain lands along water courses after planting Arundo donex on the edges.
Plantations of *Eucalyptus & Prosopis juliflora*- Area has large plantations of *Eucalyptus, Prosopis, Leucinia, Jatropha*. We need to remove these unwanted species, in stages, in small patches at one time rejuvenating the patch with desired species before moving ahead being dry deciduous forests, to create suitable habitat for fauna. Following prescriptions may be kept in mind while initiating removals.

a) Eucalyptus needs to be removed by cutting and lifting the material from the sanctuary area as the timber, leaf litter may bring in allelopathic effect, suppressing growth of other desired species. Since the overall of the valleys as observed from vintage points, show a continuous green cover of top canopy by eucalyptus, the openings in the eucalyptus has to be essentially smaller without creating bigger openings (which should scattered, over a larger area, not exceeding 15 stems per Ha) and replaced by taller sp. Such as Sterculia alata, Shorearobusta, Bishcofiajavanica, Alstoniascholaris, Adina cordifolia, Pterospermumacerifolium etc.
b) Prosopis juliflora should be removed only from the valley part and not from the southern slopes or Hill tops (ridges). Yearly removal of Prosopis should not exceed 10% of the total area of flood plains under Prosopis (approx. 600 Ha) i.e 60 Ha annually. These should be replaced by plantations of tall plants of middle canopy trees, such as Syzygiumcumini (Jamun), Mangifera indica, Holoptilia integrifolia, Mitragyna parviflora, Schleicheraoleosa etc.

c) Leucinialeucocephala (subabul) is not conducive for consumption by animals because of high mimosin content. This being a wildlife area, leucinia is required to be removed and replaced by fodder yielding small trees and bushes such as Adananthera sp., Sesbania sesban, Moringa oleifera, Enterolobium dulce, Tamrind, bushes such as Indigofera heterantha, Desmodium grandiflora. Advance growth of Carrisa and Zyziphus should be retained.

Grasslands- The area ahead of Range office (Nepli gate), at the confluence of nullahs, flood plain is required to be brought under grassland management having a clear visibility (of 800 m or higher and 2Km from Kansal gate), which will be ideal for free ranging herbivore population. The area needs to be planted with grasses such as *Bothriochloa intermedia* (~2m. tall), *Brachiariabrizantha* (1.2m. tall), *Cenchrus ciliaris, Cenchrus setigerus, Chloris gayana, Chrysopogon fulvus, Coixlacryma-jobi, Diplachnefusca, Eulaliopsisbinnata, Heteropogoncontortus, Panicum antidotale, Panicum maximum, Vetiveriazizanoides, Paspalum dilatatum*, and legumes such as: *Indigofera hirsuta, Macroptiliumatropurpureum, Macroptiliumlathiroides, Clitoriaterntea, Stylosantheshamata, Stylosanthes humilis*, *Desmodium&Sesbania* spp.

The rims, berms and slopes along the watercourses should invariably be planted with Arundo donax for 1-3 ft strip in the above defined plains.

The remaining grassland should have dense mat of aforesaid grass species intercropped with the leguminous plants mentioned above. All stagnant internal water bodies should have above grasses and legumes **but no *Arundo donax***.

(ii) Along the hill slopes:

(a) **Southern slopes:** Contour trenching be done with staggered trenches of 2 to 2.5m x1m x0.75m (lxdxb) filled with mixture of farm yard manure:sand:clay in 1:1:1 ratio with a thoroughly mixed pyrilite rock or water retaining gel (gelatin gel or any other and planted with shade bearing species such as *Dalbergia sissoo, Zizyphus jujube, Prosopis cineraria, Cordia myxa, Ficus infectoria, Ficus glomerata, Alstoniascholaris, Butea monosperma.* The pits after planting need to be soil mulched with the grass blades of Saccharum munja and wild date palm leaves growing in the vicinity. The berms & brims of loose soil need to be sown with small grass seeds such as *Dicanthiumannulatum, Bothriochloapertusa and Cynodondactylon* etc. Existing *Prosopis juliflora* and *Leucinialeucocephala* needs replacement in small patches at one time, on these slopes while retaining advance growth of other species.

(b) **Northern slopes:** Northern slopes have higher moisture levels. The most common species is *Annogeisus latifolia* (Chhal) which forms large pure patches. The other species are *Diospyros montana (kendu), Terminalia tomentosa*, etc. This can be planted with *Lagerstroemia parviflora, L. speciosa, Milletiaovalifolia, Sesbania sesban, Sesbania grandiflora, Ficus infectoria, Ficus glomerata, Siris (Albizzia lebbek, A. procera, A.stipulata*). *Adina cordifolia &Holoptelia integrifolia* can also come up there. Only open patches need to be covered or areas blank left after removal of Prosopis juliflora should be taken up. Methodology should be same as contour trenches on higher reaches, while pit planting can be deployed at lower slopes with leafy mulches over the soil.

(iii) Ridges:

In any conglomerate formation, it is the ridges which form the formidable challenge to vegetate sufficiently for providing a green cover all round the year so as to brave torrential rains, short spells of rain or hail storms. These are prone to extreme soil erosion leaving only the underlying strata. Like contour trenches, ridge trenches required to be formed and filled with fym:clay:sand in 1:1:1 ratio mixed with water retentive gels and soil mulched after planting & watering. Rims & brims to be covered with Dicanthium, Bothriochloa and Cynodondactylon grasses. Here all xerophytic and advance vegetation is tried to be retained. Tall plants of *Shorearobusta, Alstoniascholaris, Cordia myxa* should be tried during rains. A second canopy if required, should be planted with *Prosopis cineraria, Sebaniaseban& Dalbergia sissoo.*

5.2.1.3 Ecological Processes:

a) **Packs of stray dogs**, which have made sanctuary their home, have established as carnivore species in the PA. Their numbers are increasing and are resorting to group hunting of chital and Sambar. As per an estimate, there may be 4-6 packs each having 6 – 10 individuals. These are required to be eliminated from the Sanctuary. If this is not accomplished, this PA will have no free ranging herbivore to boast off. Requisite procedure under relevant acts viz., WL PA (1972) & Cruelty to Animals Act (1960), and approvals thereof may be sought from the appropriate authority.

b) **Re-introduction of Ghoral&Kakkar** (Barking Dear) is required to be done. These species are adapted to steeper slopes and will improve not only prey base in the sanctuary but add variety to the fauna and is available at this altitudinal range elsewhere in the North western Himalayas.

c)**Weed Eradication:**

Weed infestation in Sukhna WLS is a menace which reduces grazing potential for wild herbivores, hinders regeneration and is a fire hazard as well. Weed eradication program has been successfully carried out in the sanctuary and now of the entire area of Sukhna WLS of 26 sq km, only sporadic infestation of Lantana remains. The management initiated a 10 year program for eradication of Lantana weed in a three pronged strategy from 2001 to make the area totally free from Lantana by 2010. Manual uprooting was repeated till 3 years to ensure it does not reappear after first removal. It was followed by enrichment planting with suitable indigenous fruit and fodder trees like Papri, Gular

Prosopis, Dhak, Subabul, Amla, Bauhinia, Bamboo. Grasses like *Saccharum*, *Arundo donax* etc. are also coming up in open patches. Parthenium, which is found along paths and roads (soil worked areas), forming dys-climax, should be uprooted manually prior to fruiting, each year.

d) Improvement of Bamboo Thickets: Bamboo (Dendrocalamusstrictus) is naturally occurring in the area. Bamboo needs better management by way of cleaning of clumps, thinning. Bamboo is important fodder species and should be further improved in the area by planting sp. Like Bambusa bamboos, D. hamiltonii, D. strictus along nallahs.

5.2.1.4 Improve Prey- Predator ratio:

The prey base in the sanctuary is low. As a result, carnivore is not much sustained in the sanctuary. **TL- I** is autotrophs or plants. Prey base at **Trophic Level - II** has to be herbivores, for becoming part of the food chain at higher levels. These require vegetation for the year round feeding. Dry deciduous forests are not able to produce and provide much green fodder to herbivores during the heat of summer months. The animals tend to migrate closer to water and green pastures which can exist only under dense upper canopies. This has already been discussed in the preceding *para(e*). However, **Trophic Level-III**can be well developed if competition by stray dogs to jackals, foxes, jungle cats is removed. **Top of the Trophic Levels** in this part of the country is occupied by Leopard. Therefore, resident population of leopards may not be possible as animals at lower level will also migrate outside the PA in the continued jungles of adjoining states to escape predation.

This may become **a management perspective** in the **grassland management**. That after employing above tools animals may not dot on the grassland range. When the camera traps confirm temporal distribution of herbivores availability, degree of total predation (noted through surveys in and around grass land on a continued basis for a short duration say a week in each peak season) will determine the sustainability of any species in the grassland. If this is not achieved i.e. rate of predation is higher, temporary artificial barriers of 8 ft. high interlinked fencing with barbed wire on top, has to be created to reduce specific predating in grass lands. This should help to attain desired objectives of availability of herbivorsin grassland through out the day and bring back balance in prey predator ratio in the area.

5.2.1.5 Theft, Poaching & Fire Protection:

The PA is divided into management units up to Beat level. This is also to check theft of timber and non-timber forest produce, poaching of wild fauna by the illegal traders or for personal hunting gratification and protection from fire. 12 beats in an area of 26 sq. km. tends to make each beat on an average more than 2 sq. km. area. This area is large enough to be traversed in a single day or visit. Therefore, vigil has to be maintained along the vantage points and gangs during the poaching or fire seasons. Beats have therefore been proposed to be divided in to 24 compartments or sub-compartments for localizing the area where an intervention is contemplated.
Minimum equipment or arrangement with FSI or **NRSA for satellite** monitoring **in case offire** direct to the concerned staff on their mobiles is required to be attuned. Equipment and gangs having duty roaster in different valleys are to be sensitized before the fire season. Table no 4.1 in chapter 4 highlights that fire incidences in the sanctuary over the past 9 years have been restricting to a particular valley of Nepli nallah. It is therefore, imperative to look into causes which appear to be as described below-

i) A high tension wire passes through the Nepli valley, across the sanctuary and adjoining Haryana forest area. During lean period, it is important to keep a width of 10 m below the HT line devoid of any vegetation; so that the incidences of sparking or breaking loose of any wire may not burn the forest. The area may be stocked with palatable grasses with moisture conservation works, so as to enhance fodder availability and stocking.

ii) That the escaped fire coming from adjoining forest area (Morni Hills) or adjoining villages, are effectively checked by keeping fire gangs in readiness and placed in the area during such fire season. Fire watchers be kept on watch Towers erected for monitoring fire, on the onset of fire.

iii) Fire lines in these fire prone areas are required to be cleared well before fire season. Roads and Nallahs in the areas be also treated as fire lines and debris collected and control burnt well in time.

For **theft and poaching**, an intelligence net work is required to be created all around the sanctuary area in the villages touching the bounds of PA by the concerned Beat FG in the neighbouring villages. A small amount for rewards or cost of information is required to be set apart after taking up with the appropriate Govt. authority.

5.2.1.6 Reliefs & Rehabilitation:

Establishment of Rescue & Rehabilitation Centre: A new **more elaborate rescue centre** is the requirement of the PA for all small and large species, as the present rescue centre has facility to cater to the needs of only one to two species that too large herbivores.

5.3 Tourism & Eco-tourism Zone

At present, the sanctuary does not have a clear cut demarcation in respect of Wilderness or Tourism & Eco-tourism Zones. This has resulted into large scale movement of the trekkers/ city dwellers during the awareness trekking program each month, traversing through the middle of the PA by groups of people totaling to sometimes more than a thousand individuals (data in Table No. 6.1). Resultant impact affects movement of animals away from those areas where such human activity occurs.

This has necessitated formation of a separate tourism & eco-tourism zone along the outer periphery (south-west) of the PA, so that majority of area is available for designated wilderness zone (Map 6.1) demarcating zones & proposed new treks & existing treks).

This zone has following other requirements:

2017. Beautifying those water bodies and paths which fall *en route* visitations by people by planting shade trees i.e. trees with dense foliage such as *Saraca indica, Schleicheraoleosa, Magnolia grandiflora, Pterospermumacerifolium* . Flowering bushes and trees to **enhance visual diversity** of the area such as *Aesculus indica, Milletiaovalifolia, Sesbania grandiflora, Bischoffiajavanica*.

(ii) Construction of trekking routes with stabilized soil of the cut surfaces on the edges or lined edges to avoid soil erosion.

2017. Construction of raised paths on angles in between to afford views in jungle area.

2017. Development of Parking lots near the gates.

2017. Construction of a canteen cum souvenir shop & public conveniences in the Parking area near the gates.

(vi) Construction of hideouts and visits to watch towers for affording wildlife viewing.

(vii) Involvement of the community of neighbouring villages for nature guides, for cycling tours, for running facilities such as ticketing centres, etc.

These aspects have been elaborated in chapter 6.

CHAPTER 6

Management of Tourism zone
And
Conservation Education

6.1 General

Nature Tourism is the order of the day, where a major chunk of tourists, world over prefer visiting the natural areas encompassing forests and wilderness.This may be so because it helps people to relax away from daily hustle bustle & excessively busy city lives which ill afford opportunities for recouping from mental fatigue. While tourism is a growing industry at a pace faster than other sectors, much is still left here to be achieved.

Tourism when linked with economic upliftment of the local communities by affording them opportunities to earn their livelihoods from it, is termed as **ecotourism.** The changing environs due to enhanced emission of green house gases from human luxuries and necessities, increasing human populations and settlements and shrinking wilderness, raise concerns for bringing in awareness to the visiting masses. This includes values of preserving nature & natural resources, not to overuse what nature has provided. This forms the basis of conservation education as part of desired tourism & resultant ecotourism.

Healthy natural ecosystems are critical to the ecological well-being of all living entities, and especially for the economic security of people. Ecotourism has the potential to enhance wilderness protection and wildlife conservation, while providing nature-compatible livelihoods and greater incomes for a large number of people living around natural ecosystems. This can help to contribute directly to the protection of wildlife or forest areas, while making the local community stakeholders as owners in the process.

6.2 [2]Principles of Ecotourism

Those who implement and participate in ecotourism activities should practice the following:

- Adopt low-impact tourism that protects ecological integrity of wilderness areas, secures wildlife values of the destination and its surrounding areas.
- Highlight the heritage value of India's wilderness and protected areas.
- Build environmental and cultural awareness and respect nature.
- Facilitate the sustainability of ecotourism enterprises and activities
- Provide livelihood opportunities to local communities

[2] Guidelines for Ecotourism in and around Protected Areas, MoEF (2011)

- Use indigenous, locally produced and ecologically sustainable materials for tourism activities

Detailed Guidelines as prepared by the MoEF may be perused while undertaking ecotourism activities.

Ecotourism is defined[3] as "responsible travel to natural areas that conserves the environment and improves the welfare of local people.". While "nature-based tourism" simply describes travel to natural places; ecotourism is a type of nature-based tourism that benefits local communities and destinations environmentally, culturally and economically. Ecotourism represents a set of principles that have been successfully implemented in various global communities, and are supported by extensive industry and academic research.

Ecotourism is about *uniting conservation, communities, and sustainable travel*. This means that those who implement and participate in ecotourism activities should follow the following ecotourism principles:

- Minimize impact.
- Build environmental and cultural awareness and respect.
- Provide positive experiences for both visitors and hosts.
- Provide direct financial benefits for conservation.
- Provide financial benefits and empowerment for local people.

Ecotourism, when properly executed based on these principles, exemplifies the benefits of socially and environmentally sound tourism development. (Bruntland Commission, 1987).

Ecotourism in Pas requires a holistic approach, taking into account several environmental, social, cultural, economic, political and technological processes and parameters, while at the same time also respecting ecotourism principles.

6.3 Objectives

i. Educate people about the biodiversity/ wildlife and need for their conservation.
ii. Create awareness amongst a larger section of the society and gather public support.
iii. Improve quality of educational, recreation and wilderness experience.
iv. Assist the visitors in discovering the wonders of nature and its intricate relationship as a leisure activity, while generating livelihood to the needy in the neighborhood of PA.

6.4 Eco-Tourism facilities can be broken into components:

A) Physical aspects of Tourism – includes-

a) **Access to PA**:

There are 2 entry gates to Sukhna WLS viz. Kansal Gate and Nepli Gate.

(i) The route to Kansal gate is via village Khuda Alisher or village Kaimbwala of U.T. Chandigarh at a distance of 3 Km from Chandigarh.

[3](International Ecotourism Society, 1990 cited in TIES 2006)

(ii) The route to Nepli gate is via village Suketri of Haryana at a distance of 3 Km from Chandigarh.

(iii) It is possible to enter from one gate and come out from the other through an 8 Km nature trail, on- foot after completing the visit to the sanctuary.

b) Access inside PA

Trails, Roads & Paths – 8 Nos.

a.	Nepli Inspection Hut to Kansal Log Hut	8 km
b.	Nepli gate to Nepli Inspection hut via Ghareri	5 km
c.	Nepli gate to Nathewala and back	6 km
d.	Nepli gate to Nepli Inspection hut via Nathewala	6 km
e.	KansalLoghut to Nepli gate	6½ km
f.	KansalLoghut to Sukhomajri	5 km
g.	KansalLoghut to (towards Bhagwanpura) back to Kansal Loghut	5 km
h.	KansalLoghut to (towards Nepli) back to KansalLoghut	2½ km

c) Delineation of Tourism zone

Present popular tourist circuit for the monthly (Sunday) trek traverses entire sanctuary (Map 6.1) and causes lot of disturbance to the wildlife. It is popular trek and lot of citizens (young and old alike) join the trek. Data provided by the FD shows that on an average, 800 – 1000 visitors attend the monthly Sunday/ Holiday Trek (Table 6.1). Good facilities like drinking water and refreshment are provided to the visitors. New eco-tourism zone is proposed which includes treks proposed to be delineated along south-west periphery of the PA, freeing the main wilderness zone of tourist pressure (Map 6.1). Two Tracks are proposed within the tourisam zone.

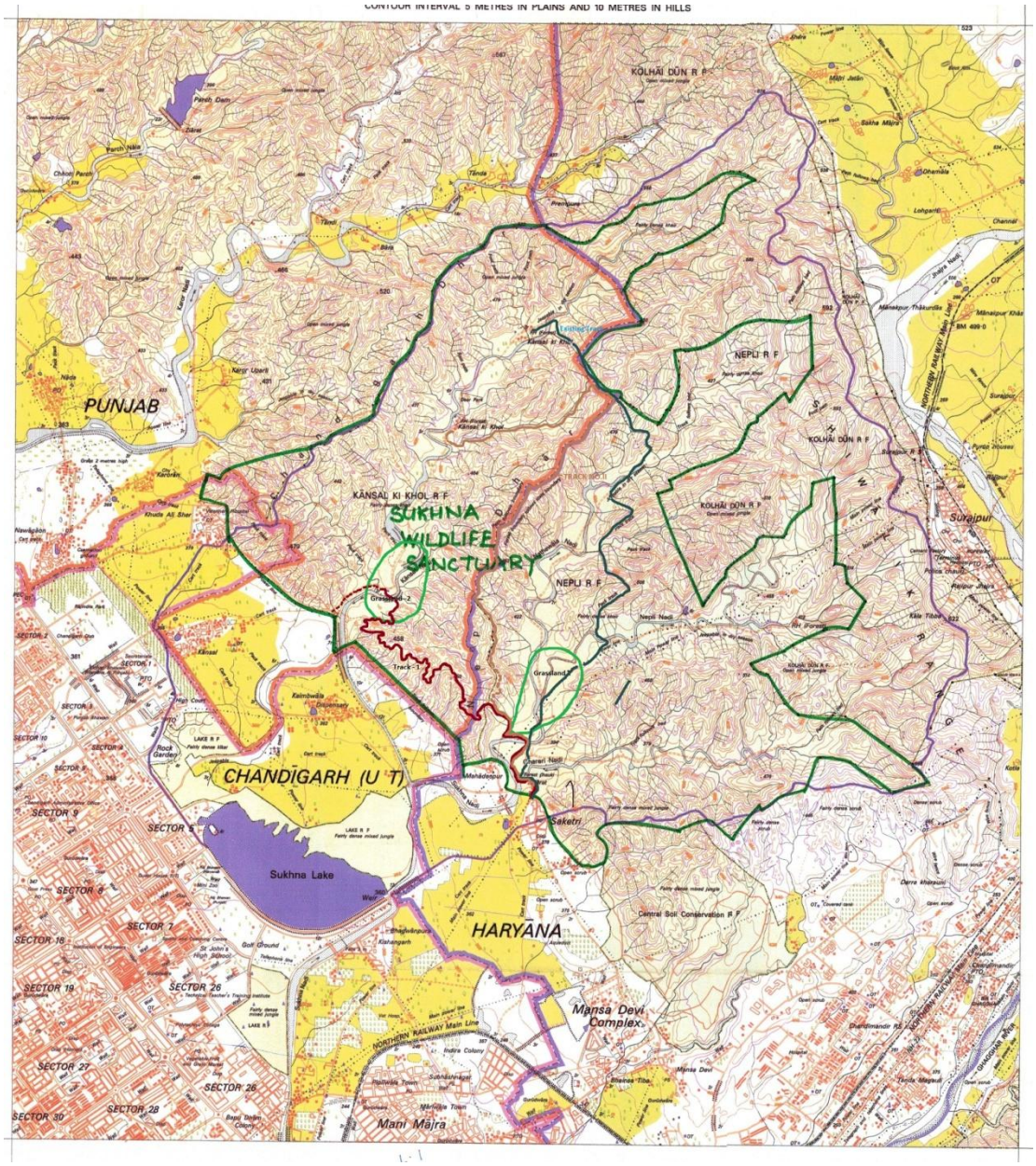
Track-I: This track is approx. 5 Km long which starts from Nepali Forest Range office, traverses along the Nepali stream, across the stream through forested area, rises to the saddle of North Weteren ridge, falls to Dam (Mahadevpur) and along the south western peripheral interlink chain fencing to the Kansal village inhabitation. From there, the path requires to be constructed to the top of ridge above Kansa Devi Temple. From there the path will be formed to the adjoining grassland, across the Kansalchoe to the old well, along the road from Kansal gate to Log Hut. This track is recommended to be used for popular Sunday/ Holiday Trek attended by around 800 – 1000 visitors.

Track-II: This track is approx 10-12 Km. This will also start from Nepli Forest Range office, across Nepli stream, from the edge of the Nepli grassland area, climbs to North western ridge, follows the ridge along the range boundaries of Nepli&Kansal range, uptill Watch Tower on the existing track from Nepli to Log Hut. From there on the existing path will be followed downhill to the road from Memnewala to Dam no 2, further on to Dam no 3 followed by track to Dam no 4 and road leading to Memnewala and

from Memnewala to old Forest Rest House.. This track is recommended to be used for smaller groups accompanied by Nature Guides. This track should be used only after widening the footpath to minimum 3 ft. wide easing the gradations and realigning directly from range boundary pillar to downhill into the Nepli gate – FRH road.

Track III: The existing Track is approx 10-12 Km and falls in proposed Wilderness Zone in the sanctuary. This track is to be used by wildlife staff, experts and wildlife enthusiasts when accompanied by Nature Guides. The path needs to be incorporated with Wildlife viewing points & hideouts.

Details have been included in Map given as below (6.1):



Map 6.1: Tourism zone map showing existing & designated tracks

d) **Developing Infrastructure**- Tracks, Cycle Paths, Rest Houses, Water Holes, Hide outs, Watch Towers, Tree top Machhans.

Infrastructure availability and areas of tourist interest are as mentioned below:-

i. Kansal Log Hut.

ii. Kansal Inspection Hut.

iii. Nepli Inspection Hut.

iv. Watch Towers – 12 Nos. (but excluding Fire watch towers situated in wilderness zone.

v. Nature Trails – 8 Nos.

i.	Nepli Inspection Hut to Kansal Log Hut	8 km
j.	Nepli gate to Nepli Inspection hut via Ghareri	5 km
k.	Nepli gate to Nathewala and back	6 km
l.	Nepli gate to Nepli Inspection hut via Nathewala	6 km
m.	KansalLoghut to Nepli gate	6½ km
n.	KansalLoghut to Sukhomajri	5 km
o.	KansalLoghut to KansalLoghut (towards Bhagwanpura)	5 km
p.	KansalLoghut to KansalLoghut (towards Nepli)	2½ km

Further, it is proposed to add new Cycling Paths, Hideouts, Tree –Top-Machhans, to give better experience of the PA to tourists.

e) **Creating Facilities for Tourist** – i) Parking facilities ii) providing noiseless public transport inside PA (Electrical vehicle/ Elephant ride/ Camel ride/ Cycle), iii) Refreshments & Canteen facilities, iv) Drinking Water Facilities, v) Garbage collection (Dustbin) facility, vi) Rest rooms/ Toilet facility, vii) shady sitting places including Gazebos, viii) Souvenir shop, ix) Sign boards, x) life size models of wild animals, landscape models, xi) Boating Facility- Kansal lake (near Kansal log hut) be further developed for regulated boating facility.
All these are new ideas with twin objective of improving visitor experience as also providing additional Livelihoods to adjoining village communities, which will also add to eco-development of the area (elaborated in chapter 7).

f) **Tourist Safety**: Providing safety measures for the tourist is of utmost importance. Proper warning signage's to be beware of wild animals and keeping small children with them, should be displayed prominently.

g) **Safety of Wild animals**: Similarly, safety of wild animals should also to taken care of by preventing any feeding by visitors or avoiding any close inter-phase. Visitors not to be allowed to carry arms or other weapons which can be a danger to wildlife.

h) **Current Visitations**:

Table 6.1 Year-wise Visitations in Sukhna WLS

S. No	Year	Number of Person Visiting Wildlife Sanctuary
1	2005-06	6580
2	2006-07	7649
3	2007-08	10733
4	2008-09	10828
5	2009-10	8154
6	2010-11	8219
7	2011-12	7061
8	2012-13	5755
9	2013-14	5495
10	2014-15	6416
11	2015-16	6127
12	2016-17	6655
13	2017-18	6440

B Services:

a) **Entry Gates**: Presently visitation to Sanctuary area is allowed through the permits issued by Chief Wildlife Warden, Chandigarh. However, this practice should continue only for wilderness zone of the sanctuary. The tourism/ eco-tourism zone should be allowed to be visited with tickets issued at entry gates for the people to move in accompanied by certified/ registered Nature Guides.

a)**Nature Guides**,

To compensate adjoining villages for the lost opportunities because of PA, as also to inculcate interest of visitors in wilderness and its processes, institution of Nature Guides may be propagated. Youth from these villages be encouraged, selected and trained as nature guides to augment their income as a self employment opportunity. Visitors could be allowed inside PA in groups of 15- 20 under the supervision and guidance of one Nature Guide, who could charge a defined fee from the visitors which should be prominently displayed at the gates.

b) **Interpretation centre**,

To enrich the experience of visitors and improve their knowledge base, interpretation centre be developed providing life-size models of wild animals, method of identification of wild animal signs (pug marks, squat, sounds, others),

ecosystem processes, wildlife documentaries etc. It is proposed to develop two such centers, one on each gate, in a phased manner. A common complex with canteen facilities, Souvenir shop and Interpretation Hall can be merged into one complex. Existing old FRH near Kansal Gate may be considered for this purpose after due modifications.

c) wildlife movie shows,

i. d) pamphlets: Good, informative publicity material and pamphlets can help in publicity and knowledge base of visitors.

i. **Liaison:** Inter agency co-operation between forest deptt, tourism deptt. cultural deptt. and NGOs should be developed to promote bio-diversity awareness through Eco-tourism in Sukhna WLS. Publicity can also be garnered by putting up hoardings at Chandigarh Airport, railway station and with the help of media. Participation of local communities can also be ensured by allowing sale of local items, T-shirts, caps,(Souvenir shop) etc.

6.5 Problems

There are many problems which deter tourists from visiting an area. On the other hand there are certain problems which are created due to tourism. These problems have to be identified and mitigation strategies worked out if eco-tourism is to be developed in Sukhna WLS for conservation education.

6.5.1. Problems For The Visitors

i. Interpretation facilities – The interpretation facilities are inadequate.

ii. Package tours – Tourist circuits do not cover Sukhna WLS, as on date.

iii. Communication – There is no bus service on week-ends or holidays for the general tourist to visit Sukhna WLS. Only those with personal vehicles can manage to reach.

iv. Inadequate Support Staff- There are limited support staff to take care of tourists and show them around.

v. Low sighting of animals – The visitors expect to see majestic, free ranging animals in the wild. But animal sighting here is not assured.

vi. Inadequate Rest room, drinking water, public conveniences and refreshment facilities.

6.5.2. Problems Due To Visitors

i. Disturbance to Wild Animals – Excessive, indiscipline and unregulated tourists in the PA causes disturbance to animals.

ii. Pollution – Tourism generates a lot of non-biological garbage.

iii. Pressure on resources – Tourism creates extra pressure on resources like water, etc.

iv. Unregulated Development – In the urgency to cater to tourism demands for infrastructure, accommodation etc, large unregulated development starts in the area.

v. Fire Hazard – There are chances of increased fire incidences due to tourist neglect.

6.6 Signages:

These may be displayed at appropriate locations for awareness of visitors. What should it display, and where signages be displayed and whom to approach for display are important aspects to watch on.

6.7Night stay:

Night stay inside the sanctuary in Rest Houses/ Inspection Huts should not be allowed, being in the wilderness zone which may cause disturbance to the animals as well as other related problems since the sanctuary is spread over just 26 sq kms,. However, hide outs may be allowed to be visited in the eco-tourism zome.

6.8 Routes Display:

Map of Sukhna WLS may be prominently displayed at the 2 entry gates and at all secondary roads/ intersections showing directions and routes to be taken by the visitors. The display boards should be weather proof and merging with surroundings.

6.9 Publicity:

Leaflets, pamphlets, brochures, reading material, etc. should be prepared and distributed to the nature lovers visiting the sanctuary. However, Caps, T shirts and posters can be made available for sale.

6.10 Grasslands & Visitor Experience:

Grasslands proposed in the chapter 5 need to be brought on tourist trails so that visitations may also afford view of herbivores to them. Also, certain sites near dams can be developed with scenic view and fruit trees which are frequented by wild animals to increase chances of animal sighting.

6.11 Herbivore Safari:

The open areas of silted up dams can be considered for development of grasslands. The area of 1-2 ha in a continuous patch reclaimed from *Lantana* can also be developed as meadows for herbivores by planting *Dhoob*etc. Few such areas as

above may be developed in tourism zone for animal congregation to enhance visitor experience by planting palatable grasses.

6.12 Sector Tourism:

A circuit tourism can be evolved in liaison with local tour operators covering other places of tourist interest in Chandigarh like rock garden, botanical garden etc.

6.13 Trainings, and Capacity Building:

This should be done once every year with management staff, hoteliers, tour operators, media etc to cope up with tourism requirements.

6.14 Nature Education Camps:

This should be organized twice a year for school children to promote conservation education and build awareness.

6.15 Safety:

Safety of Eco-tourists inside Sukhna WLS should be ensured and trekking on nature trails should be permitted with authorized guides only.

6.15 Closure of WLS:

The sanctuary should remain closed on 2 festivals viz. Holi and Diwali. These two festivals are celebrated with much rejoicing and revelry accompanied by dholak, noise, colors and fire crackers which may disturb the wild animals. Besides, the sanctuary should also be closed to public during 4 months of June to September, which includes rainy season.

6.16 Regulations, Monitoring and Evaluation

6.16.1 Regulations

i. WLS should be opened for visitors throughout the year except Holi and Diwali and during breeding season to be decided by the management.
ii. Entry to the Wilderness Zone should be allowed only to the permit holders issued by the CWLW or authorized officer. However, tickets be issued to the visitors at the Entry Gates for visiting Tourism / Ecotourism Zone along with the locally registered Tourist or Nature Guides.
iii. The speed of the vehicles inside the WLS will not exceed 10 Kms. per hour. The WLS can be visited between sunrise to sunset and no night stay inside will be allowed in the wilderness zone. However, visit and stay at Hideouts and Watch Towers for viewing wildlife at night within the Tourism Zone when accompanied by registered tourist or nature guides to be allowed by the authorities so defined by/or CWLW.

iv. Trekking on foot will be allowed only on identified nature trails either in the organized trekking events by the Department or when accompanied by the registered Tourist Guides.
v. Shouting,blowing of horn or making any other kind of noise is prohibited.
vi. Carrying of arms/ weapons inside the WLS is a punishable offence.
vii. Dogs/ pets are styrictly not allowed inside the WLS.
viii. Use of spot/ search light, flash on cameras is restricted.
ix. Carrying of liquor, cigarettes and lighters are not allowed.
x. Not littering of plastic bags, mineral water bottles, wrappers, plastic glasses, cold drink bottles etc shall be done inside the WLS. However, dustbins blending with nature may be provided at appropriate locations.
xi. Tourists be advised not to carry radios, tape recorders, transistors, CD players etc inside the sanctuary.
xii. No article, material or object shall be carried out from inside the WLS.
xiii. The provisions of Wild Life (Protection) Act, 1972 shall be strictly enforced.
xiv. The management will display the DO's and DON'T's to the visitors at prominent locations.
xv. Fines may be imposed by the management for contravention of the rules.
xvi. Wilderness zone should not be opened to tourists.

6.16.2 Monitoring and Evaluation

To monitor the various impacts on habitat and fauna, an analysis of tourist information may be done critically on following lines:-

i. Purpose of visit of tourist.
ii. Number of Indian or foreigner tourist.
iii. Peak period of visitation.
iv. Rise and fall of visitor number.
v. Proportion of students, naturalists, media persons, scientists, judiciary, politicians.
vi. Level of soil erosion and compactness.
vii. Animal behavioral changes if any.
viii. Demographic changes if any.
ix. Waste generation and its disposal.
x. Visitor – staff ratio.

6.17 Visitor Feed-Back and Its Evaluation

A questionnaire may be designed for taking visitor feed-back for evaluation and improvement where necessary. It is not advisable to prescribe any format at this stage which can be evolved by the management and standardized as per site situations and kind of tourists. However, it should invariably contain specific columns for activity

preference of tourists, expectations from the sanctuary and degree of satisfaction. Good forests, easy spotting of wildlife, picturesque water bodies, sprawling lawns of 'KansalLoghut' and 'Nepli inspection hut' and serpentine nature trails are attracting Nature lovers and other visitors to Sukhna WLS in hordes.

6.18 Funding

Nature conservation requires large investment and the results are long term and so are not visible in a short time. All sources of funding shall have to be tapped like the Chandigarh administration, MoEF, NGOs, Famous business houses, Tourism Ministry, Foreign aids etc. Chandigarh is a cosmopolitan city inhabited by high income society who have paying capacity. To thrive to become a self sustainable unit, the management may fix appropriate fee from tourists as entrance fee. Schemes like adopting particular species in the PA by business houses should be started to generate funds for species and appropriate space for display of their courtesies / donations be carried out in and around sanctuary area.

6.19 Interpretation and Conservation Education

Interpretation means a process of developing visitor interest in an area so as to enable him to appreciate the intricacies and have a better perception and understanding its beauty and complexity. It should clear the doubts and provide information of the area and its importance without asking. The interpretation center is to be designed so that maximum information is displayed through write-ups, photographs, file pictures, specimen etc. along with the history of the area. The important features of animals/birds/ reptiles and their interdependence should be displayed through innovative photographs. The language should be catchy which should stick to the mind of the reader for long. The Interpretation centre should have the following facilities:

i. Reception cum information desk.
ii. Three dimensional replica of the area.
iii. Souvenir shop.
iv. Diorama display of park.
v. Photomurals, laminated informative maps.
vi. Cultural and traditional exhibits.
vii. Animal exhibits collected from the forest.
viii. Digitized calls of animals.
ix. Directional signs of the park.
x. Any other thing of relevance.
xi. Interpretive Signs – They should be weather and vandal proof, blending with background and bilingual at a convenient height.

CHAPTER 7

Eco-development of Areas Adjoining Sanctuary

Eco-development means 'development' that is economically, ecologically and socially sustainable. It involves site specific Protected Area level planning by local people themselves to achieve sustainable development of local resources, alternative to fuel, fodder and timber and schemes to provide job alternatives to individuals and families, in order to reduce forest dependent livelihoods to sustainable levels and to ensure people's active participation in protection of the PA resources.

There are no villages inside the Sukhna WL sanctuary area. No rights and concessions have been allowed to the people living around the sanctuary area. As such there is no land use interface with the adjoining villages on the periphery of the sanctuary. No grazing is allowed inside the sanctuary area. The villages on the periphery are also not dependent upon the forests for their livelihood or for any other purposes. As such there is minimal man-animal conflict around the sanctuary. The places where biotic interferences was likely or which were prone to encroachment have already been fenced with chain link fencing (10 Km long) which has been further strenthened by boundary wall on most vulnerable areas by the department (100 metre). This need to be further strengthened to make it fully secure. Municipal services around the sanctuary need to be strengthened as dumping of garbage, inside the sanctuary could be effectively avoided.

Therefore, as such there is no requirement for any elaborate eco-developmental works in the vicinity. However influencing people's attitudes, awareness, emotions, knowledge and behavior towards wildlife and wild areas amongst the people of Chandigarh requires top priority. Rehabilitation and rescue centers for wild animals as suggested earlier need to be set up . The five villages of Kaimbwala, Khuda Ali Sher, Mahadev and Suketri situated in close proximity to the entry gates to Sukhna WLS have potential to be directly involved in tourist related activities outside, as well as, inside the PA. Residents of these villages can be engaged as Nature Guides for additional Livelihoods sources. Besides, these villagers can also be engaged for managing parking lots, Canteen facilities at either gate, souvenir shops, elephant & Camel rides, bicycles on rent etc.

Eco- Development of Villages in Adjoining States:

The Sanctuary extended over an area of 2600 ha is bounded by the hills of Haryana in the NE and E and hills of Punjab in the NW. The plains of Punjab and Haryana surround the Sanctuary in the North West and South. Morni Hills Forest Division, Pinjor of Haryana lie in the east of the WLS while Mohali Forest Division, Mohali (SAS Nager)district of Punjab lies towards the north and west. To reduce pressure on sanctuary area from adjoining states (boundary being porous), the adjoining forest divisions of Punjab & Haryana need to to be coordinated for taking up eco-development works in their respective jurisdictions. This could encompass collection of medicinal plants such as Adhatoda vesica, Tinospora cordifolia, Holorhyenaantidyssentrica , etc for either supply or local use by the people of these villages. In addition, other activities,

such as collection of broom grass, Eulaliopsisbinnata, gum of Acacia leucophloia, honey etc.

Chapter 8

Human-Animal Conflict & Resolution

As human populations expand and natural habitats shrink, people and animals are increasingly coming into conflict over living space and food.A primary reason for the increasing human-animal conflicts is the presence of a large number of animals and birds outside the notified protected areas. **Conflict between people and animals is one of the main threats to the continued survival of many species in different parts of the world, and is also a significant threat to local human populations. If solutions to conflicts are not adequate, local support for conservation also declines.**

As per information gathered from Forest Department, no compensation for damage to human or agriculture fields has been reported in and around Sukhna WLS for the last 5 years or so. Although, straying of the wild animals like Sambar, Neelgai, Wild boar into human habitations from the PA have been reported (Table 8.1). FD has quick response teams to immediately capture such strayed wild animals and release them back into the forest or take them to the rescue centre.

Table 8.1: Data on Incidence of Straying of Wild animals into Habitations

	2013	**2014**	**2015**	**2016**	**2017**	**2018 (upto April)**
Number of Complaints	26	28	45	65	47	30
Catch & Release	14	15	29	28	14	03
Dead	12	13	16	27	24	10
Not Found	-	-	-	10	09	17

Source: UT Forest Department, Chandigarh

8.1 Probable reasons for minimal man-animal conflict are as follows:

i) **South & South- West boundaries** of the PA is fully fenced with inter-link chain or brick wall, as a result, animals are not able to move out into the habitations which are mostly in south & South -West side of the PA i.eKhuda Ali Sher, Kansal, Kaimbwala, Mahadev &Suketri. However, along the North & North-East side touching Haryana & Punjab i.eMorni forest, SAS Nagar Forest Division, having villages such as Karoran, MajraJatan, Sukhomajri, Lohgarh, Dhamala, ManakpurThakurdasetc, straying of wild animals into agriculture fields does happen occasionally.

ii) **Animal density of carnivores & herbivores is seemingly low** (although no specific census data is available), which may be one of the reasons for low human-animal conflict in fringes of the PA.

iii) Another possible reason may be**, herbivores remain restricted inside** the PA **due to availability of water & green fodder** even during hottest months around these water bodies.

iv) There are **no human habitations** PA or rights of the inhabitants inside the PA, which can be potential cause of the conflict.

v) There are **hardly any case of injury** to human-beings by big cats i.e Leopards, in the neighbouring villages or Chandigarh city, because of extremely low density of Leopards in the PA. These are only occasionally visiting the PA from adjoining forests of Haryana & Punjab.

vi) **Little movementof animals** takes place **in Chandigarh** city due to available corridors in the form of water courses leading to Sukhna lake and beyond, passing through the city, which for most part of the year, remain dry and well vegetated. Such conflicts make big news when any Sambar / Neelgai move in sector 4 or 5 or Rail tracks/ Daria village etc.

vii) Occasional reports of **snakes, Python & Goh (Varanus)** entering into human habitations have also been reported in neighbouring areas of city (Chandigarh) or villages.

UT Forest Department has a responsibility to safeguard against such eventuality as mentioned above. Therefore, the department has a rapid response team to evacuate such animals into rescue and rehabilitation centre or release them into the forest.

8.2 Training

Frontline staff require updating/ honing up of skills for rescue operations with right kind of equipment so that minimum damage is caused to animal i.e**Net Throwing Guns**, **Tranquilizer guns, transport cages, traps, snake capturing rods** and **their** proper **use**. At least twice a year, mock drills of the staff are required for handling the situations. Once a formal training may also be organized with WII, Dehradun or Wildlife Trust of India etc for initial training of the staff.

Chapter 9

Research, Monitoring and Training

Research and Monitoring is imperative for sound & scientific management practices of a PA with an endeavour to improve Wildlife management, constantly and have an in-depth understanding of ecosystem processes. Often it is most neglected aspect of management.

9.1 Research

Sukhna Wildlife Sanctuary has a vast potential to act as a natural laboratory for research works in all aspects as it has diverse types of flora and fauna besides many endangered species. However, not much research work has been done so far by agencies like nearby Universities, recognized institutes, Wild Life Institute, Botanical Survey of India, Zoological Survey of India, Forest Research Institute, NGO, etc. The sanctuary has no field research laboratory or research officer. Both short term and long term research is essential to manage the sanctuary scientifically and the findings of research should be incorporated in management strategies.

9.1.1 Research Priorities suggested in Previous Plan

Previous management plan suggested following aspects of research.

1. Comparing the status of fauna within sanctuary in relation to adjoining areas outside the sanctuary with similar topography to know the changes in biota upon improvement of habitat.

2. Evaluating indicator species of undisturbed habitat in Sukhna that can be used in monitoring environmental changes in future.

3. Study on the incidence of disease and unnatural death of wildlife.

4. Study on the effect of habitat isolation on the higher mammals in Sukhna WLS.

5. To examine the possibility of linking Sukhna to the areas east and west of it in the Shivaliks so as to maintain continuity with these areas for the exchange of genetic diversity.

9.1.2 Future Research Priorities:

Research on following topics would also be of immense use for evolving future management strategies of the sanctuary.

1. Study on behaviour, habitat, feeding habits etc. of wild animals.
2. Population ecology and feeding behaviour of ungulates.
3. Study on flora and monitoring the temporal changes in floristic composition including vegetation dynamics.
4. Study on fauna of Sukhna WLS and monitoring their population.

5. Impact of habitat changes on population of wildlife.
6. Study and monitoring of endangered species.
7. Predation pattern of leopard.
8. Habitat suitability study for reintroduction of Barking Deer.
9. Study on reproductive behaviour of carnivores and ungulates.
10. Carrying capacity of the area with respect to important species.
11. Study on wild life diseases including causes of death.
12. Anthropogenic pressure on Sukhna WLS.
13. Impact of tourism on Biodiversity conservation.
14. Study on intraspecific and interspecific competition.
15. Resource assessment and valuation studies.
16. Socio-economic impacts on fringe communities of the PA.
17. Usage and impact of usage of water courses by the fringe inhabitants and its impact on Sukhna lake.(Legal status and ownership of water courses, outside the PA, leading to Sukhna Lake, needs to be ascertained).

Table 9.1 Studies Conducted:

SN	Title/ Subject	Team/Agency
1	Flora of Sukhna WLS (Qualitative analysis)	Dr.H.B.Naithani, Ex-Scientist, FRI, Dehradun
2	Species List of Birds, Butterflies and Mammals (winter survey)	Dr.ArunP.Singh, Entomology Div FRI Dehradun
3	Species List of Birds, Butterflies and Mammals (summer survey)	Dr.ArunP.Singh, Entomology Div FRI Dehradun
4	Birds of Sukhna Lake Catchment area	M.L.Narang, ZSI, Northern Regional Station, Dehradun
5	Meteorological Observations (1994-95 to 2003-04 except 1997-98)	Central Soil and Water Conservation Research and Training Institute (Indian Council of Agri. Research) 218-Kaulagarh Road, Dehradun
6	Meteorological Data (for the year1997-98)	Central Soil and Water Cons. Research and Training Institute, 27-A, Madhya Marg, Chandigarh
7	Sediment Monitoring Stations	KansalKhol and Suketri
8	Wildlife Census of Sukhna Wildlife Sanctuary, 2010	By UT Forest Department, In collaboration with Wildlife Institute of India and others

9.1.4 Suggested Research Studies:

- Impact of major management interventions suggested in chapter 5 (Strategies).

- Impact of water conservation practices on vegetation (short & long term).
- Impact of increased moisture on pathological agents in the PA (wood rot fungi of Khair in Nathewala).
- Status of introduced species such as Arundo donax on riverine flat areas & fodder availability, Pongamia pinnata on natural regeneration on flat areas, natural regeneration of Milletiaovalifolia, etc.
- Effect of enhanced moisture on burrowing rodents.
- Population studies on reintroduced Chital.
- Limiting factors in population dynamics of herbivores.

9.2 Monitoring

The foundation of future management policy of a PA should be based on critical and detailed study of mainly vegetational changes and population dynamics of wild animals. These will therefore include

1) Monitoring changes in vegetation species composition, stand condition, vegetation type, average girth and height.
2) Monitoring invasion of weeds and climbers.
3) Monitoring forest productivity and habitat suitability.
4) Monitoring changes in wildlife population and population estimation.
5) Monitoring of water quality of streams and choe passing through the Sanctuary.
6) Independent monitoring of important management intervention biennially.

Monitoring the status and habitat requirements of 'globally threatened' species inside the sanctuary.

9.3 Training

Staff of Protected Areas is involved in a variety of activities like protection, interpretation restraining of animals besides highly specialized job of routine reporting about happenings inside the forest. The front line staff of Sukhna WLS is also involved in other developmental works of forest department under Chandigarh Administration as there is no separate staff earmarked for the PA. All these duties assigned to forest staff are technical and need skill up-gradation from time to time. The already trained staff can also act as resource persons for lower level staff. Such trainings also tend to elevate the morale of staff and take them away from the monotony of their routine job. Therefore on the job training is prescribed at regular intervals for front line staff including ACFs, Soil Conservation Officers and the Range Officers. The following trainings are considered important to increase the management capability of Sukhna WLS staff and PA managers:

1) Protection duties including use of firearms, survey and demarcation, fire fighting and intelligence gathering network.

2) Tourism management including interpretation and conservation education, conducting nature camps and creating awareness among people.

3) Census of wild animals, grassland ecology and management, water source management, animal diseases, habitat improvement works etc.

4) Tranquilization, rescue and veterinary care.

5) Application of laws and regulations.

6) Post mortem of wild animals and other wildlife health care.

7) Post Graduate Diploma courses in wildlife management at W.I.I., Dehradun for A.C.F. and D.C.F.

8) Wildlife health, chemical immobilization, application of power fencing etc. at W.I.I. for Range Officers and Beat Officers.

9) Certificate courses in wildlife management at W.I.I., Dehradun for Range Officers.

10) Remote sensing training at Indian Remote Sensing Institute, Dehra Dun for A.C.F. and D.C.F.

11) Short term Sensitization & Refresher courses for Frontline staff should invariably be held once in six months.

CHAPTER10

Organization, Administration & Budget

10.1. Structure and Responsibilities

Sukhna WLS Chandigarh spread over an area of 2600 Ha area is headed by CCF and is divided into 2 Ranges, 5 Blocks and 12 Beats. CCF is also Chief Wild Life Warden. The present sanctioned staff strength and and staff in position is given in Table below .There is an acute shortage of foresters and forest guards in PA. The shortage of staff affects the execution of protection and development schemes.

Table 10.1: Present Staff Strength

SN	Category of Post	Sanctioned Strength	Status		Scale of Pay
			Existing	Vacant	
1	**2**	**3**	**4**	**5**	**6**
1	CCF	1	1	--	Level 14
2	CF	1	1		Level 13 A
3	DCF(Hq) & BG& NR	2	1	1	Level 12
4	SDSCO	2	-	02	10300-34800/ 5400 GP
5	RO/ FR	2	1	1	10300-34800/ 4800 GP
6	Draftsman	1	1	-	10300-34800/ 4600 GP
4	Dy.FR	1	1	--	10300-34800/ 4600 GP
5	Forester	12	7	5	10300-34800/ 4400 GP
6	Forest Guard	15	10	5	10300-34800/ 3200 GP
7	O/Supdt.	1	-	1	10300-34800/ 4800 GP
8	Accountant	1	-	1	10300-34800/ 4400 GP
9	Junior Asstt.	1	1	--	10300-34800/ 3600 GP
10	Clerk	3	3	--	10300-34800/ 3200 GP
12	Driver	2	1	1	5910-20200/ 2400 GP
13	Mali	2	2	--	4900- 10680/ 1650 GP
14	Chowkidar	1	1	--	4900- 10680/ 1650 GP
15	Peon	4	4	--	4900- 10680/ 1650 GP
	Total	52	35	17	

Source: UT Forest Department

10.2. Re-Organization of Ranges/ Beats

The present organization of ranges/ Beats is shown in the Table 10.1 . The present Range boundaries require no re-organization at present. However the Block and Beat boundaries need to be clearly demarcated on the ground with boundary

pillars. Compartments have created as a basic management unit (Chapter 1), and allotted to different beats.

Table 10.2: The Range wise Area details of Sukhna WLS

S.No.	Range		Block		Beat	
	Name	**Area (ha)**	**Name**	**Area (ha)**	**Name**	**Area (ha)**
1.	Nepli	1,477.98	Nepli	544.98	Upper Nepli	264.98
					Lower Nepli	280
			Ghareri	435	Upper Ghareri	200
					Lower Ghareri	235
			Nathewala	498	Ambika	130
					Piplanwali	110
					Tootanwali	258
2.	Chandigarh	1133	Kansal	689	Kansal	215
					Khuda Ali Sher	320
					Kaimbwala	154
			Barotiwala	444	Barotiwala (N)	304
					Barotiwala (S)	140
	Total	2610.98		2610.98		
Or say 2600 ha.						

Table 10.3: Compartment Details with Area

S.No.	Block	Beat	Comptt. / Sub-comptt. Ref No.	Area (in Ha.)
1	Barotiwala	Barotiwala North	1A	216.00
2		Barotiwala North	1B	88.00
3		Barotiwala South	2A	42.94
4		Barotiwala South	2B	97.06
5	Kansal	Kansal	3A	87.86
6		Kansal	3B	127.14
7		Khuda Ali Sher	4A	219.78
8		Khuda Ali Sher	4B	100.22
9		Kaimbwala	5	154.00
10	Nathewala	Ambika	6A	77.97
11		Ambika	6B	52.03
12		Piplanwali	7A	65.97
13		Piplanwali	7B	44.03
14		Tootanwali	8A	137.20
15		Tootanwali	8B	120.80
16	Nepli	Lower Nepli	9A	119.46
17		Lower Nepli	9B	107.03

18		Lower Nepli	9C	53.51
19		Upper Nepli	10A	214.58
20		Upper Nepli	10B	50.40
21	Ghareri	Lower Ghareri	11A	129.20
22		Lower Ghareri	11B	105.80
23		Upper ghareri	12A	64.00
24		Upper ghareri	12B	136.00

10.3. Staff Amenities

Following amenities to Sukhna WLS staff is suggested.

1) Special Pay to Field Staff – a special pay allowance of Rs.500 per month may be given to field staff to attract talent.

2) Housing – the field staff should be provided with reasonably good accommodation.

3) Medical Facility – as per rules.

4) Uniform and Field Equipment – the field staff should be given uniform and liveries each year as per entitlement.

5) Incentives and Awards – the staff should be adequately rewarded for outstanding/ meritorious service which not only acts as a morale booster but also sets an example for others to emulate. Section 60A of Wildlife (Protection) Act,1972 with its amendments has a provision for such rewards.

6) There is a scarcity of drinking water for staff and labour especially near Nepli gate of SWLS. A tubewell may be dug out to ease the situation which can also be used for watering Nurseries.

10.4 Budget:

Table 10.4

Scheme wise Expenditure

Sr. No.	Name of Scheme	Expenditure Year wise in lakhs				
		2013-14	2014-15	2015-16	2016-17	2017-18
1.	Communication & Building	66.36	150.00	110.00	110.00	219.65
2.	Forest Conservation Development & Regenration	125.57	200.00	190.00	201.86	424.50
3.	Social & Farm Forestry	271.00	109.28	570.00	600.00	744.00
4.	Preservation of Wildlife	457.07	692.70	263.00	266.00	430.00

Revenue and Expenditure of Chandigarh Forest Division

Sr. No.	Year	Revenue Realised (Rs. in lakh)	Expenditure incurred (Rs. In lakh)
1.	2005-06	6.160	335.00
2.	2006-07	16.06	349.00
3.	2007-08	66.28	470.00
4.	2008-09	18.68	435.00
5.	2009-10	20.29	360.00
6.	2010-11	40.38	585.00
7.	2011-12	3.18	739.50
8.	2012-13	2.75	850.00
9.	2013-14	1.50	920.00
10.	2014-15	0.76	1151.98
11.	2015-16	8.05	1133.00
12.	2016-17	5.61	1177.86
13.	2017-18	2.19	1818.15

CHAPTER 11

THE SCHEDULE OF OPERATIONS AND MISCELLANEOUS REGULATIONS

11.1 THE SCHEDULE:

On the basis of the prescriptions made in the foregoing chapters, the annual schedule needs to be prepared by the DCF Hqrs., who is also In-charge of the Sukhna WLS and sent to the CCF through the CF for approval. After receipt of administrative approval and financial sanction, the DCF Hqrs. may take up the various works which may be implemented as per the schedule. However, all such prescriptions required to be implemented as prescribed in the previous chapters (in a specific chronological order), are delineated in brevity as below:

1. **Boundary Pillars**: Work should be carried out in Ist& 3rd quarters. Boundary Pillars are required at External boundaries as well as to define Block & Beat boundaries. Compartments need to be marked on corner trees and with small plates affixed suitably. Here sizes of internal boundary pillars need to be decided by the CCF/CF for Blocks & Beats (preferably pre-casts). For external BPs, standard size be maintained as that of existing ones.

2. **Protection works**

   From fire : Priority months for forest fire: November - December, late April to early June; therefore, fire lines cleaning has to be commenced and completed twice a year in October and again in March & early April.

   From theft: Theft of wood, fire wood, fodder, honey & medicinal plants does occur from the neighbourhood even if people do not have their rights in WLS or their rights settled. So regular petrolling by Petrol teams is required in morning and evening at identified areas along the fencing or boundary wall, through out the year except during rains when wood is wet and grass is available in plenty outside the PA.

   From poaching: Usually more protection is required from September to March. However, vigil can not be reduced during summers. Usually breeding in herbivores (deer) occurs during rains, conveniently in the ensuing winters and early spring new fawns available, which require protection from packs of stray dogs.

3. **Grassland Management:** Management of designated grasslands needs part removal of overwood where density of small trees or xerophytic bushes

pose competition to grasses. Defined species of grasses need to be planted during raining season. Therefore cutting & removals wherever required have to be commenced from April to June, well before raining season. Once grass species starts germinating, it needs to be ensured that sufficient water is provided immediately after rains so that species are well entrenched, removing unwanted weeds (in September & October months).

4. **Habitat Manipulation / Change in species:** In valleys, slopes or hill tops, wherever replacement of species is warranted, all cuttings and removals in smaller patches to commence from winter months and operations completed by May of the ensuing year, followed by trenching, mixing right soil mixtures with water retentive gel additives etc. in June. The planting has to commence in July / August. Mulching must be completed by early September in all pits and trenches on slopes and hill tops.
5. **Maintenance of Water holes:** This needs to be carried out during the first quarter. So that, water from the rains is well stored during the rains. Temporary waterholes can be dug out on gentle slopes and ponds need to be lined with thick polythene sheets, this may provide effective watering solutions much after the rains not only for greener grasses but for animals within the ranges as well.
6. **Salt licks:** Addition of salt licks should commence during April in Summers and again in October after the rains.
7. **Construction of Paths, Watch Towers or Raised Paths:** The construction should be well planned being loose strata and commencement should occur invariably in all dry months and all construction of retaining walls and dykes etc. should be stopped during rains. Other construction works such as building etc. should be carried out according to the requirement.
8. To view all the activities at a glance, the schedule of proposed activities in Sukhna WLS, these have been tabulated as below in Table No. 11.1:

Table No. 11.1

Schedule of Activities

11.2 RECORD OF DEVIATIONS and IMPLEMENTED TARGETS:

The record of deviation statements are usually not maintained properly. The management should ensure that the deviation statements are maintained properly as per prescription of management plan. Deviation statements should be recorded and maintained in the standard prescribed Proforma.

11.3 THE RECORD OF EMPLOYMENT POTENTIAL:

It is important to know the man-days created in a financial year through different works. This not only gives the employment generated by the sanctuary but also gives the expenditure incurred against each scheme/work in a given month and accordingly the total wage component utilized during the year. The concerned Range Officer should thus maintain a register for such labour generation in different schemes in the Proforma shown at Table 11.2.

TABLE 11.2

Sl No.	Name of Range	Month	Nature of Work	Total No. of man days generated	Approx. expenditure	Remarks
1	2	3	4	5	6	7

11.4 THE CONTROL FORMS:

The control forms should be prepared in triplicate by the Sub Divisional Soil Conservation officers/ Range Officers for their respective jurisdiction and submitted to the Deputy Conservator of Forest, Sukhna WLS. He in turn will compile the control forms received from them and tabulate it for the whole of the sanctuary. Thereafter the Deputy Conservator of Forest, Chandigarh shall submit the control forms to the Conservator of Forest (Wildlife/ Regional as the case may be) in the prescribed format along with his comments in the relevant column. The time period specified for submission of control forms be strictly followed.

11.5 MAINTENANCE OF COMPARTMENT HISTORIES:

Since compartments have been suggested to be formed in this Plan, completion of CH files be ensured as per the detailed forms provided in Annexure -15 The continuation of data collection will become a normal practice thereafter. The compartment history is an important document and should be maintained in duplicate – one for the division level and one for the range level. The DCF Hq will be responsible for compilation and maintaining the compartment history of their respective areas at the beginning of this plan.

Besides above, the following other records should also be maintained by the management for better observation, effective monitoring and able research purposes.

(A) **Divisional Note Book** – It is an interesting record of observations and will be helpful at the time of review of management plan. All kind of animal activities like plantation damage, insect attack, epidemic, fire damage, regeneration status, habitat conditions etc should be recorded in the divisional hand book with dates and address viz. compartment number/ Beat number. This will also act as a ready reckoner of important happenings in sanctuary.

(B) **Fire Incidence Report** – This register is very important to plan the fire control measures. The record of fire incidences should be recorded in the compartment history also. The fire affected area should be indicated in a map of 1: 25000 scale. The amount spent in cleaning and burning of fire lines during the financial year should also be recorded in the fire incidence register.

11.6 POCKET FIELD GUIDE FOR PLAN IMPLEMENTATION:

A concise pocket field book containing the demarcation of zones along with the compartments/ Beats falling in each zone, the important prescriptions prescribed in them and the “Do’s and Don’t’s” inside the park should be clearly spelt out for the use of lower rung park staff. The tell-tale signs of animal sighting, the procedure for apprehending offenders, the mode of collection of samples from diseased animals and above all the visible signs for monitoring health of wild animals through ocular estimation should also find a mention in this pocket field book. This will help them to keep abreast of strategies being followed and help in time to time consultations as and when needed.

PART – III

Annexures

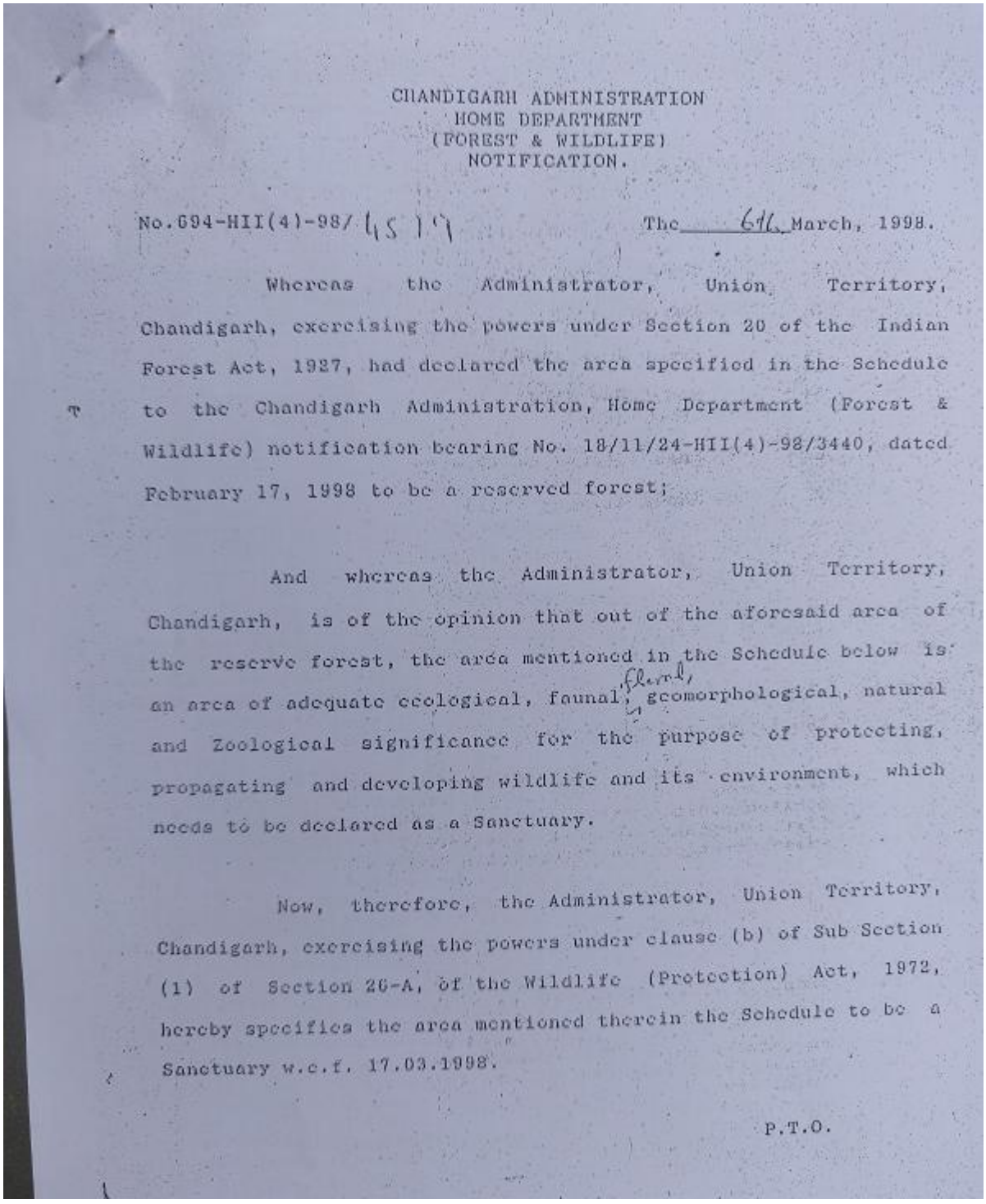
1. Notification of Sukhna Wildlife Sanctuary
2. Notification of Reserve Forest Area
3. Present Forest Cover Map of Chandigarh
4. Vegetation Map of Sukhna Wildlife Sanctuary
5. Forest Type Map of Sukhna Wildlife Sanctuary
6. Drainage Map of Sukhna Wildlife Sanctuary
7. Map of Sukhna Lake Catchment Area
8. Metrological Data from 2010 – 2017; (Maximum/ Minimum Temp./
9. Relative Humidity (%)
10. Inventory of Flora of Sukhna Wildlife Sanctuary
11. Inventory of Fauna of Sukhna Wildlife Sanctuary
12. Map showing locations of Inspection Banglows
13. Photographs of Sukhna WLS
14. Old FRH to be Convererted into Interpretation Centre, Souvneir Shop ..
15. A)Compartment History File – Formats ; B) Control Form Format
16. Wildlife Reference material for Field Identification
17. CD of Vegetation Map & Forest Cover Map
18. CD of GIS layers –

a. Veg Map
b. Forest Type Map
c. Drainage Map
d. Roads & Buildings Map
e. Contour Map
f. Wildlife Distribution Map

19. References

Annexure -1

Notification of Sukhna Wildlife Sanctuary



CHANDIGARH ADMINISTRATION
HOME DEPARTMENT
(FOREST & WILDLIFE)
NOTIFICATION.

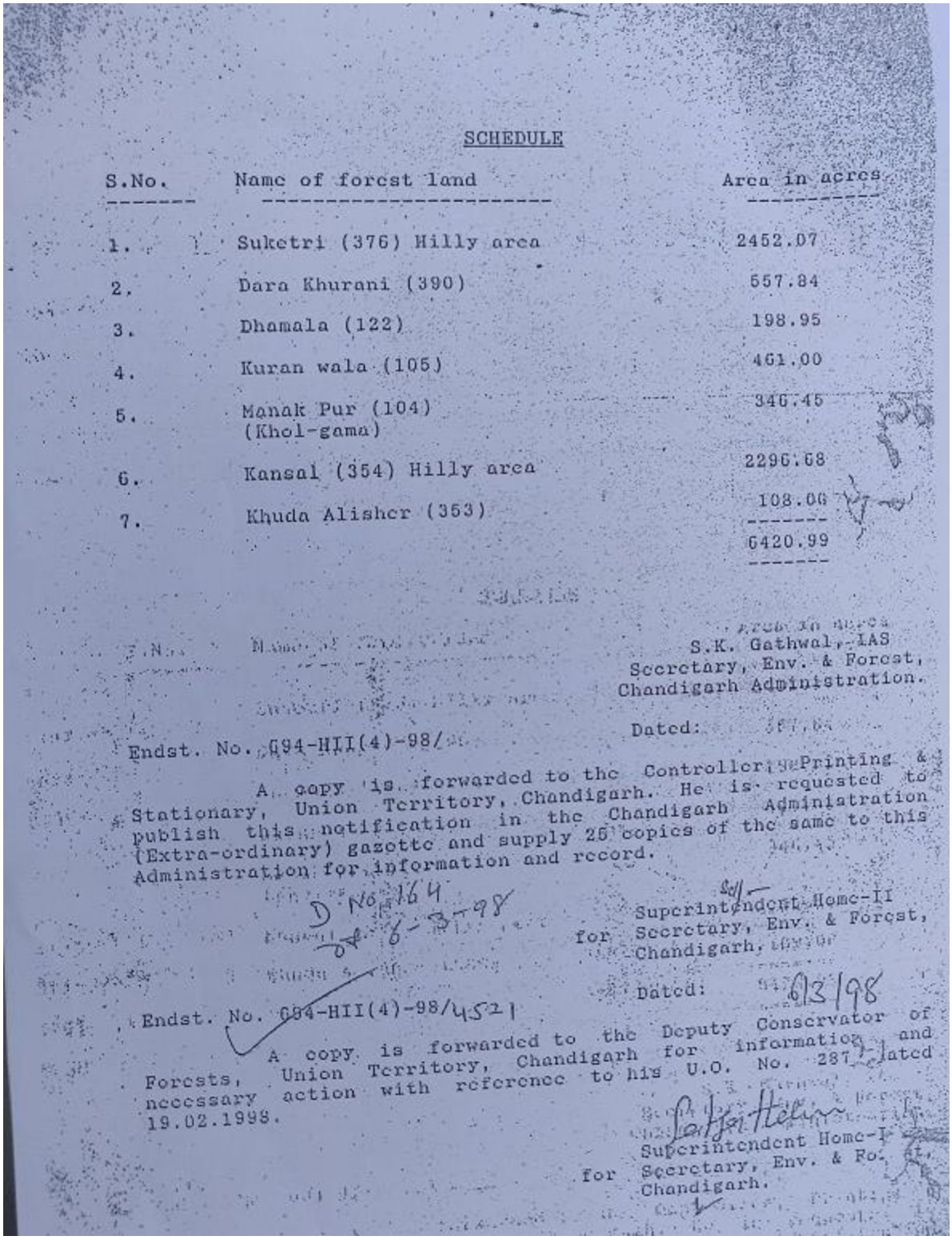
No.694-HII(4)-98/ 1519 The 6th March, 1998.

Whereas the Administrator, Union Territory, Chandigarh, exercising the powers under Section 20 of the Indian Forest Act, 1927, had declared the area specified in the Schedule to the Chandigarh Administration, Home Department (Forest & Wildlife) notification bearing No. 18/11/24-HII(4)-98/3440, dated February 17, 1998 to be a reserved forest;

And whereas the Administrator, Union Territory, Chandigarh, is of the opinion that out of the aforesaid area of the reserve forest, the area mentioned in the Schedule below is an area of adequate ecological, faunal, floral, geomorphological, natural and Zoological significance for the purpose of protecting, propagating and developing wildlife and its environment, which needs to be declared as a Sanctuary.

Now, therefore, the Administrator, Union Territory, Chandigarh, exercising the powers under clause (b) of Sub Section (1) of Section 26-A, of the Wildlife (Protection) Act, 1972, hereby specifies the area mentioned therein the Schedule to be a Sanctuary w.e.f. 17.03.1998.

P.T.O.



SCHEDULE

S.No.	Name of forest land	Area in acres
1.	Suketri (376) Hilly area	2452.07
2.	Dara Khurani (390)	557.84
3.	Dhamala (122)	198.95
4.	Kuran wala (105)	461.00
5.	Manak Pur (104) (Khol-gama)	346.45
6.	Kansal (354) Hilly area	2296.68
7.	Khuda Alisher (353)	108.00
		6420.99

S.K. Gathwal, IAS
Secretary, Env. & Forest,
Chandigarh Administration.

Dated:

Endst. No. 694-HII(4)-98/

A copy is forwarded to the Controller, Printing & Stationary, Union Territory, Chandigarh. He is requested to publish this notification in the Chandigarh Administration (Extra-ordinary) gazette and supply 25 copies of the same to this Administration for information and record.

D No. 164
6-3-98

Superintendent Home-II
for Secretary, Env. & Forest,
Chandigarh.

Dated: 6/3/98

Endst. No. 694-HII(4)-98/452

A copy is forwarded to the Deputy Conservator of Forests, Union Territory, Chandigarh for information and necessary action with reference to his U.O. No. 287 dated 19.02.1998.

Superintendent Home-I
for Secretary, Env. & Forest,
Chandigarh.

Annexure - 2

Notification of Reserve Forest Area

Regd. No.

GOVERNMENT OF INDIA

Chandigarh Administration Gazette

EXTRAORDINARY

Published by Authority

CHANDIGARH, TUESDAY, FEBRUARY 17, 1998 (MAGHA 28, 1919 SAKA)

HOME DEPARTMENT

(FOREST AND WILDLIFE)

Notification

The 17th February, 1998

No. 18/11/24-HII(4)-98/3440.--Whereas,--vide Chandigarh Administration, Finance Department (Forest and Wildlife) Notification bearing No. 18/11/24-UTFIII(2)-91/4423, dated the 9th May, 1991, it was proposed to constitute the area specified therein as reserved forest;

And whereas the Forest Settlement of the area has now been completed in accordance with Chapter II of the Indian Forest Act, 1927.

Now, therefore, in exercise of the powers conferred by the Section 20 of the said Act of 1927, the Administrator, Union Territory, Chandigarh, is pleased to declare the area specified in the Schedule below the limits of which are defined by boundary marks (pillars) erected on the ground and map filled in the office of the Deputy Commissioner, Chandigarh, to be reserved after the expiry of four weeks, from the date of publication of this notification in the official Gazette and thereafter the said forest shall be deemed to be a reserved forest.

SCHEDULE

District	Tahsil	Name of forest or land reserved	Area in Acres	Boundaries	Place where the plan may be inspected
Chandigarh		(1) Raipur Khurd (232)	77.85	as demarcated by boundary pillars	Office of the Deputy Commissioner, Chandigarh Administration, Chandigarh. The Divisional Forest Officer, Chandigarh Forest Division,
		(2) Raipur Kalan (321)	41.74		
		(3) Behlana (231)	53.46		

District	Tahsil	Name of forest or land reserved	Area in Acres	Boundaries	Place where the plan may be inspected
Chandigarh—Concld.	(4)	Hallomajra (219)	235.02		Chandigarh and the Secretar Environment and Forests, Chandigarh Administration, Chandigarh.
	(5)	Dellheri Raj Puttan (210)	274.17		
	(6)	Daria (374)	20.14		
	(7)	Mauimajra (375)	177.13		
	(8)	Mauimajragarh (216) City Area	27.05		
	(9)	Suketri (376) Hilly area	2452.07		
	(10)	Dadu Khurd (390)	557.00		
	(11)	Dhanala (122)	198.95		
	(12)	Khan Wala (105)	461.00		
	(13)	Manak Pur (104) (Khal-gama)	346.45		
	(14)	Kansal (354) Hilly area	2296.68		
	(15)	Khuda Ali Mor (353).	108.00		
	(16)	Forest area between Rock Garden and Lake	122.68		
	(17)	Kaisbwala (355) (Lake area)	72.76		
	(18)	Suketri (376) (Lake Area)	65.44		
		Total :	7548.43		

S.K. GATHWAL,
Secretary, Forest and Environment,
Chandigarh Administration.

LABOUR DEPARTMENT

Notification

The 17th February, 1998

No. 13/1/4662-HII(4)-98/3386.—In exercise of the powers conferred by sub-section (1) of Section 17 of the Industrial Disputes Act, 1947 (Central Act No. 14 of 1947), the Administrator, Union Territory, Chandigarh is pleased to publish the following Award dated 27th November, 1997 delivered by the Labour Court-cum-Industrial Tribunal, Union Territory, Chandigarh in the Industrial Dispute between Shri Paras Nath and M/s Mittal Ispat Udyog, Chandigarh referred to the said Court by the Chandigarh Administration, vide endorsement No. 13/1/4662-HII(4)-95/1858, dated the 20th January, 1997.

Annexure – 2a

Annexure-III

FOREST AREA IN U.T., CHANDIGARH

(AREA IN AC...)

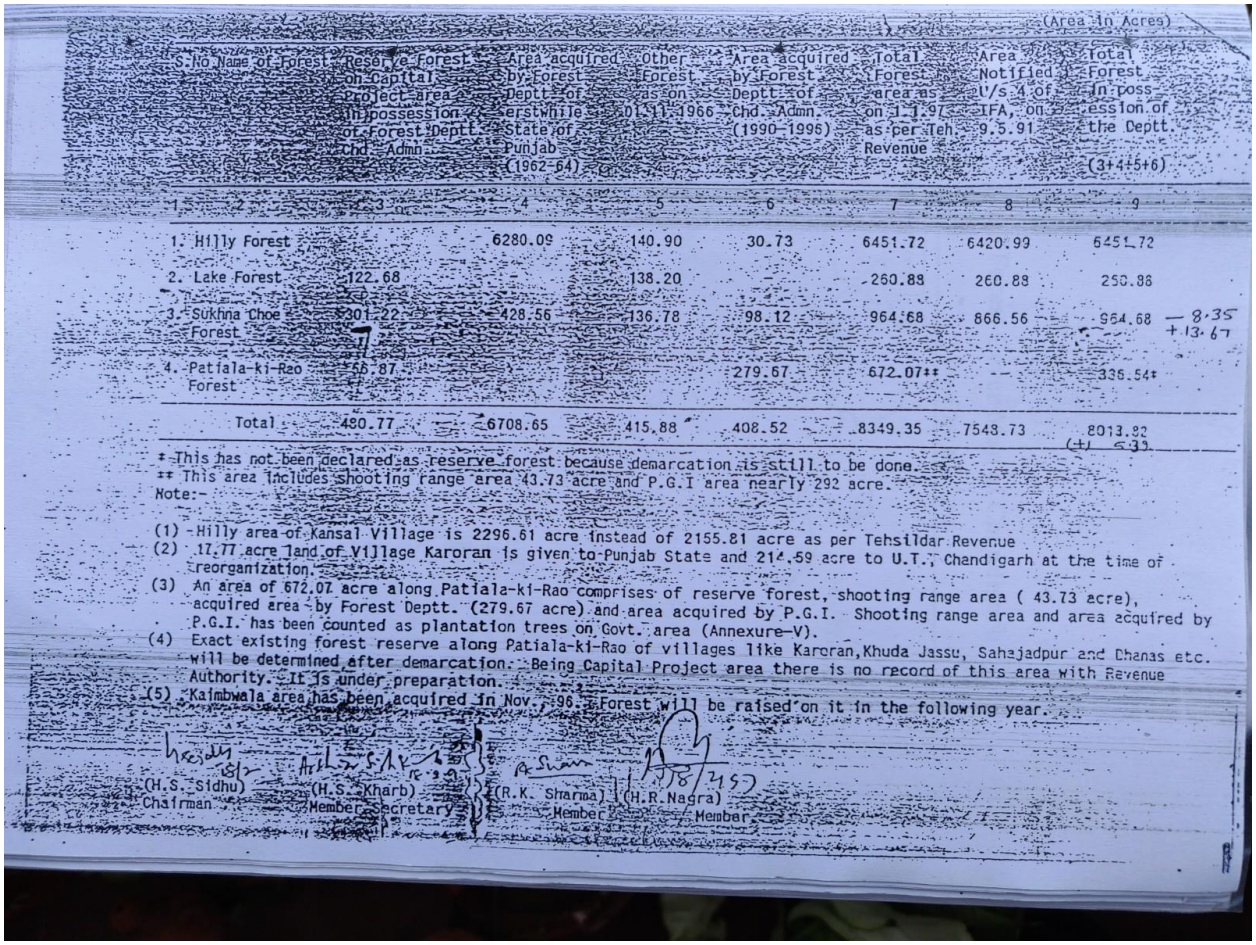
Sukhna Choe	866.56 — 8.35		Area notified U/s 4 of IFA, 1927 on 9.5.1991 by Chd Admn.
Lake area	260.88		
Hilly area	6420.99		
	7548.43 — 8.35 Acres		
SUKHNA CHOE			
Raipur Khurd (232)	77.85		
Raipur Kalan (371)	[illegible].74		
Behlana (231)	53.40		
Hallomajra (219)	235.02		
Dalheri Rajputan (218) (R.F. 61)	274.17		
Dariya (374)	20.14		
Manimajra (375)	77.13 — 8.35 + 13.67		
Hamirgarh (216) (R.F. 61)	27.05	866.50 (—) 8.35 + 13.67	
Manimajra	80.38		
Dariya	17.74	98.12	Acquired in 1992
LAKE AREA			
Forest area between Rock garden & Lake (R.F. 61)	122.68		
Kaimbwala (355) Lake area	72.76		
Suketri (376) Lake Area	65.44	260.88	
Kaimbwala	30.73	30.73	Acquired in Nov., 08
HILLY AREA			
Suketri (376)	2452.07		
Dara Khurani (390)	557.84		
Dhamala (122)	198.95		
Kuran Wala (105)	461.00		
Manakpur (104)	346.45		
Kansal	2296.68		
Khuda Allaher	108.00	6420.99	
PATIALA KI RAO			
Dhanas	127.27		
Sarangpur	123.90		
Lahora	19.29		
Khuda Jassu	9.21	279.67	Acquired in 1990
Existing reserve forest along Patiala-Ki-Rao	50.87	50.87	Exact left over reserve forest will be determined after demarcation.
		8013.82	
		(+) 5.32	

Sd/- 18/2	Sd/- 18.2.97	Sd/-	Sd/- 18
(...S. Sidhu)	(H.S. Kharb)	(R.K. Sharma)	(H.R. Nagra)
Chairman	Member Secretary	Member	Member

(i) 8.35 acre R.F. land of Manimajra village diverted for construction of Route No. 3.

(ii) 13.67 acre non-forestry land in village Manimajra received in view of diversion of 8.35 acre Forest land for route No. 3.

Annexure- 2b



(Area in Acres)

S.No	Name of Forest	Reserve Forest on Capital Project area in possession of Forest Deptt. Chd. Admn.	Area acquired by Forest Deptt. of erstWhile State of Punjab (1962-64)	Other Forest as on 01.11.1966	Area acquired by Forest Deptt. of Chd. Admn. (1990-1996)	Total Forest area as on 1.1.97 as per Teh. Revenue	Area Notified u/s 4 of IFA, on 9.5.91	Total Forest in possession of the Deptt. (3+4+5+6)	
1	2	3	4	5	6	7	8	9	
1.	Hilly Forest		6280.09	140.90	30.73	6451.72	6420.99	6451.72	
2.	Lake Forest	122.68		138.20		260.88	260.88	260.88	
3.	Sukhna Choe Forest	301.22	428.56	136.78	98.12	964.68	866.56	964.68	− 8.35 + 13.67
4.	Patiala-ki-Rao Forest	56.87			279.67	672.07**	--	336.54*	
	Total	480.77	6708.65	415.88	408.52	8349.35	7548.73	8013.82 (+) 5.39	

* This has not been declared as reserve forest because demarcation is still to be done.
** This area includes shooting range area 43.73 acre and P.G.I area nearly 292 acre.

Note:-

(1) Hilly area of Kansal Village is 2296.81 acre instead of 2155.81 acre as per Tehsildar Revenue
(2) 17.77 acre land of Village Karoran is given to Punjab State and 214.59 acre to U.T., Chandigarh at the time of reorganization.
(3) An area of 672.07 acre along Patiala-ki-Rao comprises of reserve forest, shooting range area (43.73 acre), acquired area by Forest Deptt. (279.67 acre) and area acquired by P.G.I. Shooting range area and area acquired by P.G.I. has been counted as plantation trees on Govt. area (Annexure-V).
(4) Exact existing forest reserve along Patiala-ki-Rao of villages like Karoran, Khuda Jassu, Sahajadpur and Chanas etc. will be determined after demarcation. Being Capital Project area there is no record of this area with Revenue Authority. It is under preparation.
(5) Kaimbwala area has been acquired in Nov., 96. Forest will be raised on it in the following year.

(H.S. Sidhu) Chairman — (H.S. Kharb) Member Secretary — (R.K. Sharma) Member — (H.R. Nagra) Member

Annexure - 3

Present Forest Cover Map of Chandigarh

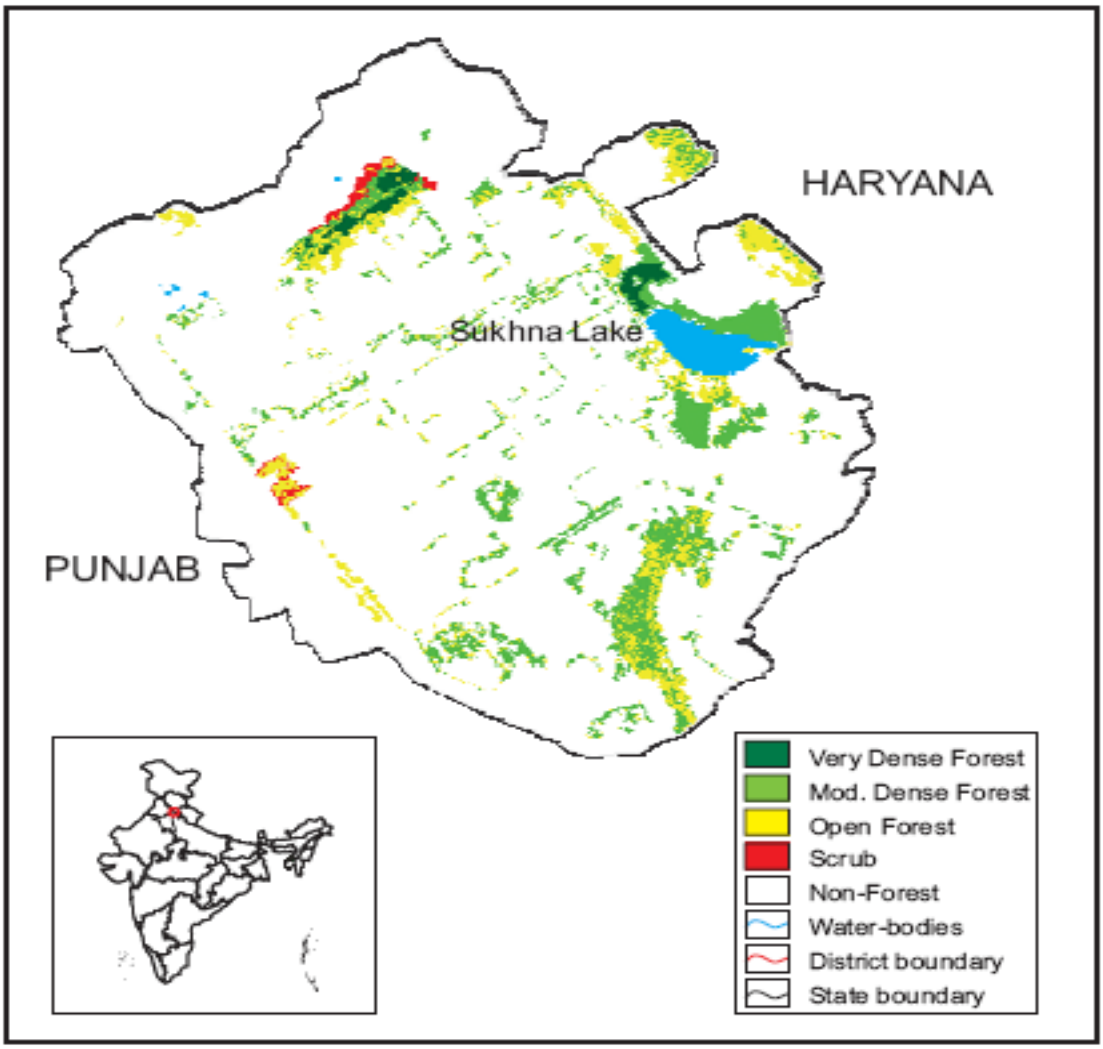
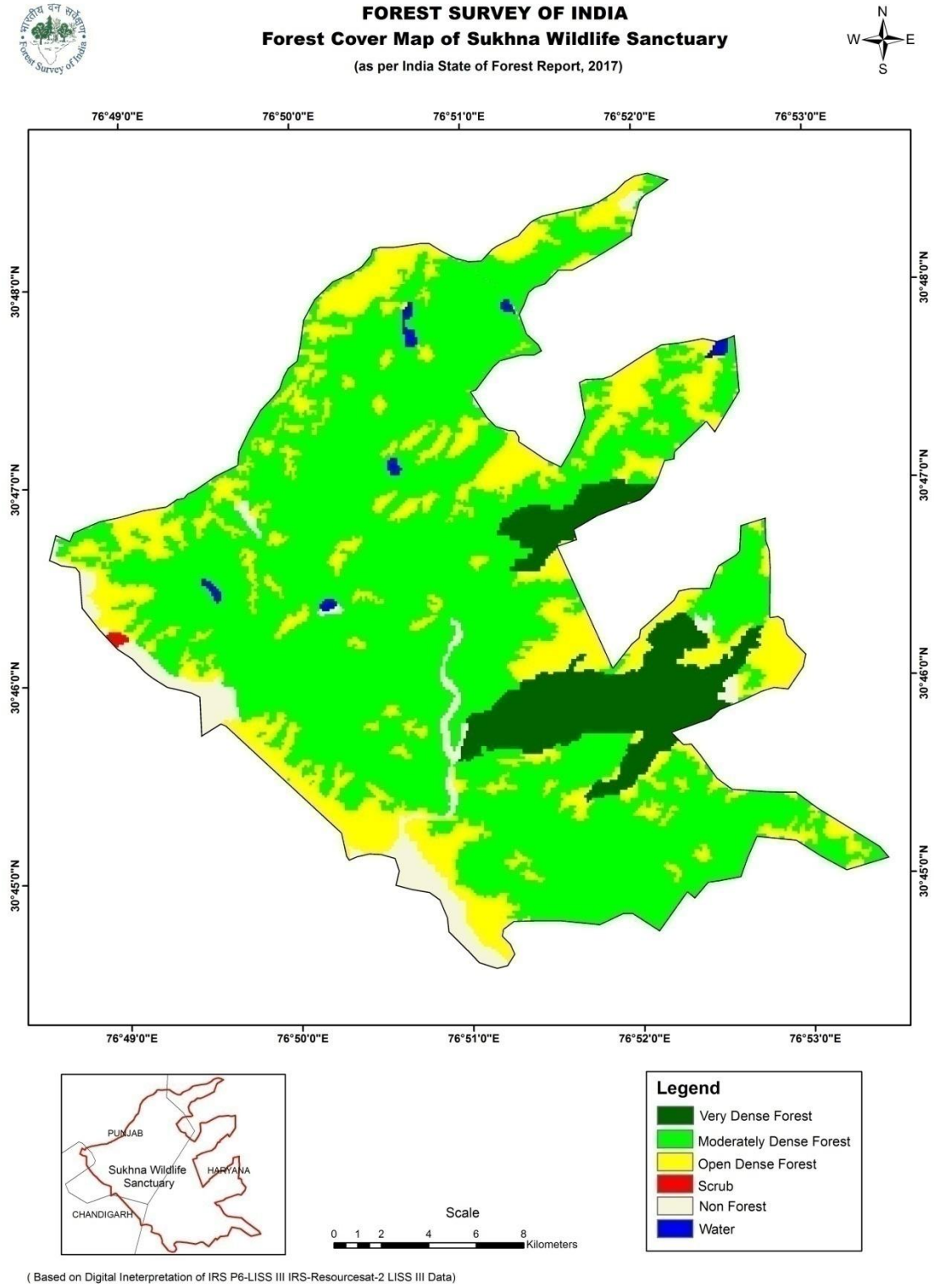
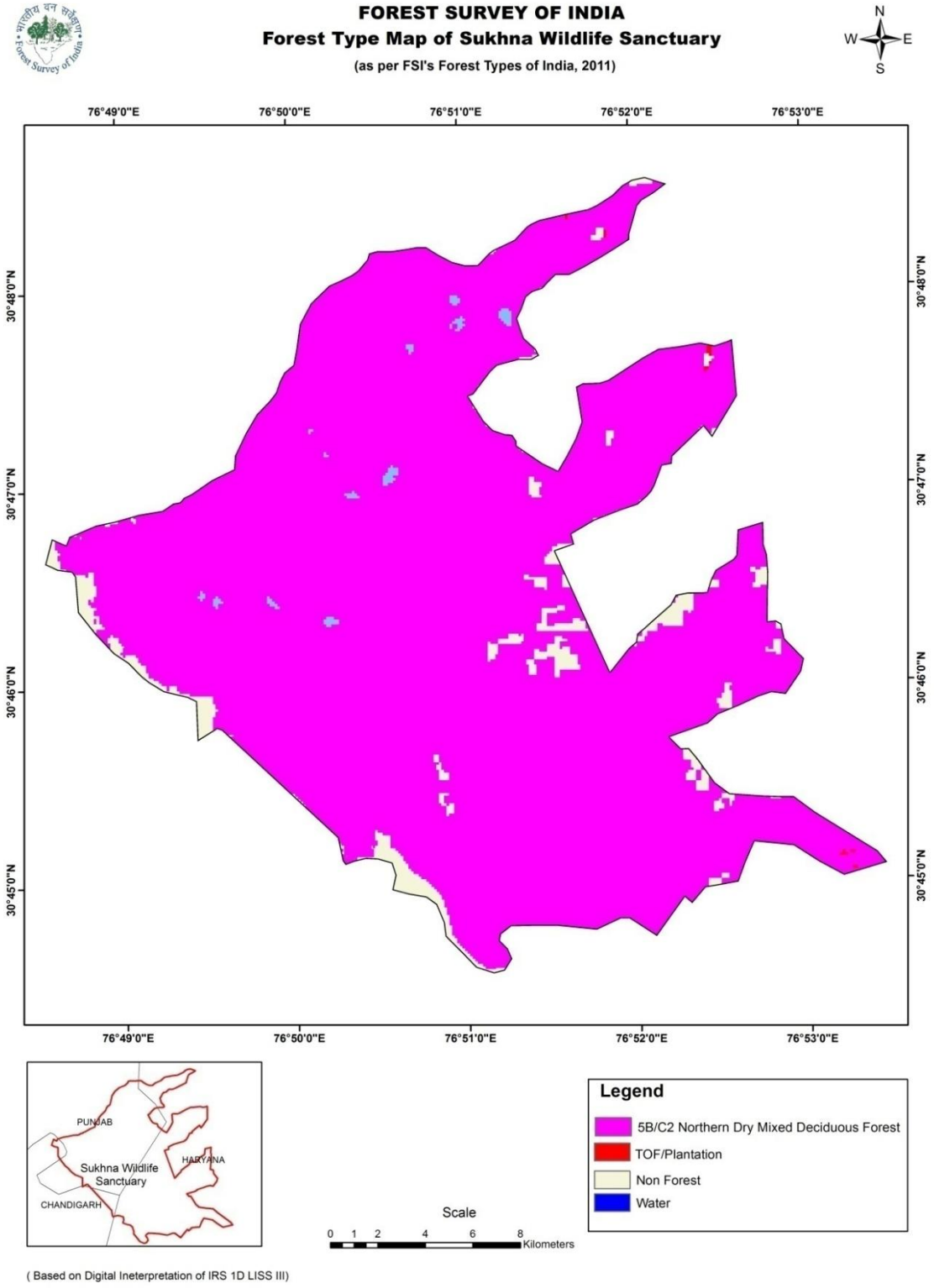


Fig. 7.31 Forest Cover Map of Chandigarh

Vegetation Map of Sukhna Wildlife Sanctuary

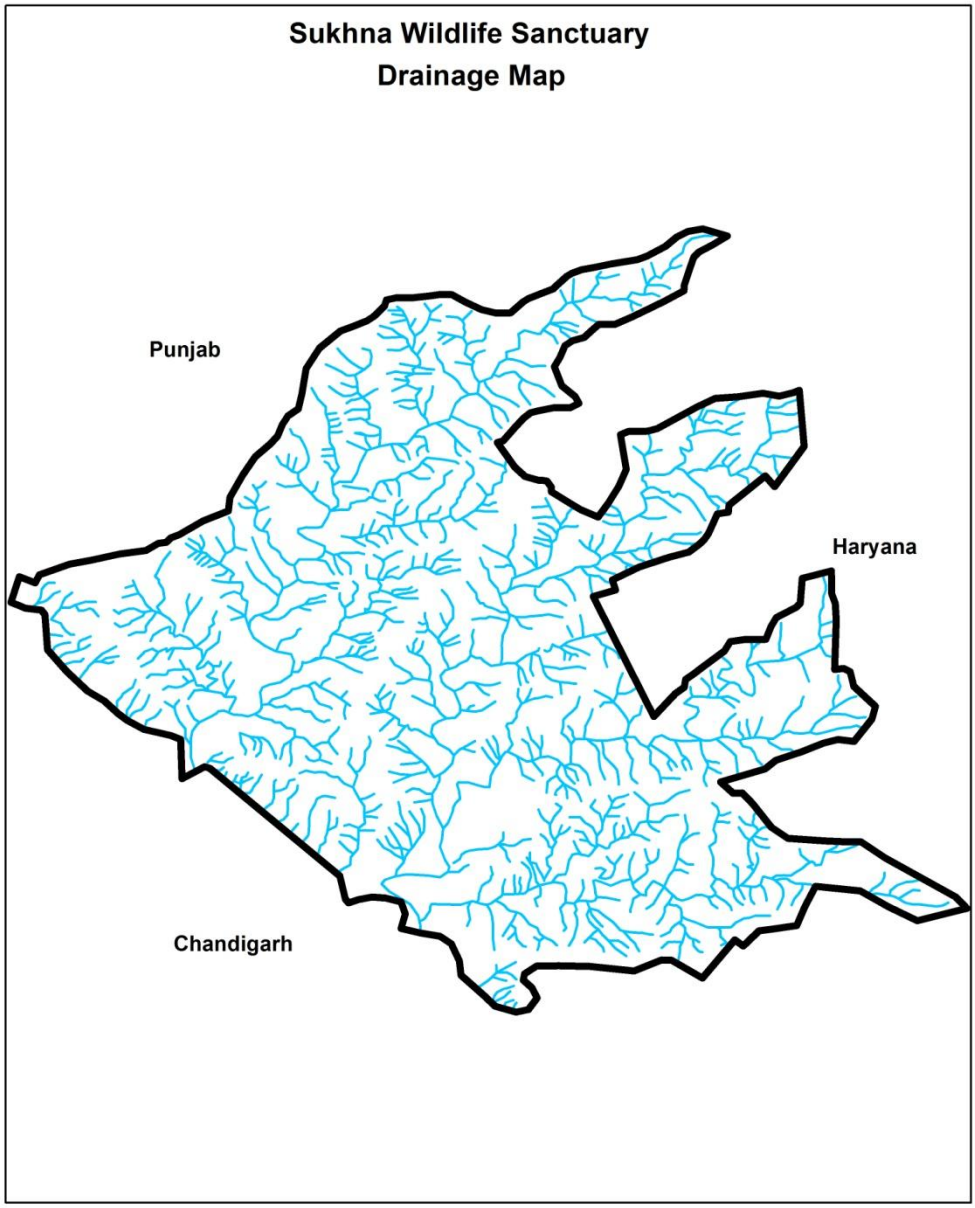


Forest Type Map of Sukhna Wildlife Sanctuary



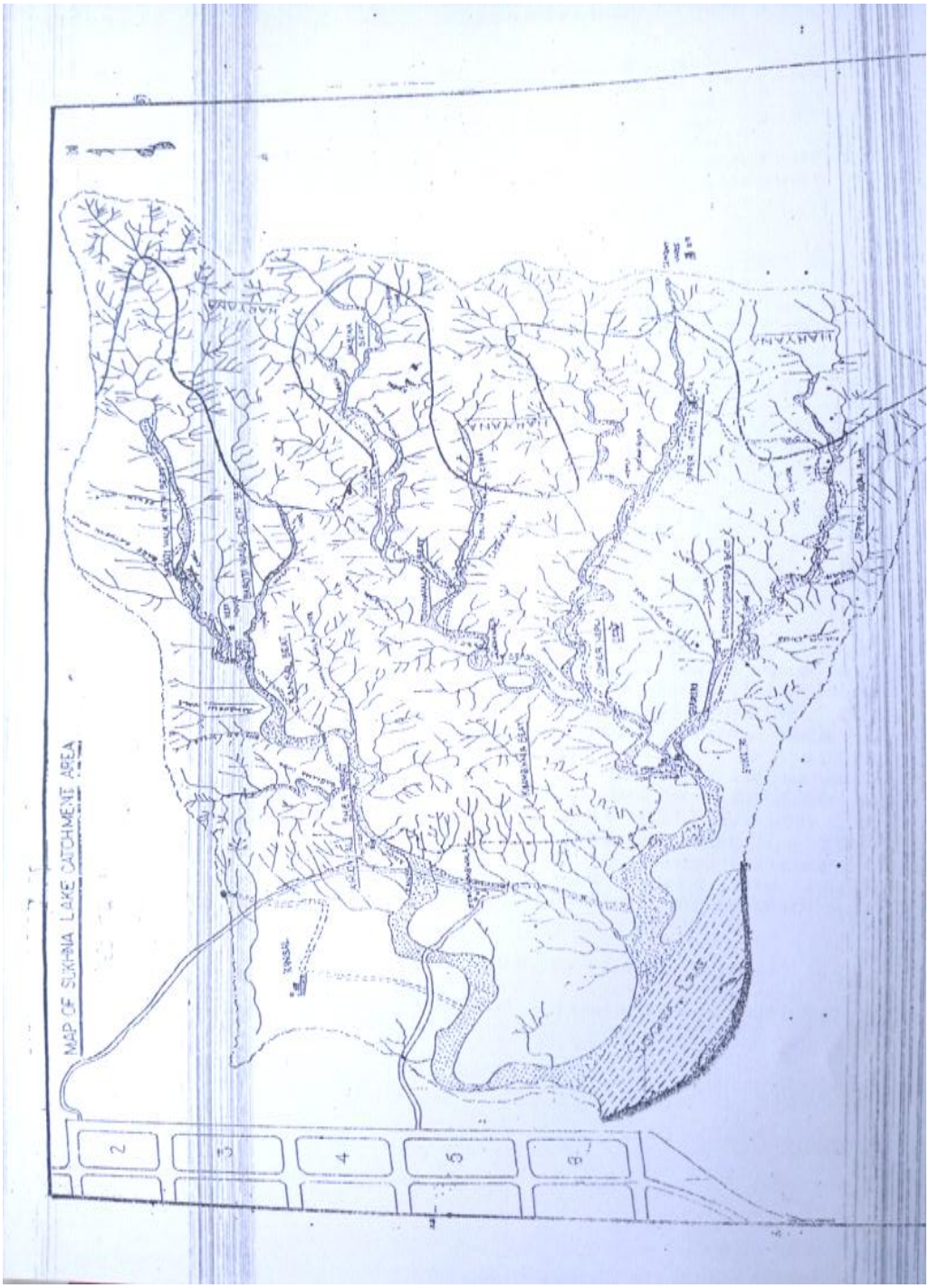
Annexure - 6

Drainage Map of Sukhna Wildlife Sanctuary



Annexure - 7

Map of Sukhna Lake Catchment Area



Annexure - 8

Meteorological Data

Maximum Temp. (^{0}C)

Minimum Temp. (^{0}C)

Avg. Wind Speed (Km/hr)

Rainfall (in mm)

Monthly averaging of Mean Maximum Temperature, Mean Minimum Temperature, Relative Humidity (Maximum and Minimum), Mean Wind Speed and Monthly Rainfall data recorded at India Meteorological departmental observatory Meteorological Centre, Sector 39-C, Chandigarh for the period from January 2010 to December 2017

YEAR	DATA ELEMENTS	MONTH											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2010	Max. Temperature (in ^{0} C)	17.0	23.4	31.2	38.2	39.1	37.6	33.2	32.9	31.3	31.3	27.5	21.6
	Min. Temperature (in ^{0} C)	06.2	10.2	16.9	22.6	26.1	25.9	26.1	26.3	23.8	19.1	12.9	07.1
	Av. Wind (in Km/hr)	3.3	4.2	5.1	4.6	4.5	4.8	5.3	2.2	1.9	1.2	1.2	1.1
	Rainfall (in mm)	008.2	015.9	000.0	000.6	014.1	188.4	365.2	246.2	323.1	001.2	000.4	072.2
2011	Max. Temperature (in ^{0} C)	16.4	22.2	28.1	33.2	38.1	34.4	32.8	32.9	32.3	31.9	27.3	22.6
	Min. Temperature (in ^{0} C)	06.4	10.6	14.8	19.4	25.4	25.5	26.6	26.0	24.4	18.1	13.2	07.8
	Av. Wind (in Km/hr)	2.7	2.8	3.9	2.9	3.6	4.0	3.0	2.7	2.7	2.2	2.2	2.0
	Rainfall (in mm)	004.0	019.4	012.1	002.2	049.3	242.6	214.1	187.3	198.5	000.0	000.0	010.5
2012	Max. Temperature (in ^{0} C)	17.9	21.1	28.0	33.6	38.5	40.5	35.0	32.1	32.4	31.0	26.6	20.6
	Min. Temperature (in ^{0} C)	07.2	08.7	14.0	19.6	24.5	28.1	27.3	26.1	24.5	17.0	11.6	08.5
	Av. Wind (in Km/hr)	3.7	5.2	5.9	4.1	4.8	5.7	4.7	2.9	3.1	2.5	2.2	4.1
	Rainfall (in mm)	048.8	003.1	003.6	040.1	004.0	002.6	154.7	288.1	208.8	002.4	000.1	014.4
2013	Max. Temperature (in ^{0} C)	16.8	21.8	27.4	33.6	39.4	35.3	33.9	32.9	33.4	31.4	26.4	21.8
	Min. Temperature (in ^{0} C)	06.2	10.7	14.6	19.8	24.9	26.9	27.1	25.9	24.3	20.3	11.5	07.9
	Av. Wind (in Km/hr)	4.0	4.9	5.5	4.9	4.2	5.3	4.3	3.6	3.1	2.3	2.9	2.8
	Rainfall (in mm)	048.8	109.4	024.9	001.5	025.4	275.1	202.2	286.2	073.6	035.7	006.9	015.4
2014	Max. Temperature (in ^{0} C)	18.6	20.3	25.7	32.9	37.3	40.3	34.8	35.1	33.4	31.9	28.0	20.2

	Min. Temperature (in ^{0} C)	07.6	10.0	14.0	17.9	23.5	27.2	27.2	26.5	24.0	18.6	11.4	07.4
	Av. Wind (in Km/hr)	3.1	3.6	5.0	5.1	4.6	4.9	4.5	4.3	4.1	2.5	3.3	3.5
	Rainfall (in mm)	079.5	055.4	082.0	026.9	061.6	036.8	153.4	030.9	107.3	011.3	000.3	087.1
2015	Max. Temperature (in ^{0} C)	16.7	23.3	26.1	32.3	39.0	37.8	33.8	33.3	33.7	32.1	28.0	21.7
	Min. Temperature (in ^{0} C)	08.1	11.7	14.2	19.9	23.5	25.5	26.8	25.9	23.9	19.0	13.4	08.5
	Av. Wind (in Km/hr)	3.6	4.6	5.1	4.6	4.4	5.1	4.5	4.1	4.5	2.8	2.1	2.9
	Rainfall (in mm)	049.7	046.6	111.8	019.7	020.4	053.9	248.9	106.8	135.4	020.4	000.0	000.7
2016	Max. Temperature (in ^{0} C)	19.5	24.6	29.2	36.5	38.7	37.5	34.1	33.5	33.8	32.8	28.5	23.6
	Min. Temperature (in ^{0} C)	07.8	10.9	15.4	20.8	25.6	27.4	26.9	26.1	25.1	18.9	12.6	08.9
	Av. Wind (in Km/hr)	2.9	3.9	4.6	5.0	5.2	4.8	4.2	3.5	3.7	2.6	3.1	2.4
	Rainfall (in mm)	004.4	002.8	063.3	013.1	057.4	137.1	143.8	167.8	032.8	000.0	000.2	016.1
2017	Max. Temperature (in ^{0} C)	19.5	23.8	27.9	36.2	38.8	36.4	34.9	33.1	33.2	33.2	26.3	22.1
	Min. Temperature (in ^{0} C)	08.2	11.2	14.1	21.5	25.6	26.3	27.6	26.4	23.9	18.8	11.9	09.1
	Av. Wind (in Km/hr)	3.0	4.7	5.7	5.8	4.6	4.0	3.9	3.5	3.5	2.1	2.1	2.8
	Rainfall (in mm)	145.5	000.7	021.8	008.6	006.3	135.7	159.4	338.3	144.0	000.0	000.0	013.8

Annexure - 9

Relative Humidity (in %)

RELATIVE HUMIDITY (in %)

nth	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
ear	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
010	95	61	86	35	75	31	46	13	49	19	64	31	90	63	91	67	92	62	85	45	88	36	91	40
011	92	56	85	43	78	35	59	23	60	26	79	46	86	62	89	63	91	61	83	36	86	39	88	42
012	88	49	79	36	68	27	67	26	43	15	52	22	82	54	87	69	89	59	80	34	81	33	88	47
013	93	57	90	51	83	39	58	23	46	16	80	50	86	61	90	66	87	56	87	47	83	35	89	45
014	93	56	91	52	83	43	66	25	60	23	59	28	82	56	85	55	87	55	84	42	81	29	87	48
015	93	63	88	45	85	46	72	35	56	21	69	31	85	60	91	64	88	53	83	40	83	35	88	43
016	91	51	84	35	81	37	55	20	57	24	75	41	86	59	89	63	87	57	80	37	78	29	91	44
017	92	51	86	40	74	31	54	19	53	23	71	38	83	56	91	65	90	58	81	40	87	42	90	49

Annexure - 10

Inventory of Flora of Sukhna Wildlife Sanctuary

TREES

SN	Botanical Name	Local Name	Family
1	*Acacia catechu*	Khair	Mimosaceae
2	*Acacia farnesiana*	Farnesiana	Mimosaceae
3	*Acacia leucopholea*	Raru	Mimosaceae
4	*Acacia nilotica ssp. indica*	Kikar	Mimosaceae
5	*Acacia modesta*	Flahi	Mimosaceae
6	*Alibizia lebbek*	Siris	Mimosaceae
7	*Anogeissus latifolia*	Chal	Combretaceae
8	*Azadirachta indica*	Neem	Meliaceae
9	*Bauhinia racemosa*	Chalonda	Caesalpiniaceae
10	*Bauhinia variegata*	Kachnar	Caesalpiniaceae
11	*Bombax ceiba*	Semal	Bombacaceae
12	*Butea monosperma*	Dhak	Fabaceae
13	*Casearia tomentosa*	Chila	Flacourtiaceae
14	*Cassia fistula*	Amaltash	Caesalpiniaceae
15	*Cordia dichotoma*	Lasora	Ehretiaceae
16	*Cordia vestita*	Gumtu	Ehretiaceae
17	*Dalbergia sissoo*	Sisham	Fabaceae
18	*Diospyros cordifolia*	Kendu	Ebenaceae
19	*Ehretialaevis*	Charmror	Ehretiaceae
20	*Eucalyptus tereticornis*	Safeda	Myrtaceae
21	*Ficus benghalensis*	Barota	Moraceae
22	*Ficus religiosa*	Pipal	Moraceae
23	*Flacourtia indica*	Kandai, kangan	Flacourtiaceae
24	*Gmelina arborea*	Kumhar	Verbenaceae
25	*Grewia oppositifolia*	Behal, Bewal	Teliaceae
26	*Lannaeacoromadelica*	Jhigan	Anacardiaceae
27	*Laucaenaleucocephala*	Lusunea	Mimosoceae
28	*Manilkara hexandra*	Khirni	Sapotaceae
29	*Mangifera indica*	Aam	Anacardiaceae
30	*Melia azedarach*	Bakain	Meliaceae
31	*Moringa oleifera*	Saijana	Moringaceae
32	*Morus alba*	Toot	Moraceae
33	*Nyctanthes arbor-tristis*	Koori, Koora	Oleaceae
34	*Ougeniaoojeinensis*	Challan	Fabaceae
35	*Pongamia pinnata*	Pare	Fabaceae
36	*Prosopis juliflora*	Mesquit	Mimosaceae
37	*Stereospermumsuaveolens*	Padal	Begnoniaceae

38	*Syzygiumcumini*	Jamun	Myrtaceae
39	*Wendlandiaheynei*	Ratala	Rubiaceae
40	*Wrightia arborea*	Dhawa	Begnoniaceae

SHRUBS

SN	Botanical Name	Local Name	Family
1	*Adhatodazeylanica*	Basuta	Acanthaceae
2	*Agave cantala*	Ramban	Agavaceae
3	*Barleria cristata*		Lamiaceae
4	*Capparis sepiaria*	Heens	Capparadiaceae
5	*Carissa opeca*	Karonda	Apocynaceae
6	*Cassia tora*		Caesalpiniaceae
7	*Datura innoxia*	Datura	Solanaceae
8	*Dodonaeaviscosa*	Gainder	Sapindaceae
9	*Grewia tenax*	Gungarm, Banchana	Teliaceae
10	*Ipomoea carnea*	Basuti	Convolvulaceae
11	*Lantana camara*	Laltana	Verbenaceae
12	*Maytenusemarginatus*	Morkandai	Celastraceae
13	*Murrayakoenigii*		Rutaceae
14	*Opuntia elatior*		Cactaceae
15	*Pavoniazeylanica*		Malvaceae
16	*Solanum surattense*		Solanaceae
17	*Ziziphus mauritiana*	Ber	Rhamnaceae
18	*Ziziphus nummularia*	Jharberi	Rhamnaceae

CLIMBERS

SN	Botanical Name	Local Name	Family
1	*Abrusprecatorius*	Lalari	Fabaceae
2	*Bauhinia vahlii*	Malzan	Caesalpiniaceae
3	*Celastruspaniculatus*	Malkangni	Celastraceae
4	*Cocculus hirsutus*		Menispermaceae
5	*Cocculus pendulus*		Menispermaceae
6	*Cryptolepisbuchananii*		Asclepidiaceae
7	*Ichnocarpus frutescens*	Bakerbel	Apocynaceae
8	*Leptadenia reticulate*		Apocynaceae
9	*Tinospora cordifolia*	Geloh	Menispermaceae
10	*Ziziphus oenoplia*	Kander	Rhamnaceae

HERBS

SN	Botanical Name	Local Name	Family
1	*Aervalanata*		Amarantaceae
2	*Ageratum conyzoides*		Asteraceae
3	*Anagallis arvensis*		Primulaceae
4	*Blumeamollis*		Asteraceae
5	*Campanula benthamii*		Campanulaceae
6	*Capsella bursa-pastoris*		Brassicaceae
7	*Dicliptera roxburghiana*		Acanthaceae
8	*Emilia sonchifolia*		Asteraceae
9	*Euphorbia hirta*		Euphorbiaceae
10	*Euphorbia prostrata*		Euphorbiaceae
11	*Gmaphalium pensylvanicum*		Asteraceae
12	*Launea fallax*		Asteraceae
13	*Launea resedifolia*		Serophulariaea
14	*Majus pumilus*		Serophulariaea
15	*Malva verticillata*		Malvaceae
16	*Malvastrum coromandelicum*		Malvaceae
17	*Oxalis corniculata*		Oxiladaceae
18	*Parthenium hysterophorus*		Asteraceae
19	*Peristrophe paniculata*	Footkada	Acanthaceae
20	*Phyllanthus fraternus*		Euphorbiaceae
21	*Rungia repens*		Acanthaceae
22	*Saussurea heterornella*		Asteraceae
23	*Sida cordata*		Malvaceae
24	*Sonchus asper*		Asteraceae
25	*Vernonia cinerea*		Asteraceae
26	*Veronica agrestis*		Scrophulariaceae
27	*Vicoa indica*		Asteraceae
28	*Youngia japonica*		Asteraceae

GRASSES

SN	Botanical Name	Local Name	Family
1	*Arundinella nepalensis*		Poaceae
2	*Aplunda mutica*	Markana	Poaceae
3	*Arundo donax*	Nara	Poaceae
4	*Chloris dolichostachya*	Madana	Poaceae
5	*Chrysopogon serrulatus*	Ghoru	Poaceae
6	*Cymbopogon commutatus*	Khau	Poaceae

7	*Cynodon dactylon*	Doob	Poaceae
8	*Digitaria ciliaris*		Poaceae
9	*Eragrostis japonica*		Poaceae
10	*Eragrostis viscosa*		Poaceae
11	*Eulaliopsis binata*	Babak	Poaceae
12	*Heteropogoncontortus*	Sarara	
13	*Neyraudia arundinacea*	Bansi	Poaceae
14	*Saccharum bengalense*	Sarkanda	Poaceae
15	*Setaria glauca*		Poaceae
16	*Setaria verticellata*		Poaceae

PARASITE

SN	Botanical Name	Local Name	Family
1	*Dendrophthoe falcate*	Banda	Loranthaceae

PALMS

SN	Botanical Name	Local Name	Family
1	*Phonenix humilis Royle*	Khajoor	Aracaceae
2	*Phoenix sylvestris*	Khajoor	Aracaceae

BAMBOO

SN	Botanical Name	Local Name	Family
1	*Dendrocalamus strictus*	Bans	Bambuscideae

PTERODOPHYTES

SN	Botanical Name	Local Name	Family
1	*Adiantum incisum*	Fern	Adiantaceae
2	*Cheilanthes bicolor*	Fern	Sinopteridaceae
3	*Equisetum diffusum*	Horstail	Equisetaceae

BRYOPHYTA

SN	Botanical Name	Local Name	Family
1	*Plagiochasma intermedium*		Marchantiaceae

Inventory of Fauna of Sukhna Wildlife Sanctuary

List of bird recorded in Chandigarh Wildlife Sanctuary, Sukhna and adjoining during 15-18 February'2005 – (Winter Survey)

SN	Common Name	Scientific Name
1	Great Cormorant	Phalacrocorax carbo
2	Little Cormorant	*Phalacrocroraxniger*
3	Little Grebe	*Tachyhaptusrufficollis*
4	Great Egret*	Casmerodius albus
5	Little Egret	*Egrettagarzetta*
6	Cattle Egret	*Bubulcus ibis*
7	Grey Heron*	Ardea cinerea
8	Indian Pond Heron	*Ardeolagrayii*
9	Greylag Goose*	*Anseranser*
10	Ruddy Shelduck*	*Tadronaferruginea*
11	Northern Pintail*	*Anas acuta*
12	Common Teal	*Anas crecca*
13	Spot-billed Duck	*Anas poecilorhyncha*
14	Mallard*	*Anas platyrhynchus*
15	Gadwall*	*Anas strepera*
16	Eurasian Wigeon*	*Anas penelope*
17	Northern Shoveler*	*Anas clypeata*
18	Common Pochard*	*Aythya ferina*
19	Ferruginous Pochard*	*Aythya nyroca*
20	Tufted Duck*	*Aythya fuligula*
21	Oriental Honey Buzzard	*Pernis ptilohynchus*
22	Black Shouldered Kite	*Elanus caeruleus*
23	Black Kite	*Milvus migrans*
24	Shikra	*Accipiter badius*
25	Common Buzzard	*Buteo buteo*
26	Booted Hawk Eagle	*Hieraaetuspennatus*
27	Steppe Eagle	*Aquia nepalensis*
28	Red-headed Vulture	*Sarcogyps calvus*
29	Cinereous Vulture	*Aegypiusmonachus*
30	Egyptian Vulture	*Neophron percnopterus*
31	Himalayan Griffon	*Gyps fulvus*
32	Crested Serpent Eagle	*Spilornischeela*
33	Grey Francolin	*Francolinuspondiceranus*
34	Jungle Bush Quail	*Perdicula asiatica*
35	Indian Peafowl	*Pavocristatus*
36	Red Jungle fowl	*Gallus gallus*
37	White-breasted Water hen	*Amauriornisphoenicurus*
38	Purple Swamphen*	*Porphyrioporphyrio*
39	Common Moorhen	*Gallinula cholopus*

40	Common Coot	*Fulicaatra*
41	Black-winged Stilt	*Himantiopushimantopus*
42	White-tailed Lapwing*	*Vanellusleucurus*
43	Red-wattled Lapwing	*Vanellus indicus*
44	Little-ringed Plover*	*Charadrius dubius*
45	Ruff*	*Philomachus pugnax*
46	Common Redshank*	*Tringatotanus*
47	Common GreenShank	*Tringanebularia*
48	Marsh Sandpiper*	*Tringastagnatilis*
49	Wood Sandpiper*	*Tringaglareola*
50	Green Sandpiper	*Tringaochropus*
51	Common Sandpiper*	*Actitishypoleucos*
52	Common Snipe	*Gallinagogallinago*
53	Eurasian Collard Dove	*Streptopeliadecaocto*
54	Laughing Dove	*Streptopelia senegalensis*
55	Spotted Dove	*Streptopelia chinensis*
56	Rock Pigeon	*Columba livia*
57	Slaty-headed Parakeet	*Psittaculahimalayana*
58	Plum-headed Parakeet	*Psittaculacyanocephala*
59	Alexandrine Parakeet	*Psittaculaeupatria*
60	Rose-ringed Parakeet	*Psittaculakrameri*
61	Common Hawk-Cuckoo	*Hierococcyxvarius*
62	Asian Koel	*Eudynamysscolopacea*
63	Greater Coucal	*Centropus sinensis*
64	Savanna Nightjar	*Caprimulgus affinis*
65	Spotted Owlet	*Athene brama*
66	House Swift	*Apus affinis*
67	Indian Roller	*Coracias benhghalensis*
68	Pied Kingfisher*	*Cerylerudis*
69	White-throated Kingfisher	*Halcyon smyrnensis*
70	Common Kingfisher	*Alcedoatthis*
71	Brown – headed Barbet	*Megalaimazeylanica*
72	Coppersmith Barbet	*Megalimahaemacephala*
73	Common Hoopoe	*Upupa epops*
74	Indian Grey-Hornbill	*Ocycerosbirostris*
75	Common Flameback	*Dinopiumjavaenense*
76	Brown-capped Pigmy Woodpecker	*Dendrocopos nanus*
77	Common Iora	*Aegithina tiphia*
78	Ashy-crowned Sparrow Lark	*Eremopterix grisea*
79	Plain Martin	*Riparia paludicola*
80	Streak-throated Swallow	*Hirundofluvicola*
81	Black Drongo	*Dicrurusmacrocercus*
82	Spangled Drongo	*Dicrurushottentottus*
83	Common Woodshike	*Tephrodornispondicerianus*
84	Long-tailed Shrike	*Laniusschach*

85	Bay-backed Shrike	*Laniusvittatus*
86	Common Starling	*Sturnus vulgaris*
87	Brahminy Starling	*Sturnus pagodarum*
88	Asian Pied Starling	*Acridotheres contra*
89	Common Myna	*Acridotheres tristis*
90	Rufous Treepie	*Dendrocittavagabunda*
91	Red-billed Blue Magpie	*Urocissaerythrorhyncha*
92	House Crow	*Corvus splendens*
93	Large-billed Crow	*Corvus macrorhynchos*
94	Large Cuckoo shrike	*Coracinamacei*
95	Small Minivet	*PericrocotusCinnamomemeus*
96	Black Bulbul	*Hypsipetes leucocephalus*
97	Red-vented Bulbul	*Pyconotuscafer*
98	Himalayan Bulbul	*Pycnonotusleucogenys*
99	Black-chinned Babbler	*Stachyrispyrrhops*
100	Yellow-eyed Babbler	*Chrysommasinense*
101	Jungle Babbler	*Turdoidesstriatus*
102	Large Grey Babbler	Yurdoidesmalcolmi
103	Grey-headed Canary Flycatcher	*Culicicapaceylonensis*
104	Tickell's Blue Flycatcher	*Cyornistickelliae*
105	White-throated Fantail	*Rhipiduraalbicollis*
106	Yellow-bellied Fantail	*Rhipidurahypoxantha*
107	Grey-hooded Warbler	*Seicercus*xanthoschistos
108	Whistler's Warbler	*Seicercuswhistleri*
109	Grey-breasted Prinia	*Priniahodgsonii*
110	Ashy Prinia	*Priniasocialis*
111	(unidentified)	*Prinia sp.*
112	Common Tailorbird	*Orthotomussutorius*
113	Lesser Whitethroat	*Sylia nana*
114	Common Chiffchaff	*Phylloscopuscollybita*
115	Hume's Warbler	*Phylloscopushumei*
116	Black Redstart	*Phoenicurusochruros*
117	Brown Rock-chat	*Cerucomelafusca*
118	Oriental Magpie Robin	*Copsychussaularis*
119	Indian Robin	*Saxicoloidesfulicata*
120	Grey Bushchat	*Saxicola ferrea*
121	Blue-whistling Thrush	*Myophonus caeruleus*
122	Dark-throated Thrush	*Turdus ruficollis*
123	Grey-winged Blackbird	*Turdus boulboul*
124	Great Tit	*Parus major*
125	Paddyfield Pipit*	*Anthusrufulus*
126	White-browed Wagtail	*Motacillamaderapatensis*
127	Grey Wagtail	*Motacilla cinerea*
128	White-Wagtail	*Motacilla alba*
129	Oriental White-Eye	*Zosteropspalpehrosus*

130	Purple Sunbird	*Nectarina asiatica*
131	Scaly-breasted Munia	*Lonchurapunctulata*
132	House Sparrow	*Passer domesticus*
133	White-capped Bunting	*Emberizastewarti*

* Birds recorded only at SukhnaLake

List of butterflies recorded in ChandigarhWildllife Sanctuary, Sukhna during 15-18 February'2005 – (Winter Survey)

S.No.	Common Name	Scientific Name
1	Indian Cabbage White	Pieris canidia (Sparman)
2	Common Tiger	Danaus genutia (Cramer)
3	Chocolate Pansy	Precis iphita (Cramer)
4	Common Bush Brown	Mycaelesisperseus (Fab.)
5	Lemon Pansy	Precis lemonias (Linn.)
6	Lesser Grass Blue	Zizeeraotis (Fab.)
7	Peacock Pansy	Precis almanac (Linn.)
8	Common Leopard	Phalanthaphalantha (Drury)
9	Yellow Orange Tip	Ixias pyrene (Linn.)
10	Common Sailor	Neptishylas (Linn.)
11	Common Indian Crow	Euploea core (Cramer)
12	Common Emigrant	Catopsilacrocale (Cramer)
13	Common Mormon	Princeps polytes (Linn.)
14	Common Grass Yellow	Euremahecabe (Linn.)

List of wild mammals in Sukhna Wildlife Sanctuary, Chandigarh

1. Rhesus Macaque, *Macaca mulatto*
2. Common Langur, *Presbytis entellus*
3. Leopard , *Panthera pardus* (reported by forest staff during winter).
4. Jungle Cat, *Felis chaus* (probably present)
5. Indian Palm Civet or Toddy cat, *Paradoxurus hermaphroditus*.
6. Common Mongoose, *Herpestesedwardsi*.
7. Small Mongoose, *Herpestesauropunctatus*.
8. Jackal, *Canis aureus.*
9. Indian Fox, *Vulpes bengalensis* (reported by forest staff)
10. Indian Flying Fox Bat, *Pteropus giganteus*.
11. The Grey Musk Shrew*, Sunucus murinus*.
12. Five-striped Palm Squirrel, *Funambulus pennanti*
13. Indian Field Mouse*, Mus booduga*
14. Indian Porcupine, *Hystrix indica*
15. Rufous- tailed Hare,*Lepusnigricollisruficaudatu*
16. Nilgai, *Boselaphustragocamelus*.
17. Sambar, *Cervus unicolor*
18. Chital, *Axis axis*
19. Indian Wild Boar, *Sus scrofa*
20. Ant eater, *Pangolin*

List of birds recorded in Sukhna Wildlife Sanctuary, Chandigarh and adjoining SukhnaLake during 25-28 May'2005 (Summer Survey)

SN	Common Name	Scientific Name
1	Little Cormorant	*Phalacrocroraxniger*
2	Little Grebe	*Tachyhaptusrufficollis*
3	Little Egret*	*Egrettagarzetta*
4	Cattle Egret	*Bubulcus ibis*
5	Indian Pond Heron	*Ardeolagrayii*
6	Black –crowned Night Heron*	*Nycticoraxnycticorax*
7	Ruddy Shelduck*	*Tadronaferruginea*
8	Asian Openbill*	*Anastomusoscitans*
9	Spot-billed Duck	*Anas poecilorhyncha*
10	Lesser Whistling -Duck	*Dendrocygnajavanica*
11	Oriental Honey Buzzard	*Pernis ptilohynchus*
12	Black Kite	*Milvus migrans*
13	Shikra	*Accipiter badius*
14	Grey Francolin	*Francolinuspondiceranus*
15	Black Francolin	*Francolinusfrancolinus*
16	Indian Peafowl	*Pavocristatus*
17	Red Junglefowl	*Gallus gallus*
18	White-breasted Waterhen	*Amauriornisphoenicurus*
19	Common Moorhen	*Gallinula cholopus*
20	Black-winged Stilt*	*Himantiopushimantopus*
21	Red-wattled Lapwing	*Vanellus indicus*
22	Eurasian Collard Dove	*Streptopeliadecaocto*
23	Yellow –Footed Green Pigeon	*Treronphoenicoptera*
24	Rock Pigeon	*Columba livia*
25	Laughing Dove	*Streptopelia senegalensis*
26	Spotted Dove	*Streptopelia chinensis*
27	Red Collard Dove	*Strepetopeliatranquebarica*
28	Eurasian Collard Dove	*Strepetopeliadecaocto*
29	Plum-headed Parakeet	*Psittaculacyanocephala*
30	Alexandrine Parakeet	*Psittaculaeupatria*
31	Rose-ringed Parakeet	*Psittaculakrameri*
32	Plum-headed Parakeet	*Psittaculacyancephala*
33	Common Hawk-Cuckoo	*Hierococcyxvarius*

34	Indian Cuckoo	*Cuculusmicropterus*
35	Asian Koel	*Eudynamysscolopacea*
36	Sirkeer Malkoha	*Phaenicophaeusleschenaulti*
37	Greater Coucal	*Centropus sinensis*
38	Large-tailed Nightjar	*Caprimulgus macrurus*
39	Spotted Owlet	*Athene brama*
40	Dusky Eagle Owl	*Bubo coromandus*
41	House Swift	*Apus affinis*
42	Pied Kingfisher*	*Cerylerudis*
43	White-throated Kingfisher	*Halcyon smyrnensis*
44	Green-bee-eater	*Meropsorientalis*
45	Blue-tailed Bee-eater	*Meropsphilippinus*
46	Brown –headed Barbet	*Megalaimazeylanica*
47	Coppersmith Barbet	*Megalimahaemacephala*
48	Indian Grey-Hornbill	*Ocycerosbirostris*
49	Common Flameback	*Dinopiumjavaenense*
50	Brown-capped Pigmy Woodpecker	*Dendrocopos nanus*
51	Common Iora	*Aegithina tiphia*
52	Eurasian Golden Oriole	*Oriolusoriolus*
53	Indian Pitta	*Pitta brachyura*
54	**Plain Martin**	*Riparia paludicola*
55	Streak-throated Swallow	*Hirundofluvicola*
56	Black Drongo	*Dicrurusmacrocercus*
57	Common Woodshike	*Tephrodornispondicerianus*
58	Bay-backed Shrike	*Laniusvittatus*
59	Brahminy Starling	*Sturnus pagodarum*
60	Asian Pied Starling	*Acridítheres contra*
61	Common Myna	*Acridítheres tristis*
62	Bank Myna	*Acridítheresginginianus*
63	Rufous Treepie	*Dendrocittavagabunda*
64	Red-billed Blue Magpie	*Urocissaerythrorhyncha*
65	House Crow	*Corvus splendens*
66	Large-billed Crow	*Corvus macrorhynchos*
67	Black –headed Cuckoo shrike	*Coracibnamelanoptera*

68	Red-vented Bulbul	*Pyconotuscafer*
69	Himalayan Bulbul	*Pycnonotusleucogenys*
70	Black-chinned Babbler	*Stachyrispyrrhops*
71	Yellow-eyed Babbler	*Chrysommasinense*
72	Jungle Babbler	*Turdoidesstriatus*
73	Common Babbler	*Turdoidescaudatus*
74	Tickell's Blue Flycatcher	*Cyornistickelliae*
75	Asian Paradise Flycatcher	*Terpsiphone paradisi*
76	White-browed Fantail	*Phipiduraaureola*
77	Grey-breasted Prinia	*Priniahodgsonii*
78	Ashy Prinia	*Priniasocialis*
79	Striated Prinia	*Priniacriniger*
80	Grey-crowned Prinia	*Priniacinereocapilla*
81	Rufous- fronted Prinia	*Priniabuchanani*
82	Common Tailorbird	*Orthotomussutorius*
82	Oriental Magpie Robin	*Copsychussaularis*
84	Indian Robin	*Saxicoloidesfulicata*
85	Pied Bushchat	*Saxicola caprata*
86	Great Tit	*Parus major*
87	Grey Wagtail	*Motacilla cinerea*
88	White-Wagtail	*Motacilla alba*
89	Oriental White-Eye	*Zosteropspalpehrosus*
90	Purple Sunbird	*Nectarina asiatica*
91	Scaly-breasted Munia	*Lonchurapunctulata*
92	Red Avadavat	*Amandavaamnadava*
93	House Sparrow	*Passer domesticus*
94	Crested Bunting	*Melophuslathami*
95	Darter	*Ahingamelanogate*

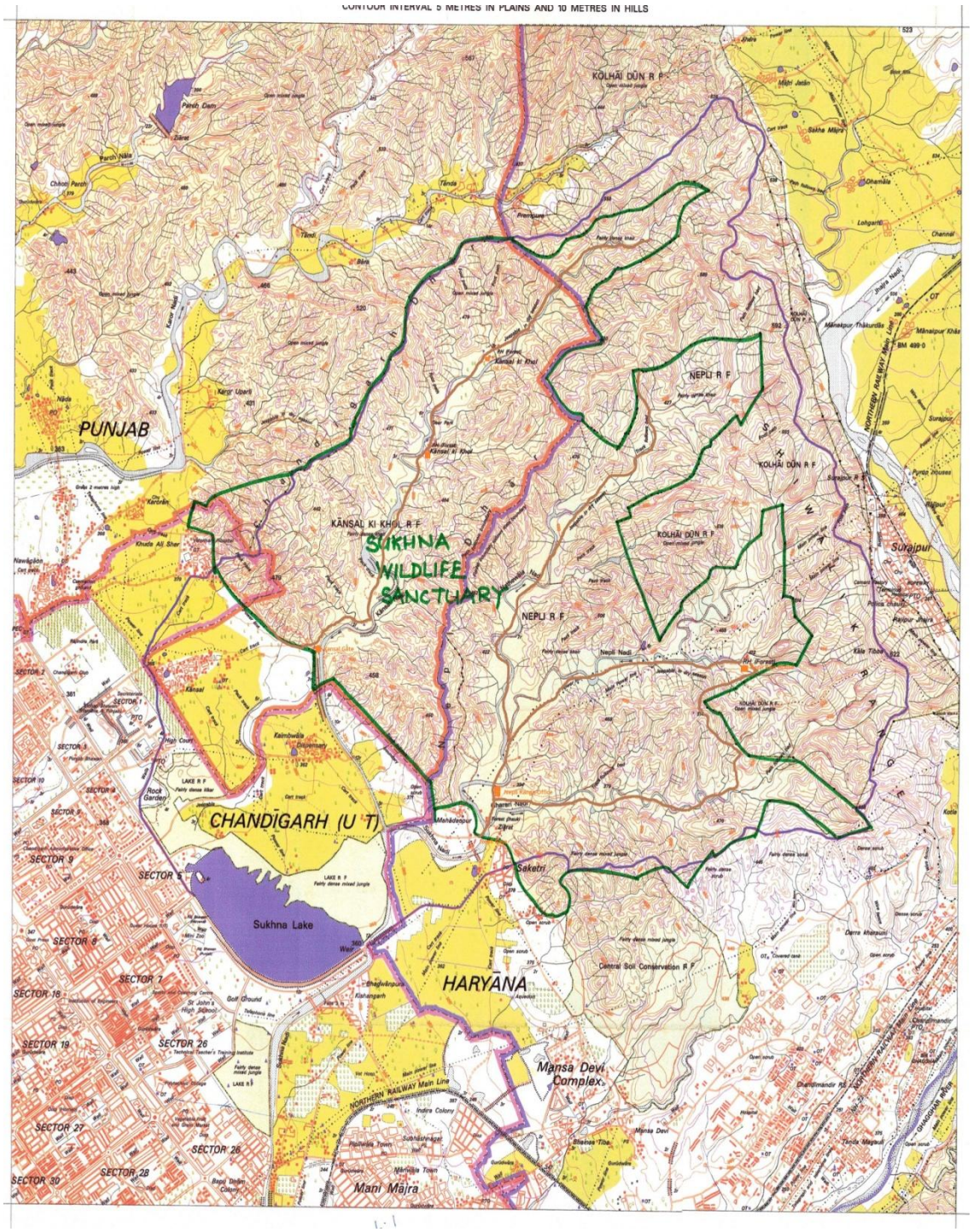
* Birds recorded at Sukhna lake only

List of butterflies recorded in Sukhna Wildlife Sanctuary, Chandigarh during 25-28 May'2005 (Summer Survey)

S. No.	Common Name	Scientific Name
1	Common Mormon	*Princeps polytes*(Linn.)
2	Lime Butterfly	*Princeps demoleus*(Linn.)
3	Yellow Orange Tip	Ixias pyrene *(Linn.)*
4	White Orange Tip	*Ixias marianne*(Cramer)
5	Mottled Emigrant	*Catopsilapyranthe*(Linn.)
6	Common Emigrant	*Catopsila Pomona* (Fab.)
7	Common Gull	Cepriosanerissa*(Fab.)*
8	Pioneer	*Anapheisaurota*(Fab.)
9	Common Grass Yellow	*Euremahecabe*(Linn.)
10	Small Grass Yellow	*Euremabrigitta*(Stoll.)
11	Blue Pansy	*Precis orithya*(Linn.)
12	Yellow Pansy	*Precis hierta*(Fab.)
13	Lemon Pansy	*Precis lemonias*(Linn.)
14	Common Castor	*Ariadnaemerione*(Cramer)
15	Common Leopard	*Phalanthaphalantha*(Drury)
16	Common Sailor	*Neptishylas*(Linn.)
17	Common Nawab	*Polyuraathamas*(Drury)
18	Plain Tiger	*Danaus chrysippus*(Linn.)
19	Common Five-Ring	*Ypthimabaidus*(Fab.)
20	Common Bush Brown	*Mycaelesisperseus*(Fab.)
21	Dark Grass Blue	*Zizeerialysimon*
22	Zebra Blue	*Syntarucusplinius*(Fab.)
23	Silver line	*Spindasisvulcanus*(Fab.)
24	Indian Red Flash	Rapala melampus *(Fab.)*
25	Least Grass Jewel	*Zizeeriaputli*(Kollar)
26	Common Pierrot	*Castaliusrosimon*(Fab.)
27	Striped Pierrot	*Tarucusnara*(Kollar)

Annexure - 12

Map showing locations of Inspection Banglows& Paths



Annexure - 13

Photographs of Sukhna WLS

Reservoire of Dam No 1 Ghareri Nala

Sambars on Ridge -1

Reservoir od Dam No 3 Memnewala

Annexure - 14

Old FRH to be converted into Interpretation Centre, Souvenir Shop & Canteen

A)Compartment History File – Formats ;

Compartment History File

Name of the Forest:
Compartment or sub-compartment No.:
Beat:
Block:
Range:
Division:

Description of Forests

Division: Forest:
Range: Compartment:
Block: Area:
Beat:

Past History of Management

Management allotment	Management Plan by T.Johri (2008-17)	Current Plan
Working Circle		
F.D.		

Part-I

1. Name:
2. Situation:
3. Boundaries: N:

   E:
   S:
   W:
4. Configuration:
5. Locality Factors: a. Altitude
   b. Aspect
   c. Slope
   d. Soil & Sub-soil
   e: Drainage
   f: Erosion
6. General Composition:

   a: Principal Species
      i. Age class
      ii. Quality
      iii. Stocking
   b: Underwood

c: Undergrowth
d: Climbers
e: Ground cover
f: Regeneration

7. Density
8. Quality
9. Injury to the crop
10. Right & concessions
11. Allotment
12. Special treatment Prescribed

Form - A

Enumeration Results

Year of Enumeration:	Compartment/ Sub compartment No.

Enumeration No.	Species	Diameter class (in centimeters)										
		10--20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100 or over	Total

B) Control Form Format

Form - B

Trees marked for felling by the Departmental Agency/ Purchaser												
Year:												
Division:						Compartment/ Sub compartment No.						
Range:												
Block:												
Year & nature of Felling	Species	Diameter class (in centimeters)										
		10 -- 20	20 - 30	30 - 40	40 - 50	50-60	60-70	70-80	80-90	90-100	100 or over	Total

Form C (Separate File)

Form D

Estimation of intensity of Lantana infestation

Name of the Forest:

Compartment/ Sub-compartment No.

Area of the compartment:

Year of Estimation	Average intensity of infestation				Comptt. Partially infested
	upto 25%	26-50%	50-75%	>75%	(area of infested portion)

Form E

Rehabilitation of Lantana infested Area

Name of the Forest:
Compartment/ Sub-compartment No.
Area of the compartment:

Year of Treatment	Area of comptt. (in Ha.)	Area treated (in Ha.)	Balance area (in Ha.)

Annexure - 16

Wildlife Reference material for Field Identification

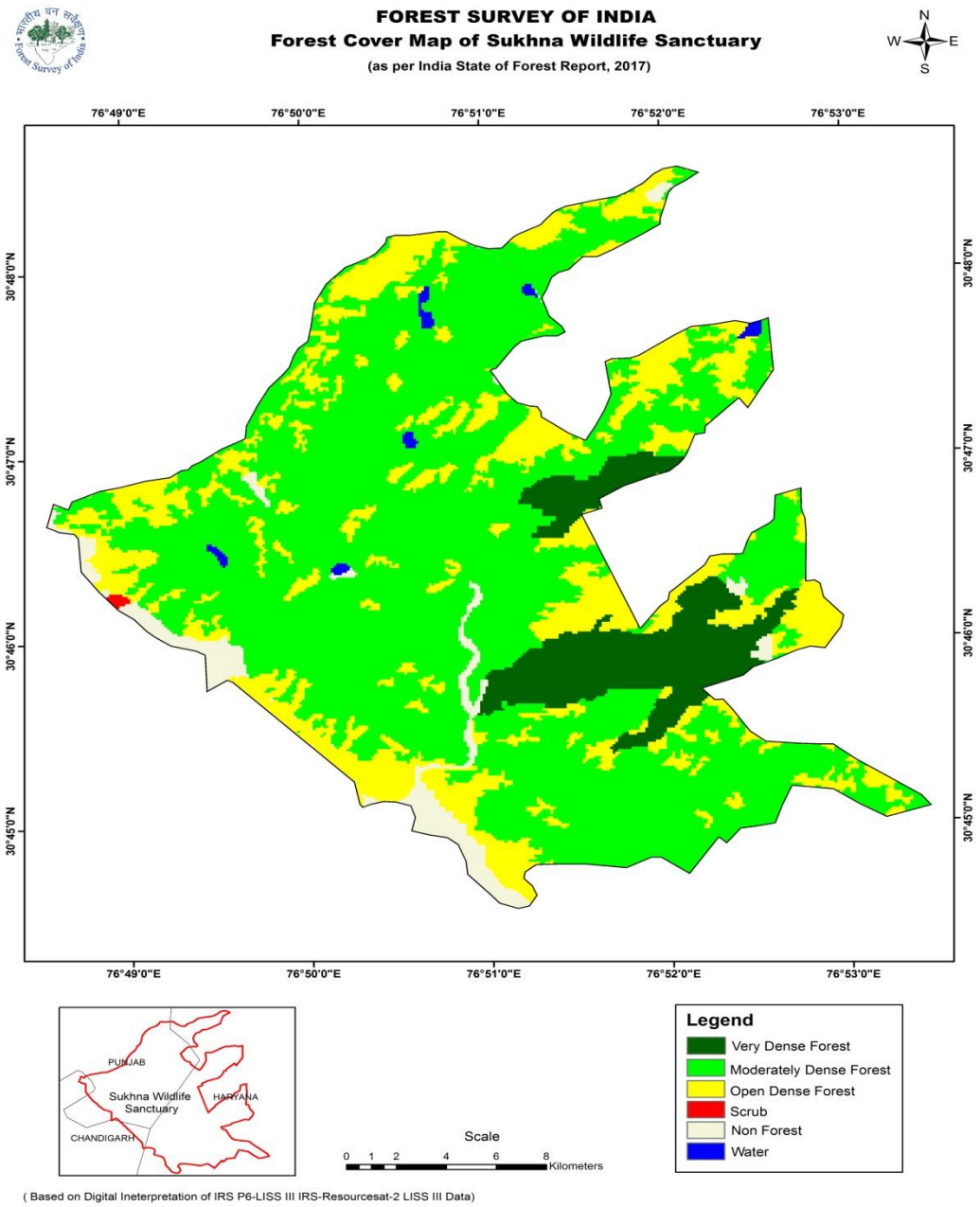
Annexure – 17

CD of Vegetation Map & Forest Cover Map

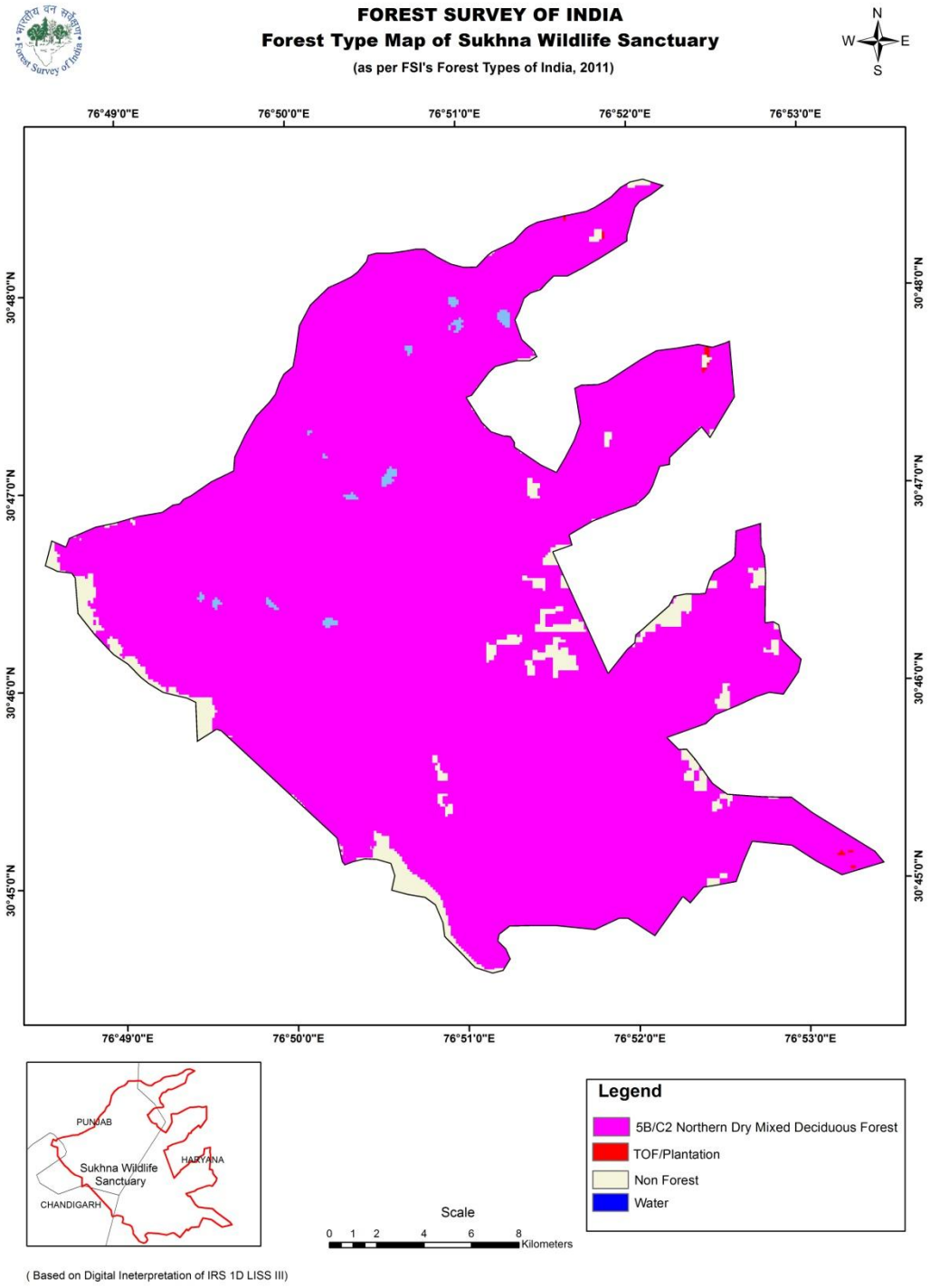
Annexure - 18

CD of GIS layers –

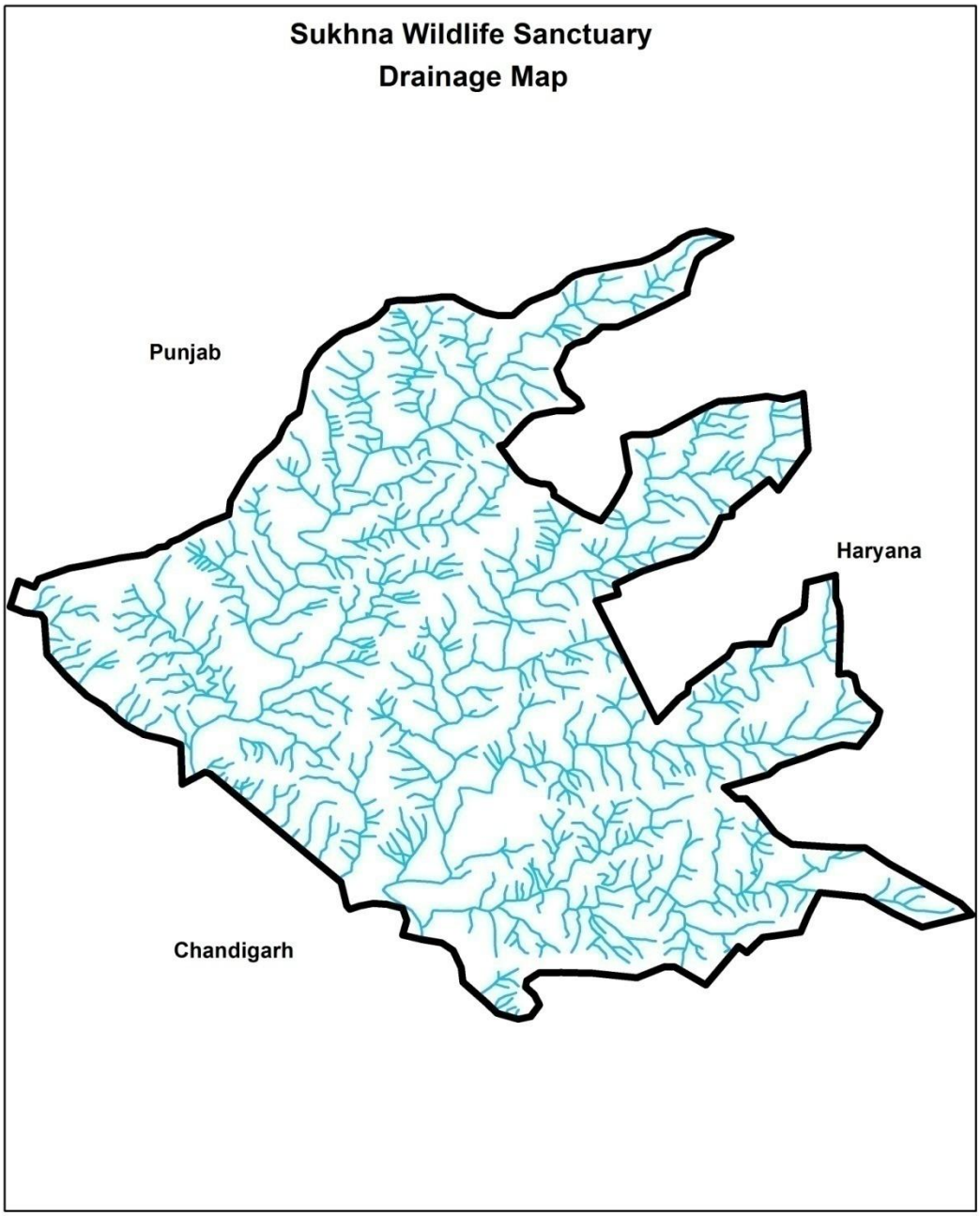
a. Vegetation Map



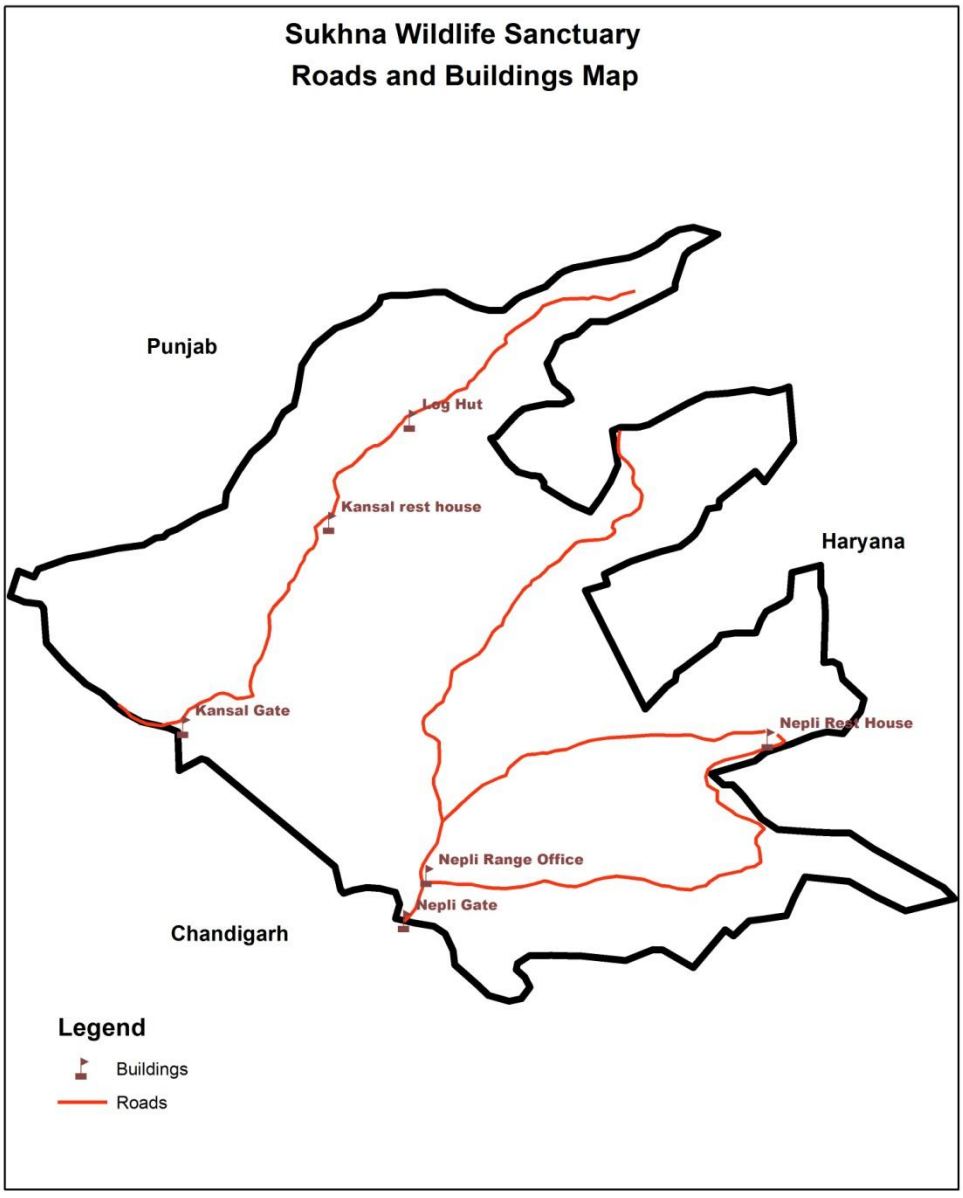
b. Forest Type Map



c. Drainage Map

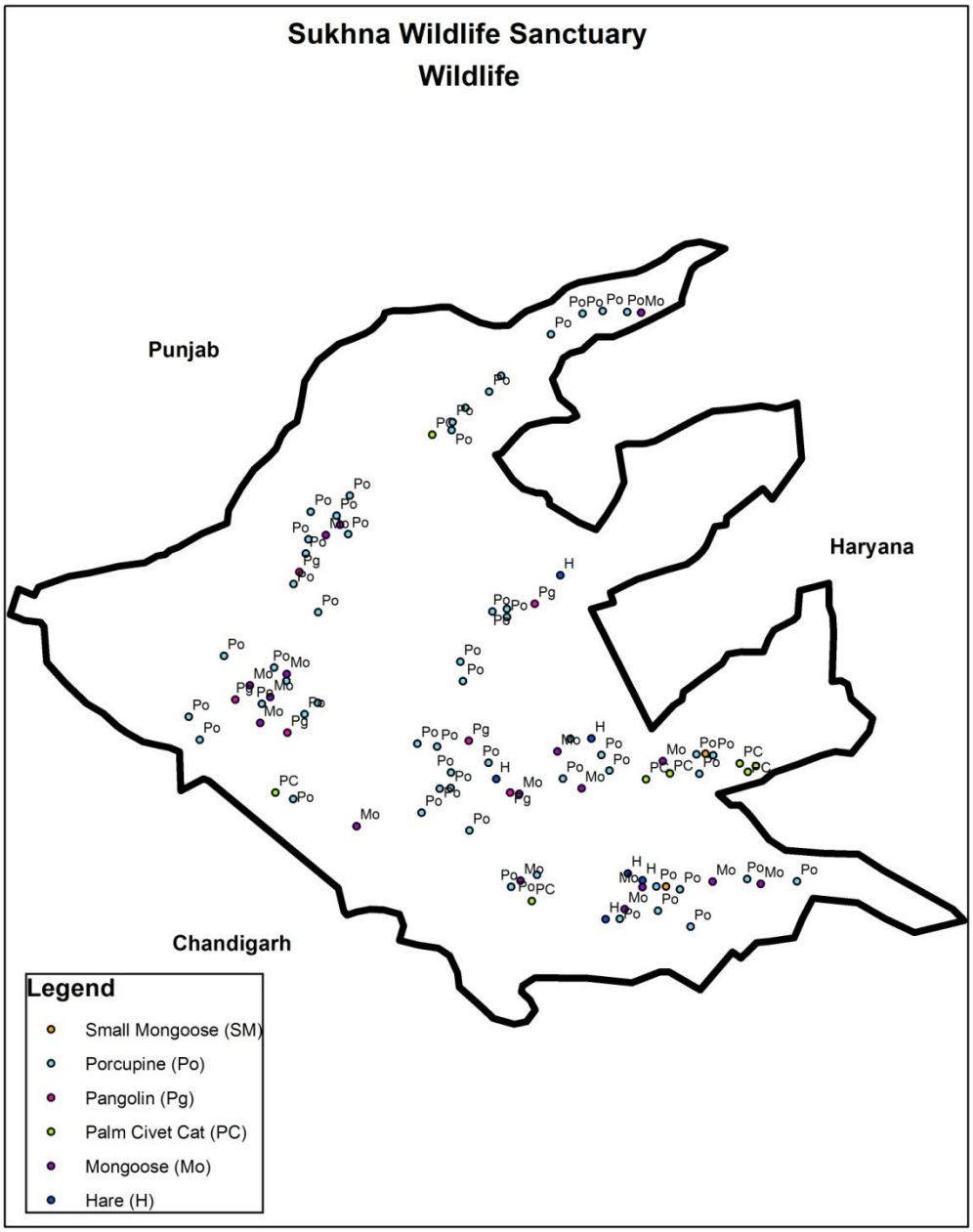


d. Roads & Buildings Map



e. Administrative Map

f. Wildlife Distribution Map (for small mammals)



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