

# Applied Bio-diversity of Sariska Region, Rajasthan

Dr. Sneha Jangir<sup>1</sup>, Dr. Sandeep Jangir<sup>2</sup>, Dr. Mukesh Kumar Sharma<sup>3</sup>

<sup>1</sup> Assistant Professor, Department of Zoology  
Shri Karni Girls PG College, Nangali Saledi Singh, Khetri, Jhunjhunu, Rajasthan

<sup>2</sup> Principal  
Shri Karni Girls PG College, Nangali Saledi Singh, Khetri, Jhunjhunu, Rajasthan

<sup>3</sup> Associate Professor, Department of Geography  
Singhania University, Pacheri Bari, Jhunjhunu, Rajasthan

**Abstract:** The study area, Sariska Sanctuary established in the year 1955-56 is situated in Alwar district between parallels of 27° 14'5" and 27° 52'12" N latitude and 76° 14'20" and 76° 32'12" E longitudes and roughly shaped like jumping frog, covering an area of 866.13 sq. Kms. with core area of 492 sq. kms. (Fig.1.1) Situated amidst the high ranges of Aravallies, undulating plateau and wide valley, the Sariska Sanctuary occupies a pride place in Rajasthan for conservation of wildlife for more than a century. The Sariska Sanctuary is one of the 28 Tiger Project of India. Consist 4 forest ranges, Sariska (205 Sq.kms). Tehla (341 Sq.kms.).

**Keywords:** Sariska Region, Rajasthan

## 1. Introduction

Akbarpur (219 Sq. kms.) and Talvriksha (101 Sq. kms.) and 83 forest blocks is a classic example of a rare amalgamation of natural history and archaeology. The Sariska Sanctuary located at south-west bottom of Alwar district is about 36 Km. from Alwar and is about 140 Km. from Jaipur on Jaipur via Alwar Delhi state highway No. 8 and approachable all weather motarable road is girdled by Aravali ranges with precipitous slopes, flat topped

crests and cascading streamlets providing an ideal location for wildlife conservation. The Sariska Sanctuary is a highly fragile ecosystem and wellclad with forests and natural vegetation of grasses, shrubs and endemic trees a true ecotone between the semi-arid north and the sub-humid south. The Rupalali river covers the major part of Sariska Sanctuary flows towards east and other river streams and rivulets are also sessional also flow toward north-east direction.



Alwar district belongs to Aravalli hill region which is a district geographical identity due to its physical homogeneity, cultural, historical, social, ecological and economic coherence. The district is situated between Yamuna-Satluj watershed divide. Physiographically, the district is characterized by north-eastern extension of the great Aravalli ranges, which runs unabated from Delhi to Gujrat. The Alwar tract of Aravallies may be divided into two zones (i) Hilly area comprising, Thanagazi, Rajgarh, Bansur and part of Mandawar, Behror and Alwar sadar tehsils and (ii) the remaining second part having a more or less plain like appearance with very small and low hill like terraces or plateaus. Alwar town is well connected by railway network and metalled roads. The town is connected with Jaipur, Delhi, Ahmedabad, Ajmer, Jodhpur by broad gauge railway line, providing easy accessibility to Jaipur, the capital of Rajasthan state and Delhi, the capital of India. Thus, owing to easy accessibility Alwar has become a centre of tourists, nature lovers and wildlife conservationists besides its historical and mythological importance. The location of a few historical, picnic spots and religious places in Sariska like Pandupol, Bharthari, Naldeshwar and Talbriksh have made this area more adorable to be frequently visited by the pilgrims and tourists. The 9<sup>th</sup> and 10<sup>th</sup> century ruins of shiva temple of Grahrajor, the medieval fort of Kankwari also add to grandeur of this project.

### 1.2 ADMINISTRATIVE SETUP:

The Sariska Sanctuary is a part of Alwar district comprising of 4 tehsils namely Thanagazi, Alwar, Bansur and Rajgarh. Thanagazi and Rajgarh tehsils are part of core-I, core-II is represented by Alwar, Bansur and Thanagazi tehsils and core-III is constituted by Thanagazi and Rajgarh tehsils. The buffer zone and villages surrounding lie in all four tehsils, administered by a common district Headquarters Alwar town, which lies to the immediate east of Tiger project. It is easy, therefore, to understand that the entire area in and around the project is densely inhabited by people most of them are Meenas, Gurjars and Bavariyas tribe. The Sariska Sanctuary is today surrounded by 300 villages and 36 villages are still part of the Project (Table 1.1).

**Table 1.1 Village Situated In Sariska Sanctuary**

S.No.	Name of Village	S.No.	Name of Village
1.	Dabali	19.	Rajor
2.	Rothkala	20.	Tilwad
3.	Kriska	21.	Tilwadi
4.	Lilonda	22.	Todajaisinghpura

5.	Sukola	23.	Gordhanpura
6.	Panidal	24.	Mallana
7.	Madhogarh	25.	Sitawat
8.	Kushalgarh	26.	Tehla
9.	Indok	27.	Talab
10.	Kalachara	28.	Murlipura
11.	Sirwas	29.	Ghewar
12.	Kankwari	30.	Dabkan
13.	Bhaghani	31.	Raikamala
14.	Haripura	32.	New Kundalka
15.	Deori	33.	Dulawa
16.	Kanlyawas	34.	Bandipur
17.	Muthrawat	35.	Nagalheri
18.	Garh	36.	Duharmala

Source: Field Director, Sariska Sanctuary, Alwar, Year 2011

### 1.3 THE TIGER PROJECT AND CORE AREA:

The Sariska Sanctuary, towards the end of the last decay, was joined to other game reserves/sanctuaries in order to provide a buffer zone to the main core area and thus reduce the grazing pressure of the wild animals and also to provide a continuous corridor to wildlife for their better genetic breeding. Thus, the Tiger Project which existed in the foothills of Aravallis is divided into three core areas along with bufferzone. Core area I (273.8 Sq.Km.) comprises the central section from Thanagazi to Baran Tal gate, including Kalighati, Kankawari, Udainath, Naldeshwar, Pandupol, Siliberi, Umri, Ganka, Duhar Mala, Sukola and Devri. This section roughly corresponds with the future national park, where no habitation is legal. There are 11 villages located in this section. Core area II (130.9 Sq. kms.) including the reserved forest of Kalikhhol, Raika Mala, and Panidhal. Core area III (87.3 Sq. kms.) covers the forests of a Mala Kishori, Selibawari, Ajabgarh, Bhangarh Narayani, Parashar and Koh adjacent to the heavily mined area to the south-west of the tiger project. Degrading forests still extend from this section through the fertile jagannathpura valley to the jamwa- Ramgarh Sanctuary. The total core area of the tiger project is 492 sq.kms. Which is surrounded on all sides by a buffer zone (374.13 sq.km.). Thus, the total area under he Sariska Sanctuary is 866.13sq.kms.

**Table 1.2 Core Area Wise Sariska Sanctuary(Area in Sq.Km.)**

Area divided in Sariska Sanctuary	Area in Sq.Km.
core area – I	273.8
core area – II	130.9
core area – III	87.3
Buffer area	374.13
<b>Total</b>	<b>866.13</b>

Source: Management Plan, 2011, Sariska Sanctuary, Alwer



The entire area of the Sariska Sanctuary (866.13sq.km.) having 36 old villages inside the forest area and about 300 villages situated at periphery of Sariska. Among of 36 villages, 11 villages are situated in core – I, 1 village in core-II, 2 villages in core – III and 22 villages are situated in buffer area of Sariska Sanctuary. Inside the core – I area of the Project, Bhagani and Deori in the south, Lionda, Sukola, Dabali in the north and kraska, New Kundalka, Rothkala in the centre of core – I, in core – II panidal and in core – III Dulawa and Bandipur in South-west exist. The existence of many villages in buffer area of the project viz. Kanlywas, Muthrawat, Rajor, Tilwad, Kalachara, Sirwas, Todajaisinghpura, Gordhanpura, Mallana, Ghewar, Sitawat, talab, Murilipura, Dabkan, etc. is again due to existence of small patches of fertile lands. The surrounding villages along the periphery of the core areas and the buffer zone are many in numbers (approx 300 villages). In the middle of Sariska Sanctuary (Between Core-I and Core-II) Jaipur –

Alwar highway No. 13, passes through, where Kishanpur, Umrain, Akbarpur villages are situated to the east of project. The other villages exist are prithivipura, Baleta, Bhandori, Pratapupura, Anawara, Boreta, Dangarwala kabas, Dhalap Kunala, Birpur, Bhigota, Ancher and Muhi. In the west, the villages exist are Bawanvas, Basilogiyan, Barhgurain, Garhi, Bhuriyawas, Duhar, Bhangaroli, Todi, Kishorida, Badhri, Kalaloka, Kishori, Nimwala Guarah, Gopalpur, Bhikampura, Jetpur, Sandhya Ka Guwara, Nirauli Gugari Ka Guwara, Ajabgarh, Dogeta and Nimla. In north, the villages exist are Raghunathpur, Baihroj, Bhira, Bahram, Hajipur, Bahram ka bas, Kali Pahari, Rampur, Badrinagr, Dhehalavas, Bhikhtpura, Ghat, Lakheri, Bisalwa, Basand, Gadhi, Kharkhari Kalan, Laduwas, Manawas and Mundawara. In south, the villages exist are Urwadri, Patel Ka Guwar, Baldeogarh, Ghatah, Palpur, Dariba, Lakhawas, Gola ka bas, Ramewala and Chanha ka bas.



#### 1.4. PHYSIOGRAPHY AND RELIEF FEATURES :

The study of physiography and general relief is of paramount importance in an ecological study as they determine the distribution of plant communities and provide habitat to wild animals. A maze of low hills and parallel ranges form the general landscape of the area, these hills are of the Aravalli mountain system which have entangled here. Relief is a surficial topographic expression of physical ruggedness of the terrain, which has also influenced the distribution and genesis of vastland in Sariska Sanctuary. The area has an undulating topography of low Aravalli hills interspersed with fertile Alluvial plains and rolling sand dunes of low heights. The most of part in of this area is a low mountainous region with extending plains in the east. The low Aravalli ranges having a south-north extension start from Ajabgarh and Thanagazi in the south and having their heights culmination to the north of Tehla Village (668m), extend further north to Sariska, Akbarpur, Narayanopur. The hills over nearly the whole Thanagazi and Rajgarh tehsil and about one-third of Alwar tehsil. Hills enclose between them fertile valleys and high table lands which are reserved forest thickly wooded with spontaneous growth used for fodder and fuel and about in a habitat of wild animals like tiger, pig, sambhar, neelgai, leopard etc. Rajgarh tehsil is level plains with scattered peaks of small hills. The hill of the western border rise boldly and abruptly from the plains on either side presenting an almost impossible wall of rock and they contain the highest peak in the area 775 m above sea level. Generally, speaking it may be said that the hill decrease in height and breadth from south to north and west to east. The slop ranges from  $<1^{\circ}$  to  $>35^{\circ}$  in the area with middle. The part of hills showing the maximum degree of slope and eastern plain with a minimum of 1 degree slope.

The valley between the hills are wide and in some cases strength for many kilometers. Flattered hills tops from plateau which are at Certain places wide from about 1 and ½ km. to several kms. The villagers have settled on some of these and their main source of living hood is cattle grazing. At certain places wells and reservoirs have been constructed to provide drinking water for inhabitants and their cattle.

The Principal peaks are the following:-

Particulars	Height in (meters)
1. Bhangarh point, ¾ miles of Bhangarh	649
2. Kankwari point, 1 & ½ miles east of Kankwari fort	677
3. Sirawas point, 1 & ½ miles south west of sirawas	651
4. Birpur (over looks pass between desti and Tehla)	626
5. Pandupol (1 mile north of temple)	655
6. Rekamala (1 & ½ miles west of Rekamala)	722

#### 1.5 GEOLOGY :

The rocks of Delhi super group and raialo series constitutes the main Aravalli Mountain and extend continuously from Gujrat-Border in south-west to Delhi in the north east over a distance of about 700 km. Highly folded and faulted supra-crustal rocks of Delhi super group cover most part of Alwar region except in the southern part where isolated exposures pf pre-Delhi super group shows a continuous thick pile of sediments having a cumulative thickness more than 6000 mts. The sequence starts

with a basal conglomerate which is arkosic at places. The entire sequence shows a facies change from calcareous members in the lower to arenaceous member in the middle and to a predominantly a gracious member in the upper portion based on this diagnostic lithologically characteristic the sub divisions of the Delhi rocks which have been proposed by Heron (1917) viz lower Raialo series, Middle Alwar series and Upper Ajabgarh series and Kushalgarh limestone. But in the subsequent publications Raialo rock were given a distinct status. Details remapping in the recent year as called for some modification on the stratigraphic succession of the Delhi rock.

The present succession fits in the reframe work of Heron's classification but differ in details.

The regional stratigraphic succession is as follows:-

Super group	Group	Formation
Post Delhi		Post Delhi intrusives
Delhi	Ajabgarh group	Aravali formation
		Bhankrol formation
		Thanagazi formation
		Sariska formation
		Khushalgarh formation
	Alwar group	Pratappura formation
	.....	Kankwari formation
		Rajgarh formation
	.....Local unconformity	Raialo group Tehla formation
	.....	Unconformity pre Delhi Dogeta formation

Area under study has good exposures of rocks of Raialo group of Delhi super group. The stratigraphic name Raialo series was intoduced by Haron to designate a Predominately calcareous formation with subordinate quartzite lying unconformaty between the Aravali super groups. The area comprises of rock kile quartzite, felspathic, schist and marble which is dolomitic at places. The basal quartzite has wide exposure in the area, forming high hills trending NE-SW. This is hard, fine, grained and massive with gray, pink to brown colour. The steative deposits and beautiful dolomitic marble near jhiri occur in crystalline lime stone at two miles east of Khoh on the road to Tehla from Ajabgarh also belong to this Raialo stage. Raialo are found exposed in the south-western part of the project in mallana valley part, extending from north of Gola ka Bas to Kho, Rampura and Mallana consisting of dolomitic limestones. Alwar series is mainly arenaceous in nature found in Garhi, Machari, Rajgarh and Mallana. Kushalgarh limestone is not major formation, is noted in the Bharthari and Dhelawas valleys.

#### 1.6. SOIL :

The ecology of a region largely depends upon the quality of soils. Most of the high ridges of Sariska Sanctuary are comprised of quartzites, conglomerates and grits. The interlinking, valleys consists of limestone, phbyllites and schists. Evidence of lava congalomerates is also occasionally met with these rocks. These ancient crystalline and metamorphic rocks with red soils that support the vegetation growth is poor in nitrogen, phosphorous and humus with a fair akkali content varying from thin light coloured, poor gravelly type on the hills to comparatively richer and thick dark type in

low lying plain. These red sandy soils are suitable for supporting forests of Dhok and its associates like salar, Gurjan, Dhak etc. The soils over the largely exposed shades in extremely shallow and supports a poor growth. Good crops of Dhok are confined to the valleys and depressions. The sandy area with alluvial margin support scrub forest of kanera (*Flacourtia Indica*) and cheela (*Butea monsperma*). The sandy clay and kankar areas support scrub forests of, khair.

**1.7 MINERALS:**

The production of minerals is the one of the indicator of economic progress of any region but all production mine had to be closed after April 1993, to protect the environment of Sariska Sanctuary by the order of Supreme Court of India. But still illegal mining is going on which has disturbed its ecological status and stress on wild life. The important minerals are found in the Sariska Sanctuary copper, Marble and Soap-stone. Copper occurs at Kho-Dariba and Pratapgarh. Dariba is the famous copper mine in the country. Dariba, Bhangarh, Kushalgarh, Pratapgarh were famous for raw copper mining but now-a-days those mines are the verge of extinction. Dense distribution of Marble found in Rajgarh and Thanagazi Tehsil. In Sariska Sanctuary at Tiwar, Mallana, and Tehla marble is found. Soap-stone is found in Nagalhari in Sariska Sanctuary.

**1.8 CLIMATE:**

The climate of this tract is sub-tropical characterised by distinct cold winter, hot summer and rainy monsoon seasons. The summer season commence from middle of March and the heat soon become intensive in April. Hot westerly winds known as “Loo” are common during April, May, and part of June. This period is extremely hot, daily minimum temperature shoots upto 42 degree centigrade. As against the mean daily minimum temperature of 30 degree. The nights are generally pleasant even during summer.

The winter season commence from November. It becomes cold in December-January. Some of the nights are frosty and the valleys of Sariska become frosty. The mean daily maximum temperature in January is 22°C as against mean daily minimum of 7°C (Table 1.3.)

**Table 1.3 : Monthly Temperature (In Degree-Centigrade-2018)**

Months	Mean Max.	Mean Min.	Month by Mean	Monthly Average
January	22.1	6.9	14.5	15.2
February	28.2	10.1	19.1	18.1
March	32.3	15.8	23.9	16.5
April	36.2	22.2	29.2	14.0
May	40.5	26.2	33.3	14.3
June	41.6	20.5	35.5	11.1
July	35.9	29.1	32.0	7.8
August	33.7	26.9	30.3	6.8
September	32.4	18.5	25.4	13.9
October	32.4	18.5	25.4	13.9
November	28.8	12.7	20.7	16.1
December	24.2	8.1	16.1	16.1

Source – Meteorological Department, Alwar.

Rainy season commence from late June and continues till middle of October. The first few showers in this well drained area Sariska Sanctuary is most enjoyable. But later high humidity and heat makes the climate aggressive.

**Table 1.4 Monthly Rainfall In Year 2018**

Month	Rainfall
January	3.00 MM
February	-
March	-
April	-
May	10 MM
June	40 MM
July	157 MM
August	128 MM
September	99 MM
October	17 MM
November	-
December	-

Source – Irrigation Department, Alwar

**1.9 RAIN FALL:**

The average rainfall is 650 mm which is highly variable in its pattern and trend. The bulk of the precipitation being from southeast monsoon in July, August and September. The winter (Jan-Feb.) rain showers are few, the average number of rainy days in a year are 30. The annual rainfall less than average was observed in year 2014, 2015, 2016 and 2018. In 2007,2008,2009,2010,2011,2012,2013 and 2017 it shows the positive trends. Droughts are also seen in year 2016 in the area and very common.

**Table 1.5 Distribution Of Rainfall Pattern (in mm.)**

Year	Annual Rainfall	Variation from average Thanagazi rainfall (mm)
2007	918	(+) 268
2008	909	(+) 259
2009	1102	(+) 452
2010	1272	(+) 622
2011	1131	(+) 481
2012	807	(+) 157
2013	682	(+) 32
2014	498	(-) 152
2015	567	(-) 83
2016	118	(-) 532
2017	847	(+) 197
2018	454	(-) 196

Source : Irrigation Department, Alwar

During summer, the wind flows from south-east. Dust storms occur in late May ranging velocity from 4.9 Km/hr. to June 6.5 km/hr. Wind velocity is shown the maximum in June and minimum in December as 1.5 km/hr. Months wise recorded data are shown in (Table 1.6)

**Table 1.6 The Mean Wind Velocity (Km./Hr.) In Alwar District (2018)**

Month	Wind Velocity Km./Hr.	Remarks
January	1.8	
February	2.9	
March	3.1	
April	4.2	
May	4.9	
June	6.5	Maximum
July	4.5	
August	2.7	
September	2.2	
October	2.1	
November	1.9	
December	1.5	Minimum

Source: Meteorological Department, Alwar

Frost nights are common especially in valleys all over the tract sariska vally is the most effected region where even the tall trees of the height of 5 meters are adversely affected.

#### **1.10 SARISKA REGION AND PEOPLE:**

The material features, which are the result of the transformation of natural landscape through human occupancy. Since the cultural attribute play a key role in the transformation of physical landscape into cultural, it is becomes necessary to understand the cultural status of the Sariska Sanctuary with reference to wild life habitat.

#### **FOREST COVER AND HABITAT**

The changing land use patterns, plantation and seed sowIng, introduction of many new plant species from time to time resulted into a mixed vegetation composition in Sariska. The present habitat status of the Sariska , therefore, a net product of both natural selection and succession as well as natural introduction of many new plant species from time to time and this has resulted into developing ecological condioions of the area in the past 100 years.

The structure of the plant communities and vegetational growth has seen many evolutionary changes over the years. The Sariska during the twenty first century may be categorized as under emergence of : tree of various species and good crown cover. Shrub, under shrub and herbs of biological diversity; grasses and sedges adapted to the marshy habitat; sub-terranian vegetation comprising the major ecosystem of the area.

Due to succession, invasion of this forest land by grasses and weeds, the forest habitat got covered into a wood land at several places, due to extinction of some native species and introduction of new ones. There was change in the floristic composition and the biodiversity. The following types of vegetation can be identified at the Sariska .

The physiognomic distribution of vegetation to a large extent is dependent upon the soil characteristics, ground water table and the interactions of vegetation and Animals. Microscale variations in these characteristics lead to vegetation diversities. The vegetation of this tract is quite dense with a huge number of species. Its vegetation can be described based on ecological land forms or habitats.

The present status of vegetational composition and forest cover categories are identified in Sariska using remote sensing technique. The remote sensing techniques provides excellent information about spatial distribution of forest cover in less time and co- effective manner.

Forest stock is key information required in forest mensuration, forest and wild life management. The present study also highlights the application of remote sensing in spatial distribution and quantification of forest growing stock. The study area is Sariska of Alwar district. The soils exhibit wide variations due to their texture, depth, stonines, colour, drainage, moisture, organic matter etc. The climatic condition is tropical.

The image prepared by B.M. Birla science and technology centre, Jaipur contains infonnation of all types of forest resources available in the Sariska . The Indian remote sensing I-C-LISS-III, (2003), data available on false colour composite (FCC) were visually interpreted with the help of limited ground truth verification. Further, based on the analysis of the forest resource information, the various category of forest class were identified for Sariska . The contents of the map is divided broadly into seven categories. The different colours of the image indicate different categories as follows:

Proposed water harvesting structure. In the present study survey of India, toposheets, management plan, existing forest maps, remotely sensed data (IRS-IC-LISS-III,(2003) and primary data were collected. On the basis of interpretation; four forest cover types and non-forest categories are identified.

The findings have shown that among these classes, the dominance is of dhok, khair, tendu, gurjan, dhak and churel forest which is also part of dense forest category, followed by open forest including salar, karaya, dhaman, ber, bamboo and khirmi forest which is badly needed management practice.

The Sariska area is rich with dense vegetation at middle part of core area-I and core area-II, located in northern part of the region. The area with its physiographic characteristics and natural resources support a wide range of vegetation. One categories that were identified and mapped include dense forest, open forest and forest blanks. The dense forest is deciduous in nature having maximum concentration areal extent at core area-I and core area-II, which is major habitat of wildlife.

This forest is particularly confined to an altitude of 500-1000 meters on undulating terrain. The open degraded forest lands are represented by sparse vegetation resulted due to heavy interferences. Some of the areas identified under this category include the hill tops. The forest blanks, appearing amidst forest areas are mostly being used for local tribes. Generally, some food crops are raised in these areas.

The results of this study, the status of forest is deteriorating very fast and overall forest cover in core area - I of Sariska region is also decreasing. In addition to forest loss and degradation due to human interference, cattle grazing, noise pollution, traffic flow is also distrubine the serenity of the forest. The reduced and narrow forest area also deter the wildlife including tiger, leopard movement across these areas. Cattle grazing and forest fires are some other hazards, which have negative impact.

Thus, the present study demonstrates the utility of remotely sensed satellite data in study of various forest cover and non-forest categories and subsequently analysis of spatial data has great impacts in preparation of wildlife management plan.

#### **RIVERINE BEDS AND VALLEYS :**

Several narrow valleys of ephemeral streams the springs cascading down the slopes of mountains abound the area. They have a canopy of well crowned trees and shrubs. The under growth of annual herbs in rainy season is enonnous

in such areas. These plants soon die with the on set of winters leaving a huge litter of dry leaves. It is in these areas that most of the herbivores live for the reason that they get forage and

water both. The fruits of some trees which are edible also allure these animals.



The carnivores animals also come here because they find an easy prey to catch. A transverse section across the Siliberi nala- one of the areas where riverine vegetation is in its most profuse state shows that on the north western part of the dry river channel, the mountain spurs are covered with thick forests of dhak, and sal which get the waters of the cascading springs and brooks while on the south eastern part lies the Umri village on a flat plateau like gravelly land where mangoes, tamarinds and bamboo thickets exists.

On the lower slope some of the peremrial grasses grow, some of which are seeds. The thickness of grassy cover increases in the rainy season. Most of the piedmont plains and

hill slops are also covered with these grasses in july and the foliage cover lasts january.

The steep slopes of north-western hill are also covered with sporadic trees of safed salar, churail, tendu and kadam trees, The succulent berries of tendu trees are favourite eatable fruits of sambhor which a bound this area, Hence a, large number of deers are found which often sit under the shades of large trees.

The stony endocarps of these berries are unetable and so they are randomly dispersed by these animals, thus, promoting a natural ecosystem of their Several deer and antilops are also fond of succulent berries and so they come under the shade of these trees to have an occasional siesta.



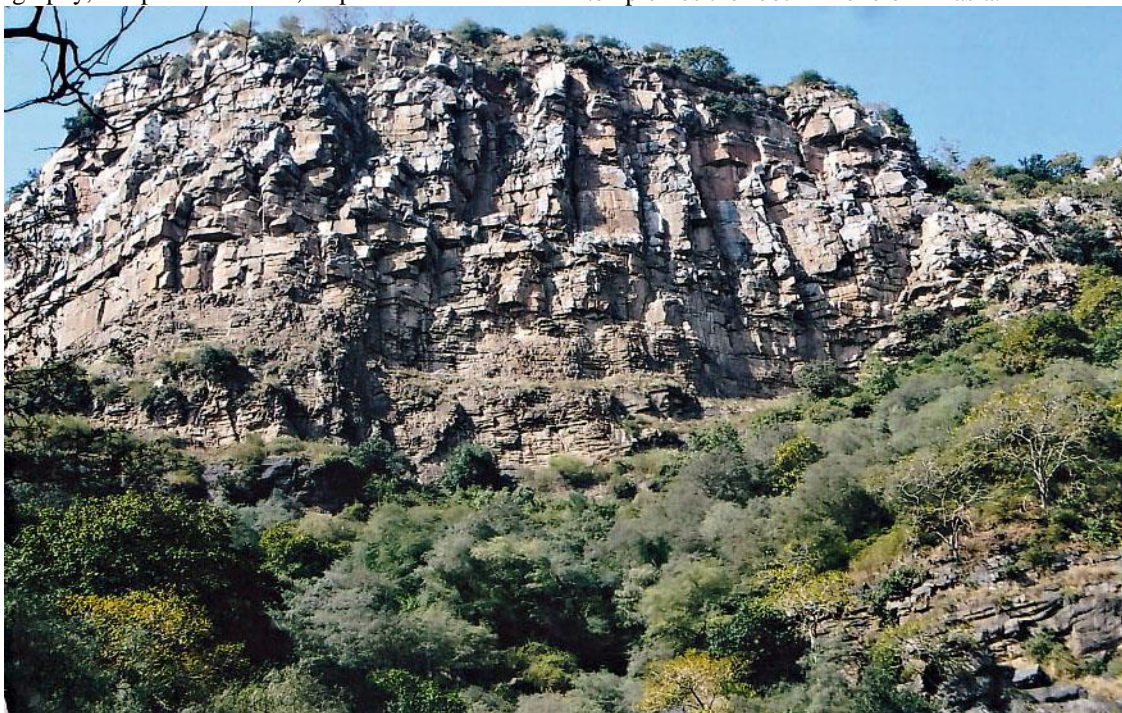
The predator tiger, in hunt of its prey, also visits these valleys and with gigantic roar and leap catches these animals easily. Due to succulent fruits on the trees of these valleys, arboreal life mostly consisting of monkeys (*Rhesus species*) and black monkeys langurs, is also rich. These animals also become an easy prey to the predators of the area.

#### FOOTHILL ZONES :

The foot hills are often marshy for about the months of a year. Areas near Rajor, Kankwari, Kriska, Karnawas the Indok villages have vast stretches of foothills, marked with a badland topography, deep eroded land, deposition of aeolian

and alluvial sand and gravels. The fertile areas of levelled plains are used for cultivation by settled villages and they are devoid of natural vegetation.

The trees and shrubs vary in size and shape and the vegetation is sparse. The vegetation undergoes kaleidoscopic changes with seasons with each tree and shrub blossoming in different parts of the year, even the slimmer season is of gaiety with a riot of colourful flowers of aak (*Calotropis procera*) shrubs, creepers of (*Cucumis callasus*), dhatura (*Solanum nigrum*), and nagphani (*Opuntia species*). On way to Pandupole temple lies the foothill zone of Kirasla.



A section across it indicates that much of the land has now been levelled where agriculture is practised. In the valley, flows the river channel which has water for about six months of the year. Two embankments have been made to store the river water for irrigation as well drinking for animal. The gravelly foothill zone has several perennial shrubs and the entire zone is covered with grasses in rainy season. The top most crest of the slopes is occupied by a thick canopy of dhak trees which becomes thicker, as the slopes of hills become more precipitous.

The mountain crests, throughout their entire length and breadth of this natural region are covered with thick deciduous forests. The most dominant tree is of dhok (*Anogeissus pendula*) also known as the 'flame of the forest'. The other types of trees found in these parts are those of dhak (*Butea monosperma*), Churail (*Holoptelia integrifolia*) and ber (*Zizyphus species*). In the way side dissected valleys, sporadic occurrences of larger trees of osalar (*Boswellia serrata*) aonla (*Phyllanthus officinales*), neem (*Azadirachta indica*), belpatra (*Aegle marmalosa*), roheda (*Tecomella undulata*) and safeda (*Eucalyptus canneldunesia*) is found.

The study of floristic composition shows a close relationship of soil, water and vegetation which are interdependent. It is discernible that in medium alkaline soil areas (upto 8.0) and where water is less abundant, species of *Acacia*, *Prosopis* and *Zizyphus* are most prominent. All these trees are xerophytic and are drought resistant.

In those areas where medium alkalinity exists, in sandy loam soils and water is abundant, the dominant species are kadam trees. In highly alkaline areas where pH values exceed 8.0 and the soil is also sandy, the vegetation consists of mostly salvadora shrubs and drought resistant grasses. Due to porous soil is always dry which permits the rats and pythons to dig burrows in the soil. It is also prominent that the khus grass also grows more profusely in saline soil areas.

#### FOREST TYPES

The forest being scattered over a large area on various geological and soil formations, vary greatly in composition and quality. Edaphic and biotic factors have determined their distribution. In Sariska good forest growth occurs in valleys where better soil and moisture conditions exists. The main species of the tree which cover over (90 percent) of the Sariska area is dhok (*Anogeissus pendula*).





Its associates with salar (*Boswellia serrata*), and gurjan (*Lannea commendelica*) which grow on rocks and dry areas. Khair (*Acacia catechu*) is common in valleys and Bamboo (*Dendrocalamns strictus*) grows in extremely limited extent along with well drained branches of the streams and moist and cooler aspects of the hill where soil formation still exists. It is also found in valleys.

The trees are generally slow growing and attain poor height. The height of trees vary from 4.5 metres to 7.5 metres. In favourable localities the height upto 12 metres is attained. Imli (*Tamaraindus indica*), Aam (*Mangifera Indica*), Jamun (*Syzygium cumini*), Tendu (*Dispyros Malanoxylon*) Bahera (*Termiqalia bellirica*) Arjun (*Terminalla arjuna*), Churel (*Holoptelia integrifolia*), Siris (*Albizzia lebbek*), etc. which grow in moist localities attain large size, both in crown spread and height, where valleys fan out in open and where they flatten and become wide, dhak (*Butea monosperma*) grows gregariously. These forest habitat have been classified on the basis of their species and composition as follows :

#### **Anogeissus pendula (Dhok) Forest :**

This is the principal species growing in the Sariska the *Anogeissus pendula* forest type which is an edaphic climax in tropical dry- deciduous forest according to champion and seth (1968).

The dhok is a gregarious tree species and is often found in pure stands in the middle slopes of the hills where it may form over (80 percent) of the crop. Dhok is a useful tree for fuel and characoal making. The average height of trees varies from 8 to 12 metres. In Sariska, dhok is found only in the upper crests of the hills. The under growth is usually very sparse.

Natural regeneration of these species occurs during the rainy season when all the trees become green with profuse branching and leaf formation. But soon after the rains, the entire land scape turns copper brown with leaf shedding and only the naked stunts of trees cover on the hill slopes. Its

woody branches are use in making of Balliyan, Chan and Chhapper of human huts in this region.

The common associates of Dhok are Khair, Tendu, Khirni, Gurjan (*Lannea commendelica*), Dhak, Churel and Ber (*Zizyphus mauritiana*) are found at the foot of the hills, in valleys and along nallahs. Tree species like Jamun (*Zyzygium cumini*), Kadam (*Mitragyana parvifloia*), Gular (*Ficus glomerata*), Rohini (*Mallotus phillippinesis*) are found in most localities.

#### **Boswellia serrata (Salar) Forest :**

Next to dhok, Salar is the principal tree species. of these forests. "Boswellia forest" which is an edaphic climax in group 5 tropical dry deciduous forest according to champion and seth (1968). It is found on hill tops and is mixed with dhok upto middle of the slopes. Salar are used for building materials like doors and windows. the wood of the trees is hard and durable so these forests have been exploited for 10 kg in the past. The height of trees varies from 6 to 9 metres with average diameter of 20 to 25 cm. They usually occur on sandstone formations.

There is always a thick under growth in these forests. Birds like pipit, owl and pigeon are make their nests on its branches while tiger and leopard take rest under its shelter.

The common associates are Gurjan, Karaya (*Sterculia urens*), Tendu (*Dispyros melenoxylon*), Dhaman (*Grewia latifolia*), khair and safeddhok as in Kalighti and Gamka area of Sariska Range. The forests add to the beauty of the landscape when their leaves start tuming into rusty and paleyellow appearances in September before fall.

#### **Acacia catechu (Khair) Forest :**

Khair is an important associate of dhok and salar and occurs scattered on tops and hill slopes. The barks of khair are used for making 'Katha' which is edible in betals. These barks are also used for dyeing and hardening the animal hides and skins used for making shoes.

On account of their great economic value, Acacia catechu trees have undergone vast exploitation in the near past.

The trees are usually 5 to 10 metres high and the regeneration is poor. In Sariska such forests are very rare now. The forests occupy the plateau regions where sub soil water is deficient.

***Butea monosperma* (Dhak) Forest :**

Dhak's leaves are used for making leafy plates (Pattars) and leafy bowls (donas). These forests cover the entire ranges of Kalighati, Jodhwass, Kiraska, Rajor, Bhigani, Urri, Todi Nijran and Nandu. These trees grow in badly drained soils which remain water logged for many months.

They also grow profusely in stony soils preferably in the foothill zone of large ranges. *Butea monosperma* usually forms pure stands and the trees are 8 to 10 metres high. Due to boggy soils underneath, the regeneration of trees is profuse both from seed and root suckers.

***Dendrocalamus strictus* (Bamboo) Forest :**

Commonly known as bamboo forest, the long stalks of *dendrocalamus species* are used for huts and houses. The

Sariska abounds with such forests which are found in narrow valley-soften along the courses of stream and springs. Bamboos generally form pure stands in moist depressions.

The clumps of bamboos are of varying sizes with 10 to 30 clumps 0.2 to 5 cm. diameter while the height of bamboos may vary from 3 to 6 metres. Indiscriminate cutting of bamboos in the recent past has greatly reduced the thickness of these forests.

**Scrub Forest**

They are degraded forests of bushes and grasses which are confined to certain arid tracts for example, south of Rajor and Dabkan hills, there is an open country covered with a dense scrub. The most common shrubs found in these areas are *Zizyphus jujuba* (Red ber), *Zizyphus nummularia* (big ber), *Mimosa hamata* (Shisham), *Euphorbia caducifolia* and *Grewia tenax*.



The ground vegetation consists of grasses like *Aristida species*, *Oichanthium annulatum*, and a number of creepers. The leaf and fruits of ber are favourite food of Monkey, Sambhar, Chital and other herbivores, while Shisham is used in making of furniture for human use.

**Miscellaneous Forest**

These are found along nallahs, rivers and tanks which are more or less perennial. The dry tropical river inforests according to champion and Seth. The common species found are Gular (*Ficus glomerata*), Chila, Jamun, Kadam, Khajur (*Phoenix sylvestris*), Rohini Gular, Jamun and Khajur produce fruits rich in sugar contents, which are eaten by herbivores. Many birds make their nest on trees of Gular, Kadam, Chila, Neem, Peepal, Jamun and Rohini.

Other miscellaneous forest of inferior nature, saline/alkaline scrub savannah consisting of Jal (*Salvadora persica*), Hingota (*Balanites aegyptica*), Kair (*Capparis decidual*), Bel (*Aegle marmillose*), Ghatbor (*Zizyphus xylopara*) and Jhariber (*Zizyphes nummularia*).

Their fruits of bel, Ghatbor, Jhari ber and Kair again are liked by herbivores animals specially in summer when for

age is dry and many a time it is not available, While the tiger usually take rest under the shadow of Jal (*Salvadora persica*).

**AQUATIC VEGETATION**

As there is no permanent or big lake inside the area, the aquatic vegetation is poor. In temporary ponds or nalas where rain water stagnates for a few months aquatic species like *hydrilla*, *verticillata*, *Potamageton crispus*, *Potamageton pectinatus*, *Potamageton perfoliatus*, *Vallisnarira spiralis*, *Zanichellia palustri* are common occasionally *nymphodies cristatum*, *Trapa bispinosa* and *Nelumbo nucifera* are also met with alteman there sessilis, *Ammania baccifera*, *Bacopa monnieri*, *Eclipta alba*, *Mdwegia perennis*, *Potentialla supina*, *Limnophila indica*, *Polygonum glabrum*, *Polygonum barbatum*, *Anagellis aquntica* are some of the common species found in marshly habitats around ponels, water courses and streams. *Typhaangustata* is some times associated with these and pure population of *Pondanus odoratissimus* has been noticed at Bhangarh.

**GRASS LAND**

Grasses grow every where in protected valleys and slopes of the mountain. Extensive grasslands are found on inter mountain plateaus, vast plains and flat tops of mountain. Seven grasslands viz. Kankwari, Haripura, Siliberi, Lilunda, Sukola

and Ganka are used as pasture lands. Kankwari grasslands are located the heart of the forest reserve but they are surrounded by several villages like Pilapani, Kankwari, Kaniyawas, Mitrawas etc. and so there is always a great pressure of grazing by milch animals of these villages.

### **DENSITY AND FREQUENCY OF VEGETATION**

Relative density of a plant species is the population size in relation to some unit of space. It is generally assessed and expressed as the number of individuals, or the population biomass per unit area or volume. The effect that a population exerts on the community and the ecosystem depends not only on what kind of organism is involved but also on how many individual plants are present.

In a natural ecosystem there are definite upper and lower limits to species population sizes that are observed in nature could exist for any length of time. The upper limit of density is determined by the energy flow i.e. productivity in the ecosystem the trophic level to which the organism belongs and the size and rate of metabolism of an organism. The lower limit may not be so well defined but in stable ecosystem, at least, homeostatic mechanisms operate to keep density of the common or dominant organisms within rather definite limits.

To measure the relative density and frequency of plant species in the present work the simple quadrat method has been used. Four areas each 100 sqm. in size (10m x 10m) were selected in four varied topographical terrains viz. valleys (kalighati area), plateaus (siliberi area), hill top (pandupole area) and hills slopes (kraska area).

The number of plants were counted in each quadrat and relative abundance of plant species. No. of individuals of all species in all quadrats, The frequency indicates the dispersion of a particular species in a community. It can be defined as the change of an individual of a given species to be present. in a randomly placed quadrat. This can be studied by sampling the study area at several places at random and recording the names of the species that occur in each sampling.

#### **DENSITY OF VEGETATION COMMUNITY :**

It is discernible that the relative density of Dhok (42.85/100 sqm) is highest on all terrain, followed by Salar (14.28/100sqm) and the Dhak (11.11/100sqm) but other species like Khair (4.78/100sqm), Ber (3.17/100sqm), Gurjan (1.58/100 sqm) and Kadam (1.58/100 sqm) are in very low numbers in all quadrats.

The Dhok plants are present on all terrain and its frequency is 100 percent in all selected quadrat. The Salar is present on valley, hill slope and hill top but rare in plateau while Dhak is present at hill top terrain and its frequency is (75percent) in all selected quadrat. Tendu and ber present on plateau and hill slope but valley and hill top, is devoid of this community.

While Khair is negligible in valley and hill slope and their frequency is (50 percent) in all selected quadrat. Bamboo, palm and Churel are rare on plateau hill slopes and hill top, while Gurjan and Kadam are seen rarely on valley, hill slopes and hill top their frequency is (25 percent) in all selected quadrat.

It is discernible that the species densities of all types of plants are highest on plateau and in the valley terrains while on hill slopes and hill top the density of plant species is low, But a closer examination reveals that on plateau and valley the highest number of plants are Dhok, Salar, Dhak and Churel

which provide fodder and shelter to herbivores animals which sit in their shades during day hours.

#### **FREQUENCY OF VEGETATION COMMUNITY**

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The most important component of the vegetation is formation of trees. The trees are at different stages of growth. ranging from 1 meter to 15 metres. The pattern of trees reflects that the tendu, Khair and ber trees are marginally scarce, while Gurjan, Churel, palm, Kadam and bamboo trees are much scarce of Sariska region, specially in the vicinity of villages because of their economic importance and illegal cutting of trees at large scale.

#### **IMPACT OF PLANTATION**

Entire Sariska forest area has been divided in four categories viz. Good tree cover, moderate tree cover, less tree cover and forest blank according to observational study. Normalized density vegetation index is one of the best indicators for classifying forest cover and has been widely used in present study.

Most of the forest area of Sariska cover with good biomass (34.6 percent) . This good biomass found in Pandupol, Kalighati, Slopka, Nahar Sati and Kankwari forest area. Second large category of forest cover estimated in forest blanks (28.40 percent) followed by moderate biomass (15.2 percent), other biomass (11.50 percent) and less biomass (1.030 percent). The forest blanks are present in Indok, Panidhal, Dabkan, Thla, Jaisinghpura and Garh forest area.

The moderate biomass found in Bandipur, Bharthai and Sariska village forest area. Other biomass mainly present in Talvriksh and Sirawas forest area and less biomass mainly found in all 36 villages areas of which are situated in Sariska.

A very few studies have been done on the vegetation of Sariska and simultaneously it observed that no appropriate record has been kept of the plantation of the Sariska. So, it would be appropriate here to have a review of the impact of plantations done in the past with a view to fill this void.

The ecological evaluation of the plantation works of all introduced species have managerial diversity motives. The study of the survival and tolerance capabilities of forest plants can be important to ecologists for understanding the plant succession process. It can also help to develop improved vegetation in this area which in the past has suffered occasional drought and flooding.

The Sariska is an important breeding area for herbivora, and it is now the stronghold of some species in indo-gangetic plains, e.g. Shambhar and Chital. It is also a vital habitat for the declining population of Tiger, Leopard etc. Therefore, the impact of the plantation work, which has drastically altered the habitat composition of Sariska needs a closer examination.

Over the entire period of 20th century almost each and every part of this forest has been replanted either by herbs, shrubs or trees or by grasses. As a result of this, there have been dramatic changes in original habitat types. The floristic changes occurred during the past years which turned the character of most of the forest, Sariska forest have caused a considerable scientific debate among foresters, botanists and ecologists.

Forests are rich in species endemic to small geographical areas. Therefore, a study of such species aids the study of evolution, allowing researcher to see how species evolve when isolated from other similar species. Through the detailed investigation of entire of forest, plantation works done in

past, it appears that the area of Sariska was an open forest and undrainable marsh before the present century.

After early nineties felling of trees commenced here to meet the demand of firewood and charcoal at Alwar. This resulted in destruction and reduction of animal habitat. Looking at the gradual deterioration of this once splendid wood land, the consequent, plantation of indigenous as well exotic species was done year after year.

Experiences so far and the entire old records reveal that although natural germination took place but wild cattle and deers neelgai etc. grazed them. Similarly planted saplings could not survive due to grazing by cattle and ungulates and also due to their non-adaptability in this particular area. Only those plants could grow, which were guarded by bushes or any other types of natural protection. Many old Bamboo trees are washed away due to floods in Nallahs in every rainy seasons, specially (1996).

Besides, the growth of salt loving plants, the khair was a big success due to their adaptability. These plants and shrubs were sown almost every year from ninteens onwards and have now established in all conditions of the habitat.

The plants of Hingota (*Balanites aegyptiaca*) ; Anwala (*Phyllanthus emblica*) ; Anjeer (*Ficus palmata*); Khirni (*Manilkara hexandra*); Imli (*Tamarindus indica*) could not adopt themselves and died within a span of 2 to 5 years. The Tal trees (*Terminalia argunleta*) were grown many times but failed to grow.

Recently in last decade (1998-2008) of past century the experiment of Bamboo plantations along the nallah get some expected success. Once abundant and profusely growing plant, Ber (*Zizyphus mauritiana*) which gave heavy crop of plums (during 1980-85), gradually declined and these shrubs now exists scattered here and there is much less numbers.

Old native trees found in the early half of the past century like Kala siris (*Albizzia odoratissima*) which gave its name Sariska ; Bahera (*Terminalia iabellerica*); Kadya (*Sterculia urens*); Barna (*Crateva nurvala*) etc have become extremely rare or are standing on the verge of extinction from the Sariska. The grooves of Kadam once flourishing more than thousand hectares of land are fast vanishing kind now confined to a few favoured spots.

In addition to major endemic plant species e.g. Arjun (*Terminalia arjuna*) and Gugal (*Commiphora mukul*) of course in less numbers, were planted over a period of 100 years. It was also found during the study that karad grass (*Dicanthium annulatum*) cropping on a commercial scale was also tried many times (between 1970 to 1990) in grassland and scrub level areas but result were not encouraging.

It was also found that except the Dhok and Salar, no other plant species could survive on mounds, whatever the reason. Cheed and cycas are two new introducing plant species in Sariska in recent years.

It is also interesting to note that *Prosopis juliflora* after repeated efforts of its eradication (1970 to 2000) could not be removed from Sariska. *Prosopis* is today encroaching the maximum land of the Sariska and even in water logged areas it is growing monstrously. If it continues to spread as it is today one day it will be a cancer for this beautiful forest. Another species of shrubs called Jungle weed (*Lantana camera*), Adusa (*Adathoda vesica*), Panwar (*Cassia tora*) which were observed during half past of last century are today spreading rapidly in the wood lands created habitat problem.

In brief, vegetation types of Sariska and their floristic composition have markedly changed and accordingly the soil, water, land scape and all other components of the ecosystem have changed in the past one hundred years.

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