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# Radhanagari Wildlife Sanctuary: A Geo-Environmental and Biodiversity Study



Dr. Sanjay Baburao Sangale



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## ***PREFACE***

Radhanagri Wildlife Sanctuary is a abode of variety of wild animals and extremely rich flora and fauna. Radhanagri Wildlife Sanctuary has revealed that there are 419 faunal species including 20 species of amphibians, 58 species of reptiles, 284 species of birds and 47 species of mammals. Similarly this area has a total 325 floral species, which includes 200 trees, 70 shrubs and herbs, 40 creepers and 15 epiphytes.

The present book of Radhanagri Wildlife Sanctuary has been done from the geographical point of view. The principle strategies are directed more towards understanding the bio-diversity and various effective geo – environmental factors in the area. Radhanagri Wildlife Sanctuary has diverse Flora and Fauna. Biodiversity is there in all forms that are at genetic level, species level and ecosystem level. The whole area falls under the Western Ghat, which is recognized as one of the “Hot Spots” of bio-diversity in India.

The book provides information about Radhanagri Wildlife Sanctuary is one of the important wildlife sanctuaries in India which established in 1985 by the Government of Maharashtra with moderate area under reserve forest i.e. 351.16 Sq. km exclusively for bison. Owing to the location in Western Ghat this sanctuary has national and global importance in respect to the biological diversity. Therefore there is a wide scope of study the region through conservation and protection point of view.

This book, which concentrates on Wildlife, is a precious gift of God to this planet. The term ‘wildlife’ not only caters to wild animals but also takes into account all undomesticated lifeforms including birds, insects, plants, fungi and even microscopic organisms. For maintaining a healthy ecological balance on this earth, animals, plants and marine species are as important as humans. Each organism on this earth has a unique place in food chain that helps contribute to the ecosystem in its own special way. But, sadly today, many of the animals and birds are getting endangered in Radhanagri Wildlife Sanctuary. The natural habitats of animals and plants are being destroyed for land development and farming by humans. Poaching and hunting of animals for fur, jewellery, meat and leather are other great factors contributing to wildlife extinction. So, for us as humans, it becomes a great responsibility to save the wildlife, our planet and most importantly our own selves.

In simple language, this book gives readers complete information without compromising complete details. Development without destruction has become an

important global issue. Increase in human and cattle population has resulted in diversion of vast tract of forest land for agriculture and grazing. This has adversely affected the wildlife and wildlife habitats in the country. *In situ* conservation of biomes in different ecological/biogeographical zones of the Radhanagri Wildlife Sanctuary by establishing sanctuaries therefore becomes important for conserving biodiversity. The need to protect floral and faunal values of an area assumes even greater significance when development activities either directly or indirectly threaten the biological diversity of the region.

I express my sincere thanks to Hon'ble Meenatai Jagdhane, Member, Managing Council, Rayat Shikshan Sanstha, Satara and Principal, Dr. N. S. Gaikwad, R. B. N. B. College, Shrirampur, Dist. Ahmednagar (Maharashtra) for his support and valuable guidance. I would also like to express my deep gratitude to my research guide Dr. D. H. Pawar for his persistent guidance for the completion of this book. In addition, my friends and teachers/colleagues also helped me with their inputs and suggestions for the completion of this book. We therefore, hope that this book would meet the expectations of our readers. A lot of efforts and time is spent in the preparation of the book. However, the entire credit of this work does not go to the author alone but a number of people share their credit that helped me in compiling information. Farther I would like to record my gratitude to Dr. Abhinav Kurkute who spent a lot of time in preparing the maps and also the team of book Publishers, Bhumi Publishing, Kolhapur (Maharashtra) especially Dr. S. A. Vhanalakar deserve thanks for publishing the book in a short period. Lastly, but not the least, thanks are due to my family, whose time was encroached upon, while working on this book. They deserve our thanks for letting us work without complaining and providing a congenial environment at home.

I welcome suggestions for improvement of this book from research scholars, teachers, scientists and students.

- **Sanjay Baburao Sangale**

## **ACKNOWLEDGEMENT**

I want to thank my mother and my father for having me  
and my teachers for teaching me.



This book is dedicated to my father  
Late Baburao Savaleram Sangale  
with love.

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## **CHAPTER - I**

### **INTRODUCTION**

#### **1.1 INTRODUCTION:**

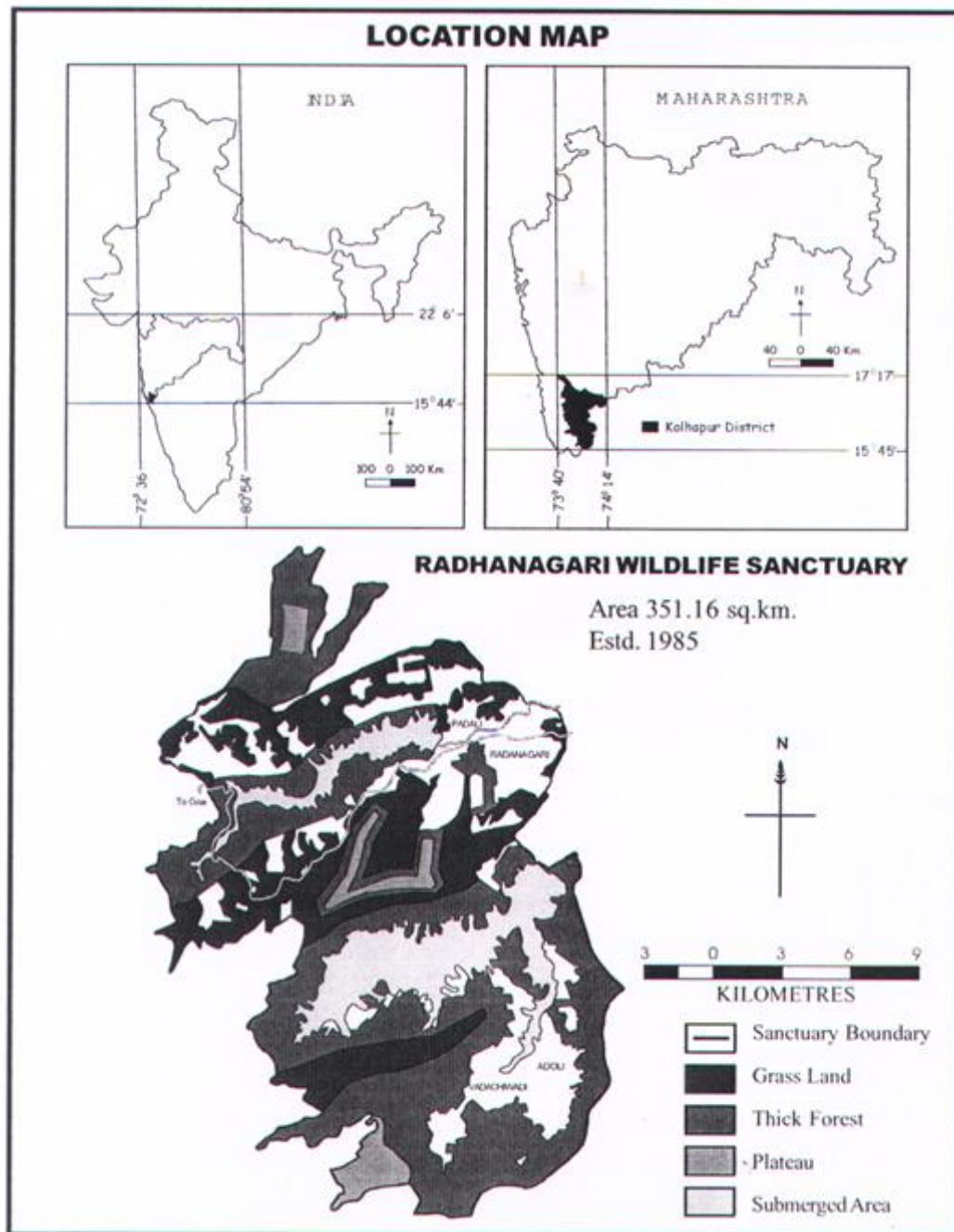
**R**adhanagari Wildlife Sanctuary is situated in greenly ranges of Sahaydri of Western Ghat in Kolhapur District. Western Ghat which is well acquainted as a one of the most vulnerable and delicate biodiversity hotspots in the world. Previously jungle of Radhanagri was specially used as favorite hunting spot by the king of Kolhapur Chhatrapati Shahu Maharaj. In the year 1958 this game reserve including places from south and west including Panlet, Olvan, Gaganbawada and Mouje Taliye making altogether 19.61 Sq. Km of an area was declared as Sanctuary for bison and recognized as Dajipur Bison Sanctuary (Reserve Forest). After that by taking into account the importance of diversified forests and occurrence of distinguished wild animals, the Government of Maharashtra and the Revenue Department of forest tried to develop and secure these places by law. Therefore by the Government rule no. WLP 1085 CR/581/V.F.5/ dated 16/09/1985 the jungles of the catchments zone of 'Laxmi Lake' Radhanagari and 'Rajarshi Shahu Sagar' Kalamawadi dam declared as Radhanagri Wild life Sanctuary . Now this Radhanagari Wildlife Sanctuary is famous exclusively for Gaur the Bison and other wild animals. In India it is well recognized.

As a result of expansion of Radhanagri Wildlife Sanctuary, even wild animals in Karnataka State are frequently migrating to the Radhanagri Sanctuary. Especially wild Tuskers and Bison are frequently migrating in the forest of Radhanagri. According to 2004 wild life census, there was considerable population of Bison from 395 to 610. The study of Radhanagri Wildlife Sanctuary in that respect is very important. The versatile geographical environment of Radhanagri Wildlife Sanctuary includes surface structure, soil, climate, plant and animal diversity which have tremendous scope to look into. In addition the study of Natural Resources i.e. Water, minerals, Flora and Fauna is also having a large scope. In global and national respect management and planning of wild life, plants, soil and forest with its conservation for the development of Radhanagri Sanctuary is very important.

#### **1.2 LOCATION AND EXTENSION OF THE STUDY AREA:**

The present investigation is restricted to Radhanagri Wildlife Sanctuary which occupies southern and western parts of Radhanagri and Gaganbawada Tahsil in Kolhapur District. The Kolhapur district is one of the 35 districts of Maharashtra and situated in the

greenly ranges of Sahyadri in the southern part of Maharashtra. Radhanagri Wildlife Sanctuary is 95 km from Kolhapur.



Radhanagri Sanctuary is well known among the 35 Sanctuaries in Maharashtra. This is also recognized as Dajipur Reserve Forest. Radhanagri Sanctuary has a slight dumbbell shape and extended in the Bhogavati and Dudhganga basin. It has east – west stretch of about 23 km and north – south is about 31 km. There are two ranges namely Radhanagri (WL) and Dajipur (WL) covering 18336.41 hectare and 9898.29 hectare respectively. Altogether it covers 28234.70 hectare which is 351.16 Sq. Km. according to the area

occupied by the forest it is 23147.50 hectare by Reserve Forest, 4728.59 hectare area is occupied by protected forest whereas 358.61 hectare area is occupied by Unclassed Forest.

In respect to the forestry there are two ranges (each range occupy 250 sq. km of an area), six rounds (each round occupy 30-40 sq. km of an area), 17 beats (each beat occupy 10 sq. km of an area), 46 compartments (basic management unit) with 33 villages. The study area is bounded on the North by boundaries of villages Taliye Bk., Borbet, Manbet and Padsali, on The West by Sindhudurga and on the South by Bhudargad Tahsil and on the East by boundaries of villages Durgmanwad, Piral, Farale, Rajapur and Aini. The total length of boundary is 495.63 Km. incorporating 208.63 km external boundary and 287 km internal boundary.

The area under study lies between 16<sup>o</sup> 10' to 16<sup>o</sup> 30' North Latitudes and 73<sup>o</sup> 52' to 74<sup>o</sup> 14' East Longitude, located in the catchments area of Bhogavati and Dudhganga basin. Annual rainfall is about 2500 mm to 5000 mm. Height from the mean sea level is in-between 550 m to 1000 m. (Map: 1)

### **1.3 SELECTION OF TOPIC:**

The selection of the topic is based on the following considerations:

- 1) Radhanagri Wildlife Sanctuary is situated in greenly ranges of Sahyadri of Western Ghat which is famous for Bison and other wild animals.
- 2) The Radhanagri Wildlife Sanctuary is situated in the ranges of Western Ghat which has global and national significance in respect of vulnerable and delicate ecology and biodiversity.
- 3) In the study region, there is an impact of physiography on Flora and Fauna.
- 4) Radhanagri Wildlife Sanctuary is one of the renowned and most famous and rapidly developing tourist centers in western Maharashtra.
- 5) The most important species of vegetation and wild animals, which are distinguished for the ecological balance occur in this reserve forest. Most of these plant species are endangered or on the verge of extinct.
- 6) For the preservation of the forest some master plan is needed.
- 7) The study of Radhanagri Wildlife Sanctuary has not yet been done in the view of biodiversity by any geographer.

All these above considerations have motivated to do a geo-environmental study of Radhanagri wildlife Sanctuary with respect to biodiversity.

#### **1.4 OBJECTIVES OF THE RESEARCH:**

The main objective of the present study is to recognize biodiversity of the area by identifying and demarcating the flora and fauna with their environmental set-up including physiography, soil, drainage pattern, climate, diversified species of plants and animals and its management and planning related to conservation.

In view of the above following specific objectives are mainly focused in ongoing study.

- 1) To obtain the basic information of Radhanagri Wildlife Sanctuary from Remotely Sensed images, Google Earth images, Toposheets, Supplemented with field work on different aspects such as Geology, Geomorphology, soil, climate, Bio-Diversity with its Management and Planning.
- 2) To study the floral diversity (Plants, Herbs, Shrubs, Trees and Climbers etc.) by direct observation and from Kolhapur district flora.
- 3) To look into the faunal diversity (Wildlife: Animals, Birds, Reptiles etc.) by observations and records.
- 4) To find the scope of management and planning which is related to soil, forest, and wildlife conservation.
- 5) To explore and identify the problems resulting from the natural and human interaction with the environment of Radhanagri Wildlife Sanctuary.

#### **1.5 METHODOLOGY, DATABASE AND SOURCES:**

In this study, the biodiversity in respect of plants and animal is considered. Therefore this study is based on exhaustive field survey in this respect the study is conducted as described bellow:

##### **1) Preliminary Investigation:**

In Preliminary Investigation, an available literature is consulted. Pre-field stage commenced with the collection of required map of Radhanagri Wildlife Sanctuary and related information, toposheets, aerial photographs etc.

##### **2) Field Work:**

Preliminary Investigation is followed by Field Work with an objective to check interpreted details and to incorporate additional information as encountered and suggested in preliminary work. However identification and observation of floral and faunal species had unavoidable significance.

A field study has been planned with the help of aerial photographs, maps, Google Earth images and records. The observation of plants and animals has been conducted during field work with the use of GPS device.

### **3) Analysis of the Data Collected in the Field:**

The collected data has been processed and analyzed, different quantitative and statistical data are applied for interpretation and to draw inferences. The results are presented through different cartographic presentation like graph, charts and maps.

The actual field survey of the area is done in several stages. There are preparatory works including collection and reproduction of data and statistical methods, field work, observation of Geo-Environmental set-up, plants and animal's diversity working out of the proper maps and writing of final reports.

#### **Database and Sources:**

The proposed work is based on primary as well as secondary data.

##### **1) Primary Sources of Data:**

The primary data has been collected through field work, observation, discussion during field work.

##### **2) Secondary Sources of Data:**

The secondary data is collected from published records of the Government like Conservator (Wildlife) Division, Kolhapur, Assistant Conservator (Wildlife) Radhanagri Sanctuary, Radhanagri, Ranger (Wildlife) Dajipur, Ranger (Wildlife) Radhanagri.

It also includes published and unpublished reports and abstracts, journals, books, soil reports and available literature on sanctuaries and forest news bulletin etc.

Socio-Economic Review of Kolhapur District, Statistical abstracts, Census of India, District hand book, Gazetteer of Maharashtra State, Kolhapur district Gazetteer, data regarding weather parameters (Rainfall, Humidity and Temperature) collected from India Meteorological Department (IMD) regional station Kolhapur, Geological and soil data will be collected from the records of the Geological Survey of India (GSI) Department of Geology and mines, Government of Maharashtra State, the Agricultural Department, Groundwater Survey and Development Agency (GSDA) Government of Maharashtra, Remote sensing imageries, Google Earth imageries, Toposheets are the chief tools used for further study.

In the above context and keeping in a view understanding the physiographical characteristics, the Remote Sensing imageries have also been used in conjunction with

Geomorphic and Environmental factors obtained from field survey to analyze, detect, by mapping of existing status of plants and animals.

#### **1.6 SIGNIFICANCE OF THE RESEARCH WORK:**

Near about 200 sanctuaries, National Parks and other miscellaneous natural areas have been established in the country to provide protection to wildlife of different categories and to conserve diversified plant species. Sanctuaries having natural habitat provide maximum protection and optimum living conditions to the plants and animals including avifauna (birds) and reptiles. No killing or possession of wild animals is allowed in the sanctuaries except the written permission by the concern authority.

The wildlife action plan was started at national level in 1983 in India with the basic objective to chalk out and due implementation of strategies, programs and projects for the conservation of existing and future wildlife in the protected areas which is increased from the existing 3 to 4% of geographical areas of the country.

Radhanagri Wildlife Sanctuary is one of the important wildlife sanctuaries in India which established in 1985 by the Government of Maharashtra with moderate area under reserve forest i.e. 351.16 Sq. km exclusively for bison. Owing to the location in western ghat this sanctuary has national and global importance in respect to the biological diversity. Therefore there is a wide scope of study the region through conservation and protection point of view.

The data drawn during fieldwork is correlated and verified with existing Biodiversity studies of plants and animals which also give a concrete idea about the integrity between physiography and environmental conditions and biodiversity on the basis of which management and conservation of plants and animals can be checked out. In the context of biodiversity it is very important to conserve such delicate and vulnerable ecosystems to maintain the balance of the biosphere.

#### **1.7 OUTLINE OF THE RESEARCH WORK:**

Entire work has been systematically and very meticulously organized in to five consecutive chapters including conclusion and recommendations.

The first chapter consists of statement of study area, selection of topic, objectives of the research, methodology, database and sources, significance of research work and brief review of Literature. The second chapter is concerned with geo-environmental setup which incorporates geology, physiography, drainage system, climate, soil and availability of resources. The third chapter is related to biodiversity and existing status of plants and

animals with value of flora and fauna at different levels. Problems and conservation of the biodiversity has also been discussed appropriately. An impact of physiography on flora and fauna has also been recognized. The fourth chapter deals with the management and planning includes conservation of plants and animals. Where as, the final chapter is of conclusions and viable recommendations, suggested for the development of study area.

### **1.8 REVIEW OF LITERATURE:**

On the research front it is found that several attempts have been made by environmentalist, botanist, zoologist and some scientists as well as geographers and scholars from other disciplines to study the different aspects of various important wildlife Sanctuaries and National Parks in India and abroad. Regarding the study of Radhanagri Wildlife Sanctuary is also likewise, it is mostly done by botanists with the botanical views, therefore it is recognized that there is need of all attention to do geo-environmental studies and its impact on flora and fauna in the sanctuary. However from the view of biodiversity there is ample scope for study.

Some scholars who studied wildlife sanctuaries (Reserve Forests) and National Parks have referred and reviewed accordingly.

**1) Choudhary A. K., Sharma P. K., Chandel S. (2005)** have discussed about the medicinal and aromatics plants biodiversity, its present status and need of conservation.

**2) Eilu Gerald and Obua Joseph (2005)** has clarified and explained tree condition and natural regeneration in disturbed sites of Bwindi Impenetrable Forest National Park, Southwestern Uganda. Therefore, high intensity human disturbances were associated with fewer signs of mammal damage. Damage to trees by physical agents and climber abundance increased with intensity of disturbances except in completely disturbed forest.

**3) Guha Sumit, (1999)** in his draws attention on a wide range of history of forest communities in India and explore environment in an ancient agrarian society. He has threw a light on continually modified environment under the influence of man.

**4) Kadavul K., A. Pragasam, A. K. Dixit, R. Diane Joseph and J. Prasena. (2006)** has clarified and explained Biodiversity of Host Species of Mistletoes of Pondichery, Coromandel Coast of India. The plant parasites namely, *Dendrophthoe falcata*, *Viscum orientale*, *Cuscuta reflexa* and *Cassytha filiformis* were found to be colonizing certain plant species of Pondechery vegetation of the Coromandel Coast, South India and its nearby areas. Totally 49 hosts of the above parasites were noted. The parasite *D. falcate* was observed on 37 varied hosts, *viscum orientale* on 2 hosts, and *cuscuta* and *cassytha* on other

hosts. The taxonomy, economic damage and control measures of the parasites have been briefly discussed in this paper.

**5) Kadir Yilmaz, Selcuk Inac, Huseyin Dikici and Ayse can Reyhanli (2004)** gave the management plan with a view to conserve the bio-diversity for posterity and development of the protected area and to create nature conservation awareness among the people on scientific lines based on the National Forest Policy and National Wildlife Action Plan.

**6) Moza M. K., Bhatnagar A. K. (2007)** explained the needs and modes of biodiversity conservation. They stated that, for biodiversity conservation, reclamation and restoration, study of reproductive biology can provide important paradigms. Such studies would be proving to be fruitful in planning various programs specific to different habitat.

**7) Perara G. A. D. (2005)** has clarified and explains diversity and dynamics of the soil seed bank in tropical semi-deciduous forests of Sri Lanka. The nature and the magnitude of the soil bank of tropical semi-deciduous forests at Sigiriya. Sri Lanka were examined in 41 experimental plots established along a chronosequence of forest age to reveal the potential role of the soil seed banks in forest regeneration and succession following a large-scale disturbance. Species composition and abundance in the soil seed banks were influenced by the time of the year and the structure of forest where the latter is highly determined by the age of forests after a large-scale disturbance. Clumping of seeds in the soil seed bank was commonly seen in all studied forests. Soil seed banks of young successional forests were dominated by agricultural weeds, and their seeds were mainly dispersed by wind. Therefore, such seed bank increased and the seed banks do not often contribute to the forest regeneration. After about 20 years, the diversity of the soil seed bank increased and the seed banks contained some forest tree and shrub seeds. Since the microclimate of such forests are more favorable for seed germination and seedling establishment, seeds which reach these forest might germinate and establish well, contributing to successful forest regeneration and succession. Seed bank of mature forest contain less number of seeds but are also dominated with grass and agricultural weed species. Therefore, these seed banks can not support the natural regeneration of tropical semi-deciduous forest after a large-scale disturbance. Instead, speed of grass and agricultural weed species would germinate and establish if a disturbance occurs. Therefore, such forests are under a threat of degeneration with frequent disturbances.

**8) Rawat M. S. S. (2004)** has explained social and cultural role of trees and forests in the Garhwal Himalayas. In the Garhwal Himalayas forest constitute a dominant feature of the



natural landscape of the region. Besides fulfilling the basic needs (food, fodder, fuel, shelter and clothing) of the people forests provide base for the economy and play a crucial role in the socio-cultural life of the Garhwali community. Forests and trees find their impressions in myths, rituals, performative arts, feasts, festivals, songs, dances, house design, custom and clothing of the people. So much so that the entire culture of Garhwal may be termed as 'Van Sanskriti' (forest culture) because of the deep attachment of the people towards forest. It is this concern which has given birth to the 'Chipko Movement' to save the forest from unscrupulous human greed's and growing development activities.

**9) Srivastava Sudha (2003)** briefed the forests and their spatial relations with a case study of Raigad District. Tropical forest form and important resource base for both subsistence and commercial purposes. They are also components of the Carbon and water cycle with science and technology progressing by leaps and bounds especially the transport sector, rapid strides has been made in development of region, which were hither tucked away in the far interior accessibility brought in its wake possibilities of exploitation of resources of such region. A long history of occupancy by man instilled tradition that took care of the resources without their degradation but with the colonial rule and its imposition came a change in attitude locals got alienated and their interest in conservation waned with the simultaneously growth and spread of Mumbai Forest were further depilated. This gave rise to changes in their form and composition. The present paper seeks to identify distributional pattern and relations of forest of Raigad to slope and coverage and how measures should be taken to improve the situation.

**10) Yadav S. R. and Sardesai M. M. (April 2002)** documented and published Flora of the Kolhapur district. In this flora Prof. Yadav and Sardesai has accounted complete listing of floral plants occurred in Kolhapur district. The classification of flora has given according to Benthun and Hooker's system in which family wise listing of the plants has been given. About 2360 species are identified and reported, generally wild plants, medicinal plants, cultivated plants, cropping plants, ornamental plants has been identified.

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## **CHAPTER – II**

### **GEO-ENVIRONMENTAL SETUP**

#### **2.1 INTRODUCTION:**

**T**he present study of Radhanagri Wildlife Sanctuary has been done from the geographical point of view. The principle strategies are directed more towards understanding the bio-diversity and various effective geo – environmental factors in the area. Radhanagri Wildlife Sanctuary has diverse Flora and Fauna. Biodiversity is there in all forms that are at genetic level, species level and ecosystem level. The whole area falls under the Western Ghat, which is recognized as one of the “Hot Spots” of bio-diversity in India. The lush green forests of this area protect and feed the catchments of two major reservoirs namely “Rajarshi Shahu Sagar” of Kallamwadi and “Laxmi Sagar” with several minor tanks and water holes in Radhanagri Taluka. The rich bio-diversity of the sanctuary provides ample opportunity for research and education. The area of the sanctuary extends over 351.16 Sq. Km.

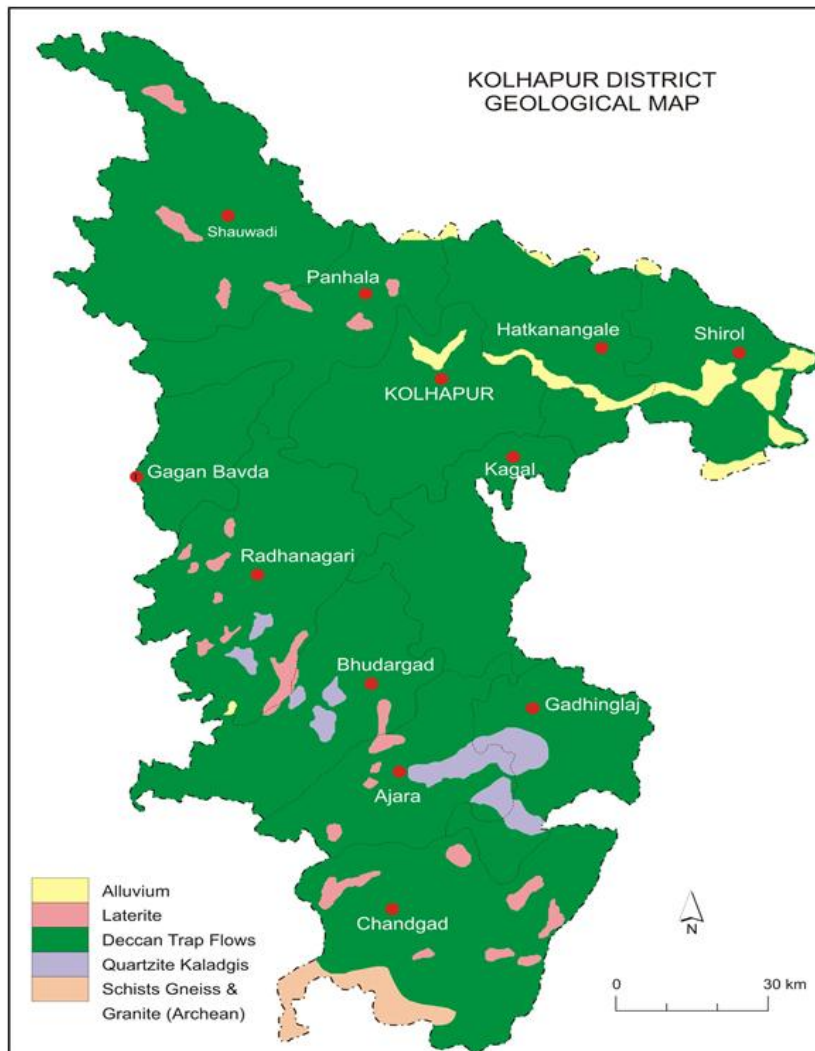
This area has got global and national significance. The Gaur (Bison) is the flagship species of this sanctuary along with the presence of Tiger, Panther, Sloth Bear, Giant Squirrel, Mouse Deer Barking Deer etc. Majority of the area is under thick forest. Grasslands are in small pockets, but they are very important for herbivores. The plant community in various habitats gives rise to plant diversity in the area. Most of the area is undulating and hilly which is the typical feature of Western Ghat.

The drainage pattern in this area is well developed. Dangs (Thick and dense forest patches) and Sadas (Open patches of Laterite Plateau) are the unique habitats in this sanctuary. The climate is moderate. The mean annual rainfall is about 2500 mm and maximum 5000 mm. The biological and ecological value of the area is of global significance and well recognized.

Radhanagri owing to the part of Kolhapur district while understanding the topography of the Radhanagri Wildlife Sanctuary one has to see the topography and other physiographical features of Kolhapur district which is the extreme Southern district of Maharashtra state, covering total area of about 7685 Sq. km. of Deccan Plateau lying along the east of Sahyadri, a part of Western Ghat. The Southern and Western part of district is hilly and remote accessibility. There are many forts important from the geographical, historical and botanical point of view that is namely Bhudargad, Gagangad, Panhala, Pargad, Rangana, Samangad and Vishalgad etc. The wind-gaps among the Sahyadri

Mountain are called Ghat or passes which are having inevitable importance in accessibility and are abode and habitat of rich biodiversity. Amba, Anuskura, Bhui-bavada, Hanumanta, Karul, Fonda, Ramghat and Tillarighat are famous in this context.

## 2.2 TOPOGRAPHY, GEOLOGY, DRAINAGE AND SOILS OF THE KOLHAPUR DISTRICT:



Kolhapur situated between  $17^{\circ} 17'$  to  $15^{\circ} 45'$  North Latitudes and  $73^{\circ} 40'$  to  $74^{\circ} 14'$  East Longitudes and cover total area of about 7685 Sq. km. The average height above sea level varies from 390 to 900mts. It has east-west stretch spread of the district which is about 75 km. and the north-south is about 102 km. The district is bounded by Sangali from east and north where as the Belgaum district from Karnataka State towards the east and south. From the west the boundary of district terminates with the escarpments of Sahyadri ranges of Sindhudurg and Ratnagiri district. Warana River make natural boundary of the district from the north side.

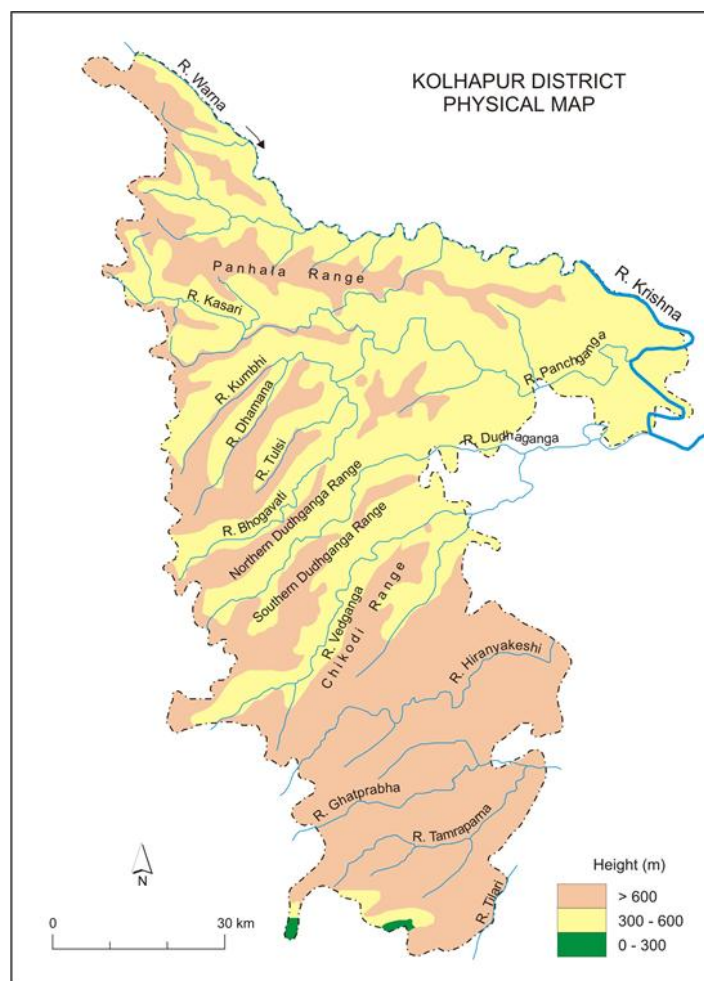
There are 12 tahsils with 1203 villages and 12 towns incorporating Kolhapur district. Tahsils includes Ajara, Bhudargad, Chandgad, Gadhinglaj, Gaganbavada, Hatkanangale, Kagal, Karveer, Panhala, Shahuwadi, Shirol and Radhanagari. According to the 2001 census, the total population of Kolhapur district is about 3515413.

The physical setting of the Kolhapur district can be best appreciated in the background of its geology, relief and drainage. The details of the geology of the district are very important. In general major portion of the district occupied by the 'Deccan Trap' influences extremities the rock of the Dharwar and Lower kaladgi series which introduce a change in the topography. The district as the whole is a part of the Deccan tableland with an average height of 1800 ft above sea level. The Sahyadrian scarp forming the most prominent feature along with western boundary forms the gently uneven to towering crest of the Sahyadries. All the ranges of the Sahyadries have characteristic lava topography (Map: 2).

The Dharwar Phyllites and Amphibolities outcropped with granite-gneiss are the oldest rocks noticed near Ajara in district. The lower Kaladgi series next in Chronological order rests over the Dharwars and the Granite-gneiss. Deccan trap formation overlies the Kaladgi bed and is spread over almost the entire district. A large extensive lava beds have undergone large-scale erosion along the river valleys, exposing some where the underlying Kaladgi and Dharwar groups of rocks. The plateau tops are generally capped by laterite, over altitudes of 900 mts. to 1100 mts. (Map: 3)

Kolhapur district has well-developed river valley and drainage pattern. There are five main tributaries of River Krishna, such as Dudhganga, Ghatprabha, Hiranyakeshi, Panchganga, Tamraparni and Warana. Warana has 80 km. length; Panchganga has 130 km. length with its tributaries Bhogawati, Tulasi, Dhamani, Kumbhi and Kasari. Doodhganga has two tributaries i.e. Vedganga and Hiranyakeshi has a 55 km. length, Vedganga has 75 km. length, Ghatprabha, Tamraparni, Shuk and Jamda are other important rivers in Kolhapur district. All major rivers originate from Sahyadri Ranges in the West and drain to eastward direction and flowing to the Bay of Bengal. (Map: 4)

The Kolhapur district has mainly five types of soils (Map: 5). Laterite soils occur mainly in the Western hilly region of heavy rainfall. The top of the hills and plateau are not covered by forest. The major soil types as below:



**Table 1: Soils of the Kolhapur District**

Types of soil	Percentage	Area
Laterite soil	10.62%	Radhanagari, Gaganbavada
Reddish brown soil	32.80%	Shahuwadi, Panhala, Radhanagari
Coarse shallow soil	25.60%	Hatkanagale, Panhala, Karveer, Bhudargad, Gadhinglaj, Radhanagari, Kagal, Chandgad
Black soil (Medium)	19.68%	Shirol, Kagal, Gadhinglaj, Chandgad.
Black soil (Deep)	11.30%	Hatkanagale, Kagal, Gadhinglaj

### 2.3 CLIMATE, RAINFALL AND TEMPERATURE OF THE DISTRICT:

The district has very salubrious tropical monsoon type of climate. This is pleasant and healthy. The western part of district always experiences cooler climate than eastern part of the district. Generally there are three seasons viz. summer (March to May), rainy (June to October) and winter (November to February). All these seasons are moderate.

**Table : 2**

**The Maximum / Minimum Temperature at Dudhaganganagar (° C)**

Sr. No.	Year	January		February		March		April		May		June		July		August		September		October		November		December	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	1991	31.00	21.00	32.00	23.50	34.50	25.50	35.50	27.00	35.00	27.00	33.00	26.00	27.00	24.50	26.00	22.00	32.00	25.50	32.00	24.00	32.00	21.50	31.50	19.00
2	1992	30.50	14.00	31.50	14.00	38.50	19.00	42.50	22.50	40.00	23.00	39.00	23.00	33.50	22.50	32.50	21.00	33.00	21.50	32.00	23.00	32.00	18.00	20.50	14.00
3	1993	30.50	12.50	33.00	14.10	36.50	17.50	40.00	23.50	40.00	23.00	38.00	36.50	30.50	20.00	29.00	19.50	29.00	21.00	30.00	21.00	30.50	20.50	27.00	16.00
4	1994	29.00	15.00	32.50	15.00	37.50	23.00	38.50	20.50	38.00	22.00	34.00	20.00	27.00	20.00	27.00	20.00	30.50	19.00	30.50	19.00	28.00	17.00	27.00	11.00
5	1995	28.50	14.00	33.00	16.00	27.00	19.50	39.00	24.50	38.00	22.00	39.00	22.50	32.00	21.50	31.50	22.50	30.00	20.00	30.00	20.00	28.00	17.00	27.50	15.00
6	1996	28.50	13.00	34.50	16.00	38.00	21.00	38.00	21.50	39.00	23.00	39.50	21.50	32.50	20.00	28.50	18.00	30.00	18.50	29.00	19.50	29.00	15.00	27.00	18.00
7	1997	29.50	13.00	31.00	13.50	37.00	19.50	38.00	21.00	39.50	21.50	35.00	21.50	29.00	27.50	25.00	19.00	30.00	20.00	33.00	19.00	29.00	20.00	27.50	17.50
8	1998	28.50	15.00	29.00	16.00	35.50	20.50	38.50	23.00	39.00	25.00	36.00	25.00	31.00	23.50	30.00	21.50	28.00	30.00	28.50	21.50	28.50	18.50	26.50	13.50
9	1999	27.00	13.50	31.50	17.00	36.00	20.00	37.00	22.00	36.50	23.00	30.00	22.00	30.50	20.50	27.50	21.00	28.50	20.00	29.00	31.00	29.00	17.00	27.00	15.00
10	2000	29.00	14.00	29.50	15.00	35.00	20.50	37.00	24.00	37.50	22.50	31.50	21.00	33.50	22.50	31.50	18.50	34.50	22.00	31.00	21.50	32.00	16.50	28.00	12.00

Source : Management Plan, Radhanagari Wildlife Sanctuary - Plan period 2001 - 2002

**Table : 3**  
**Rainfall at DUDHAGANGANAGAR (R.W.S.) mm**

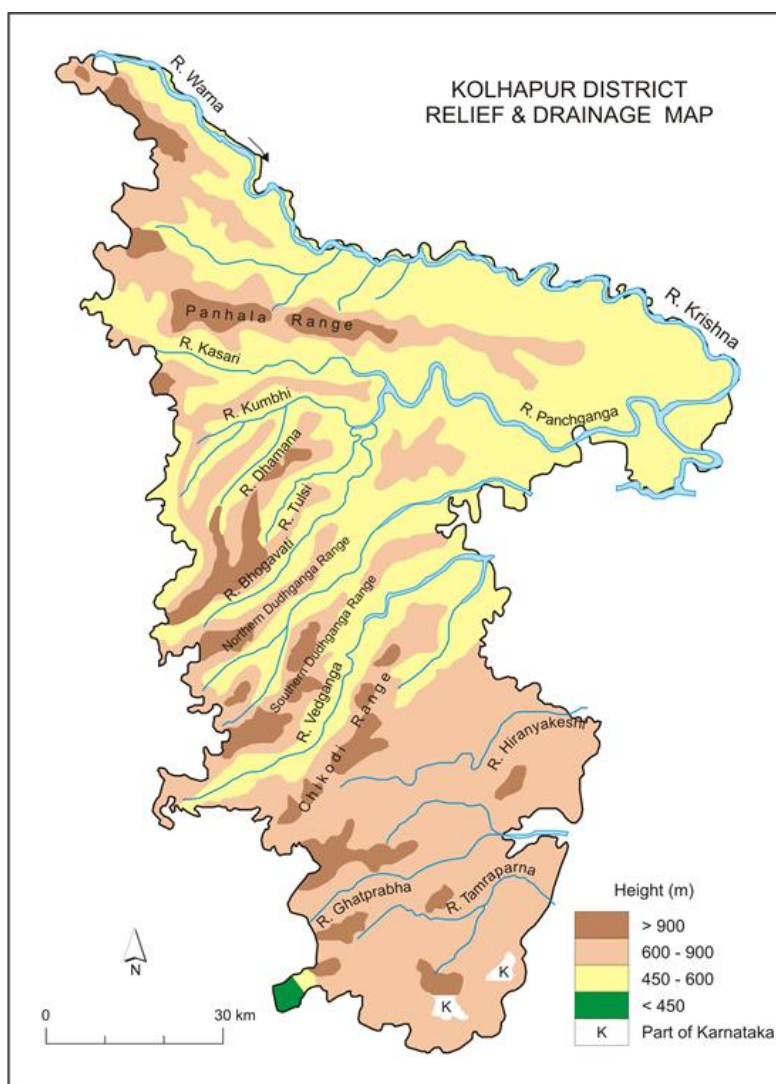
Sr. No.	Year	Jan	Feb	Mar	April	May	Jun	July	Aug	Sept	Octo	Nov	Dec	Total
1	1998	0.00	0.00	0.00	0.00	40.00	1434.60	2018.60	1819.20	734.40	450.00	54.40	0.00	6551.20
2	1999	0.00	0.00	0.00	0.00	211.40	1791.40	2880.00	847.60	386.20	335.40	19.00	0.00	6471.00
3	2000	0.00	0.00	40.00	0.00	330.00	820.00	2010.00	1701.00	320.00	40.00	30.00	0.00	5291.00
4	2001	0.00	0.00	18.00	10.20	29.40	1003.00	1816.80	1416.00	31.80	64.60	57.60	0.00	4447.40
5	2002	0.00	0.00	0.00	12.20	6.80	522.40	1356.40	480.40	120.20	336.00	0.00	0.00	2834.40
6	2003	0.00	0.00	0.00	0.00	113.20	718.20	1131.20	594.00	205.00	237.40	34.80	0.00	3033.80
7	2004	0.00	0.00	0.00	60.80	20.40	1503.80	2449.00	1421.00	1072.00	343.00	15.60	0.00	6885.60
8	2005	0.00	0.00	0.00	0.00	0.00	874.00	1869.00	1617.00	647.00	68.00	0.00	0.00	5075.00
9	2006	0.00	0.00	6.00	0.00	163.00	641.00	2273.00	1971.00	135.00	66.00	78.00	0.00	5333.00
10	2007	0.00	0.00	0.00	4.00	9.00	1064.00	1434.00	1620.00	454.00	24.00	25.00	0.00	4634.00

Source : Radhanagari Tahsil & Kolhapur Wildlife Division.



The amount of rainfall received, decreases rapidly from west to east. The average annual rainfall is 1645 mm. within the district and varies from about 500 mm. in Shirol tahsil in east to 6000 mm. in Gaganbavada tahsil in west.

The district has a large range of temperature between winter and summer and between day and night. In summer, the temperature rises as high as 41.66°C during the months of April and May and its goes down as low as 14.44°C during the months of December and January. In the district, there are March, April and May the hottest months and December, January and February are the coldest months in the year.

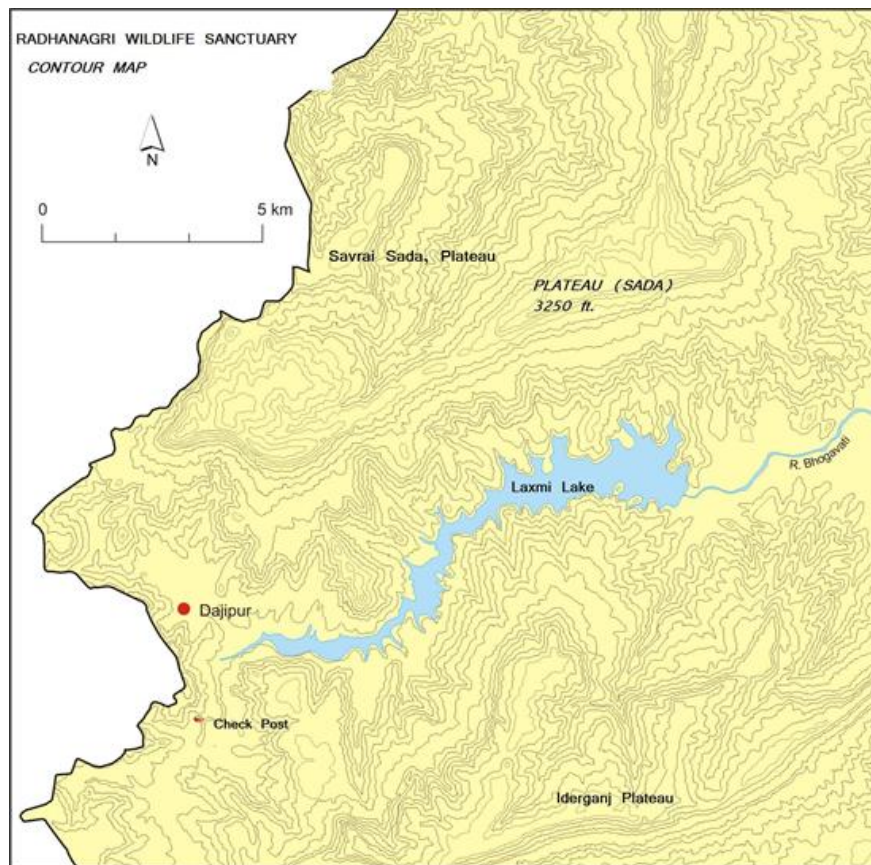


#### **2.4 GEOLOGY, DRAINAGE AND SOILS OF THE RADHANAGRI WILDLIFE SANCTUARY:**

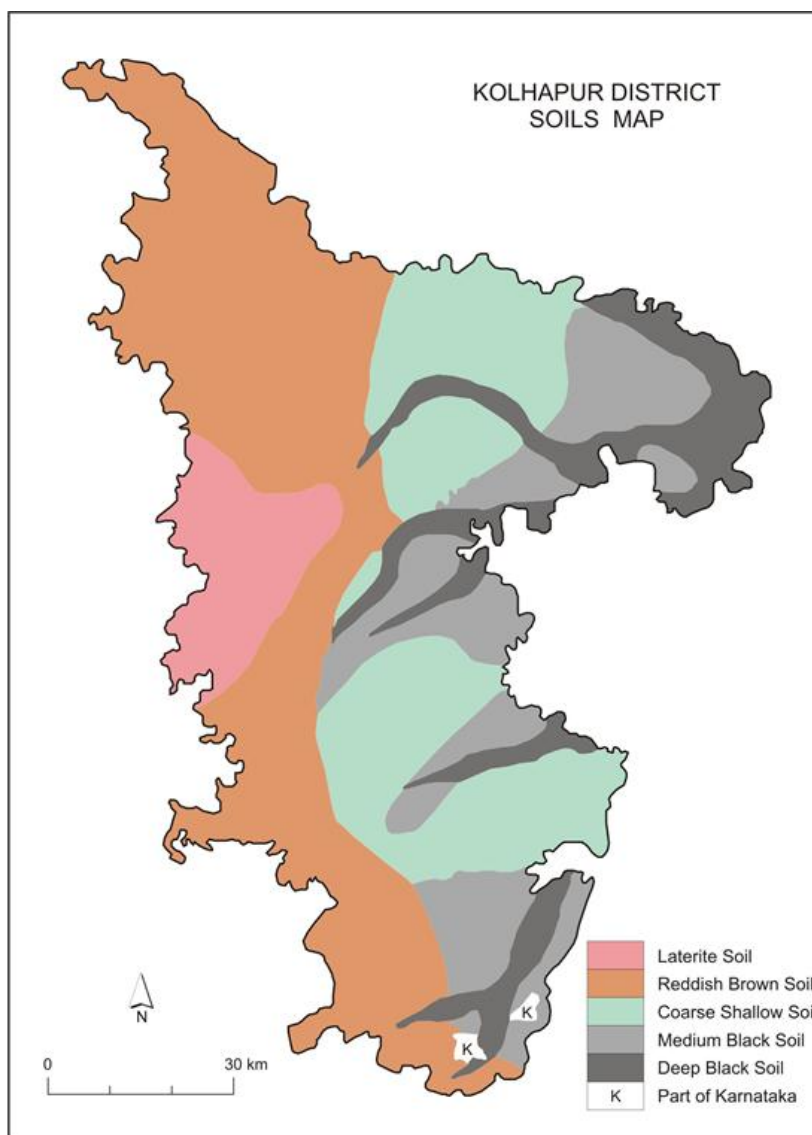
The Radhanagari Wildlife Sanctuary is in the Western Ghats of Sahyadri mountain ranges. The whole area is a rugged territory. Eastern part of the sanctuary is less

rugged, but the area is undulating. The open plateau tops are the main feature in this area. The main geological formation of the area is the Deccan trap. The rock mainly consists of basalt, which was formed due to volcanic activity. Bauxite is the main mineral ore found in the areas like Padli, Savardhan, Ramanawadi, Patpanhala, Dublewadi, Savarde plateau.

Radhanagri area shows the largest bauxite deposits seen over about 4 to 8 Km patch north of Radhanagri on Kolhapur – Phonda Ghat road and is accessible by footpath from Radhanagri dam site. The massive Bauxite varying in thickness from 2 – 5 meters. It is estimated that about 10, 80,000 tons of Bauxite may be available in this area. (Govt. Rpt.)



A proper survey has been done of this area, approximately 85 lack tones of Bauxite might be found but this area has been declared 'Bison protection forest area' by the Government of Maharashtra (Gazetteer 1990). However, Bauxite mining is being conducted at Durgmanwad town which is on the verge of North-East boundary of Sanctuary which caused major disturbance to district wildlife habitat in the area. Soil is formed from parent rock Deccan trap and is of lateritic type. The soils of grayish green loam and murum are found on gentler slopes in this area.



## 2.5 CLIMATE, PHYSIOGRAPHY AND DRAINAGE OF THE RADHANAGRI WILDLIFE SANCTUARY:

The climate is moderate with three seasons broadly divided into wet, cold and hot. Summer extends from February to May. The rainy season from June to September and winter season from October to January. During summers mean temperature ranges from 30°C to 35°C, maximum being 41°C. The minimum temperature during winter is 9°C to 16°C. The mean annual rainfall is about 2500 mm and maximum being 5000 mm. There are storms during rainy season, during monsoon season and some times in winter season. Western part of the sanctuary gets covered with thick fog (Table: 2, 3).

Topographically the region has large diversified surface. The most of the area of this sanctuary is an undulating surface which is the typical feature of the Western Ghats. The

plateau tops are flat and are with sparse vegetation particularly devoid of trees. The plateau region is mostly covered with the grasses and this area acts as a shelter place for wild animals during monsoon seasons to avoid disturbances from the leeches and mosquitoes. Due to the undulating physiography, the drainage pattern in this area is well defined dendritic type. The area is the catchments area of the Bhogavati and Dudhganga major rivers with many nalas and streams which act as the feeder channels to the main rivers (Map: 6).

Radhanagri Wildlife Sanctuary has many peaks, some hills height from 2400 ft. to 3200 ft. Savarai hill (3200 ft.) is the highest point in this area. If one can see the area as its altitude and percentage of occupied area the inferences come forward as 44% of the area is occupied by the hills which are having 2000 to 2500 ft altitude. The 40% of an area is occupied by the hills of 2500 to 2800 ft height, whereas the hills of 2800 to above 3000 ft occupy 16% of an area. Radhanagri Wildlife Sanctuary have 25 peaks such as Nanacha Dung, Ugavaidevi hill, Patpanhala, Kegadicha Sada are the important hills. The rocky trap provides many interesting features of valley, hills, gorges etc. which has influence on the land use and Flora and Fauna in the region (Map: 7).

The drainage network of the area quite interesting because it is seen that the drainage network is structurally and litho logically controlled. Over all the fine network of dendritic type of drainage network has been seen, however at the north side of the area the radial pattern of drainage network primarily draining towards the south has particularly been seen. This is the highest point at 3232 feet. The majority of the tributaries are draining in to the back water of the Radhanagri dam which is constructed on Bhogavati River. The fluvial erosion is a major geographical process which is shaping the area. The deep gorges, valleys, trenches are seen in the area (Map: 8).

## **2.6 FLORAL AND FAUNAL RESOURCES:**

The geographical area of the sanctuary is classified in reserved forest, protected forests, unclassed forests, and other government lands, gairan and mulkipad area. The total area of the sanctuary is 351.16 Sq. Km. In view of forestry there are 2 ranges (area under 250 Sq.Km.), 6 rounds (area under 30-40 Sq.Km), 17 beats (area under 10 Sq.Km.), 46 compartments (basic management unit) and 33 villages in the sanctuary (Map:9). The area falls under the western region. The plateau tops in this region are lateritic in origin, small grasses and stunted vegetation of *Syzygium* and *Mimolol* are common on such plateaus. While slopes of these plateaus have got very good vegetation. The main species found are

Jamun, Mango, Anjani, Hirda, Surangi and Par Jambul, Ain, Kinjal, Bibla, Nana, Behada, Umbar, Assana Kumaba, Kumkum etc. Zulumb is common species in sanctuary. The shrubs like Bhoma, Shendri, Jangli, Limbu, Pendri, and Karvi are the common species in sanctuary. Under different plan schemes various plantation activities had been carried out in the sanctuary area. The purpose of which is different as per the objects of the scheme.

Radhanagari Wildlife Sanctuary is home of variety of wild animals. Out of the 47 species of mammals recorded in this area, 7 species of mammals are of endangered status, namely Tiger, Leopard, Sloth Bear, Bison, Mouse Deer and Pangolin. There are as many as 264 species of avifauna recorded in the sanctuary. There are 59 species of reptiles, two of which are of endangered status namely Indian Python and Indian Monitor Lizard. There are 66 species of Butterflies recorded from the protected area.

Amphibians are generally found in rainy season in most of the area and some times in decaying ground vegetation in the forest. All together 20 species from 2 orders, 5 families and 10 genera are listed in the sanctuary.

Animal in the present context refers to the faunal life of the protected area. Sanctuary has diverse wildlife, though no scientific wild life survey of this region has been made so far, the records are prepared from the study of pugmarks, droppings and actual sighting by the field staff and reports from local people. There is no uniform method for population estimation of different species. Considering the hilly terrain, scattered water holes, biotic interference on the periphery, it is not possible to follow a particular technique to estimate the number of wild animals within the sanctuary. Hence the pugmark technique as well as water hole counting methods is followed simultaneously for the Tiger and Panther. The population estimation of other wild animals such as Bison, Sambar, Barking Deer, Wild Boar, Mouse Deer, Sloth Bear is done by using the water hole counting method and 20% block counting method in the month of May every year since 1994.

## **2.7 IMPACT OF WATER RESOURCES ON FLORA AND FAUNA:**

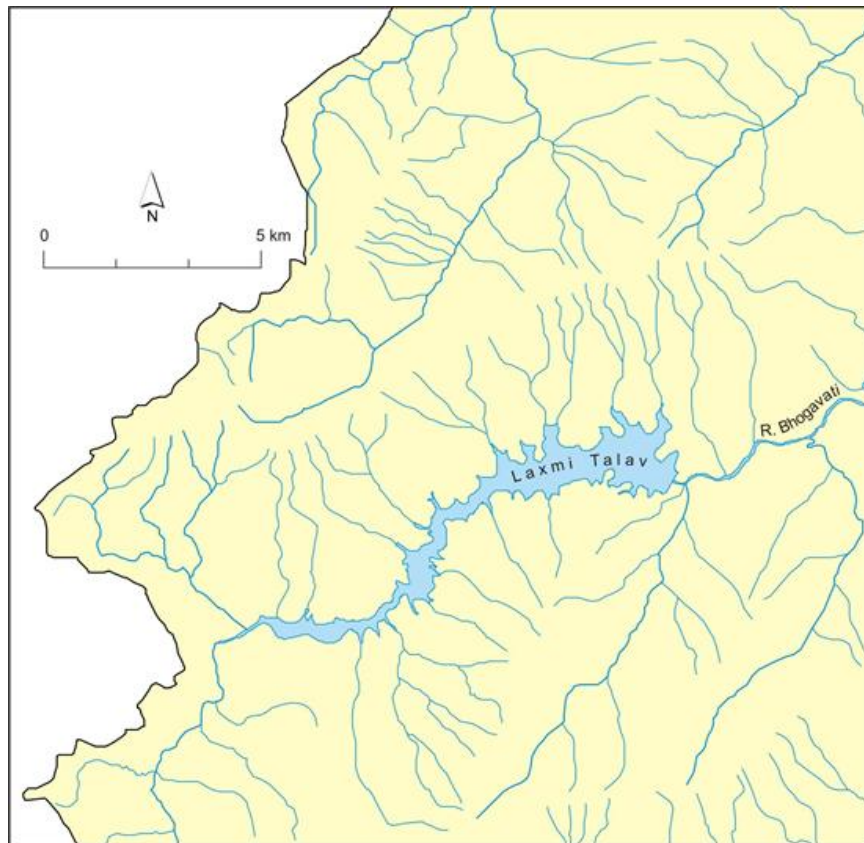
There are numerous streams perennial and seasonal, scattered all over the area. Two dams have been constructed on the rivers Bhogavati and Dudhganga. The catchment of these two reservoirs is included within the sanctuary. These two reservoirs and their surrounding forests constitute prime habitat for the wildlife of this sanctuary.

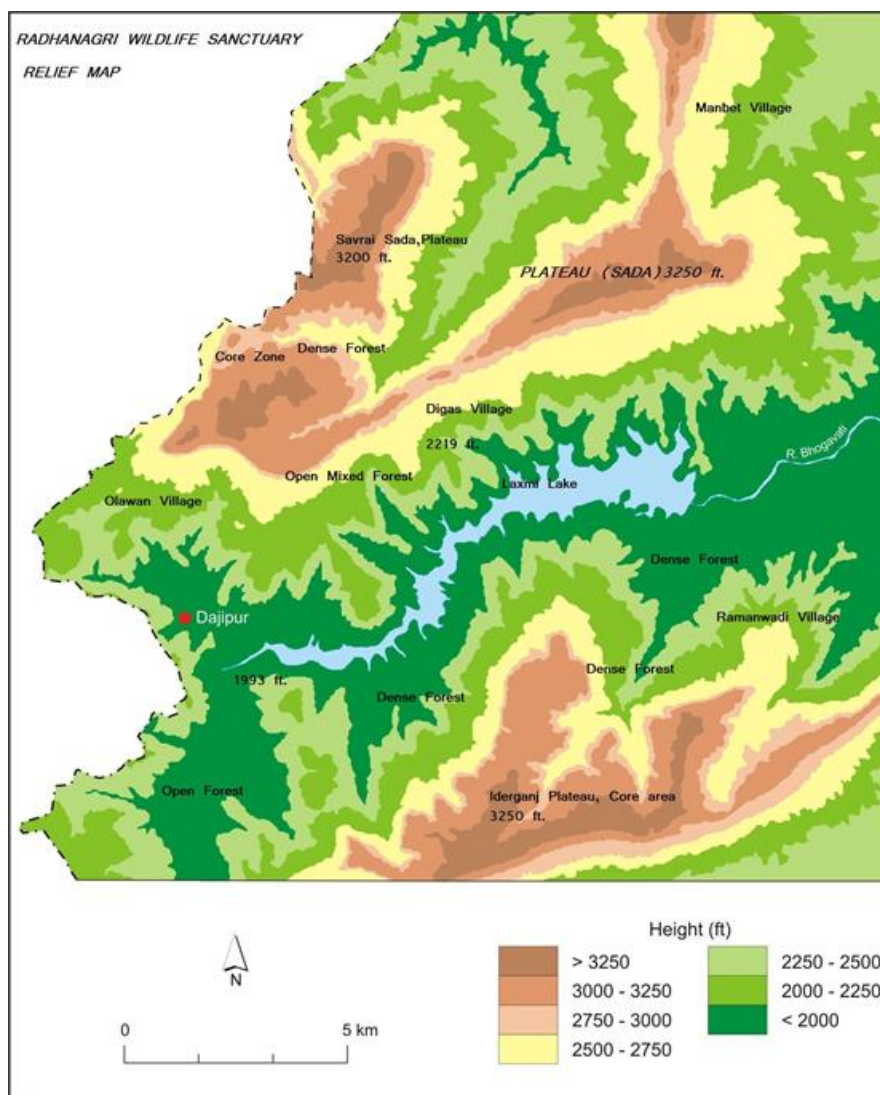
Water is the most important component of a habitat. In addition, water bodies themselves act as a habitat for several species of animals. Water bodies scattered all over the sanctuary, which provides drinking water to wildlife. Two rivers namely Bhogavati and



Dudhganga are the main sources of water (Map: 12). There is one percolation tank in the old Dajipur Sanctuary at 'Savarai Sada' which is seasonal. In addition, there are two Kolhapur type bandharas in the old Bison Sanctuary, which provides water to wildlife throughout the year. In addition to this, there are some water holes on perennial nalas, which are maintaining every year. Wild animals frequently visit these water holes during pinch period.

As per the manual of wildlife management technique, an animal can under normal circumstance walkup to an average distance of 2.5 Km. to quench its thirst. Therefore there should be a minimum of one water hole within a radius of 2.5 Km. as per the criteria 80% of this protected area is effectively covered with water. So the water sources to the wildlife are sufficient. But in the effectively covered area also some new water holes are required for easy accessibility.





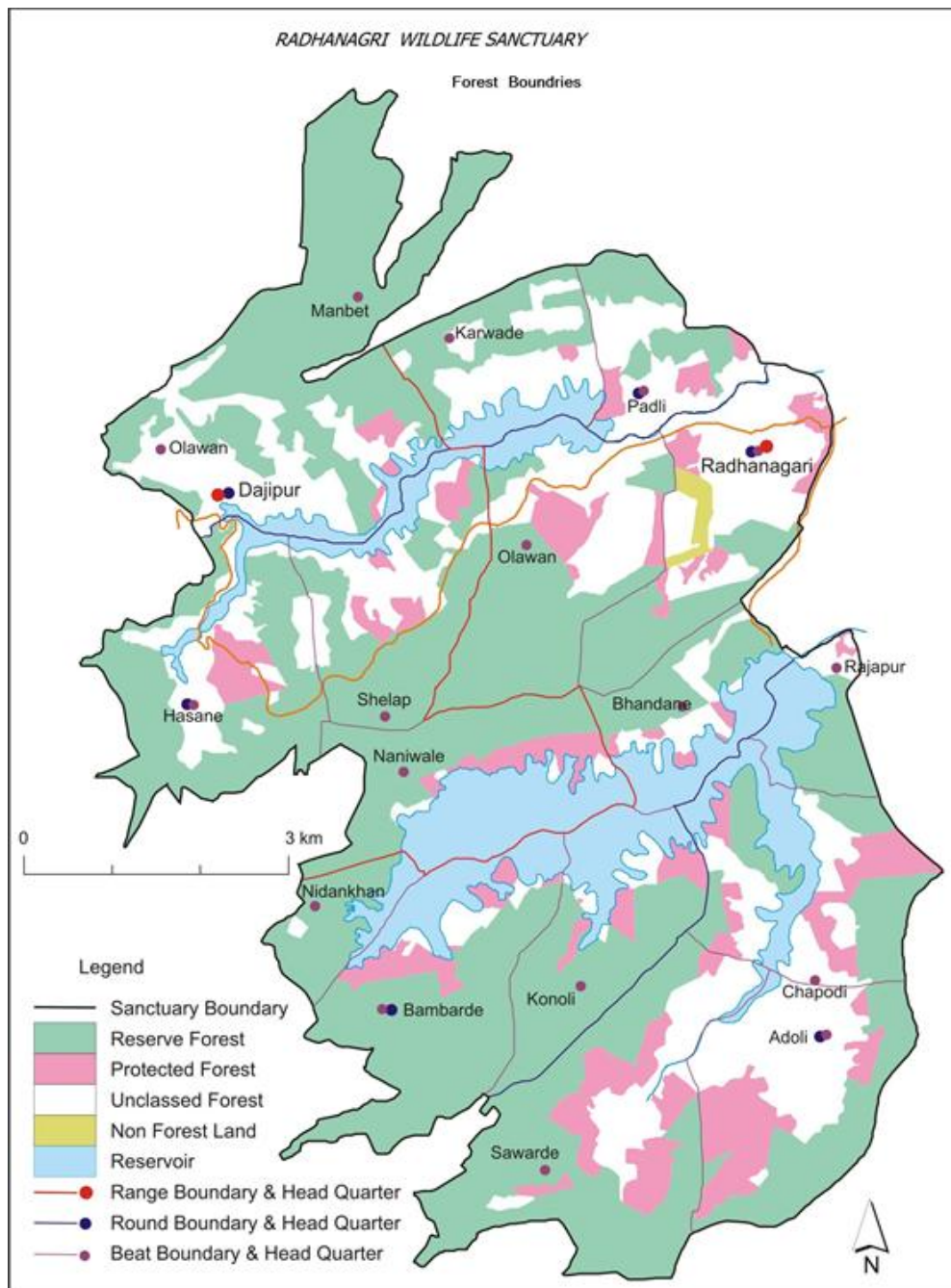
## 2.8 IMPACT OF PHYSIOGRAPHY ON FLORA AND FAUNA:

Topographically the region has large diversified surface. (Image:8) The plateau tops in this region are lateritic in origin, small grasses and stunted vegetation of *Syzygium* and *Mimoxylon* is common on such plateaus while slopes of these plateaus have got very good vegetation. The flat land vegetation is densely in the sanctuary. *Zulumb* is a common species of plants at altitude under 700 m above mean sea level; *Haldia* and *Pandhara boka* are dominated.

The sanctuary has forest types i.e. Southern tropical semi evergreen and sub type West Coast semi evergreen forest, Southern tropical moist mixed deciduous forest, West Coast tropical evergreen forest which are belong to the major groups of tropical forests.

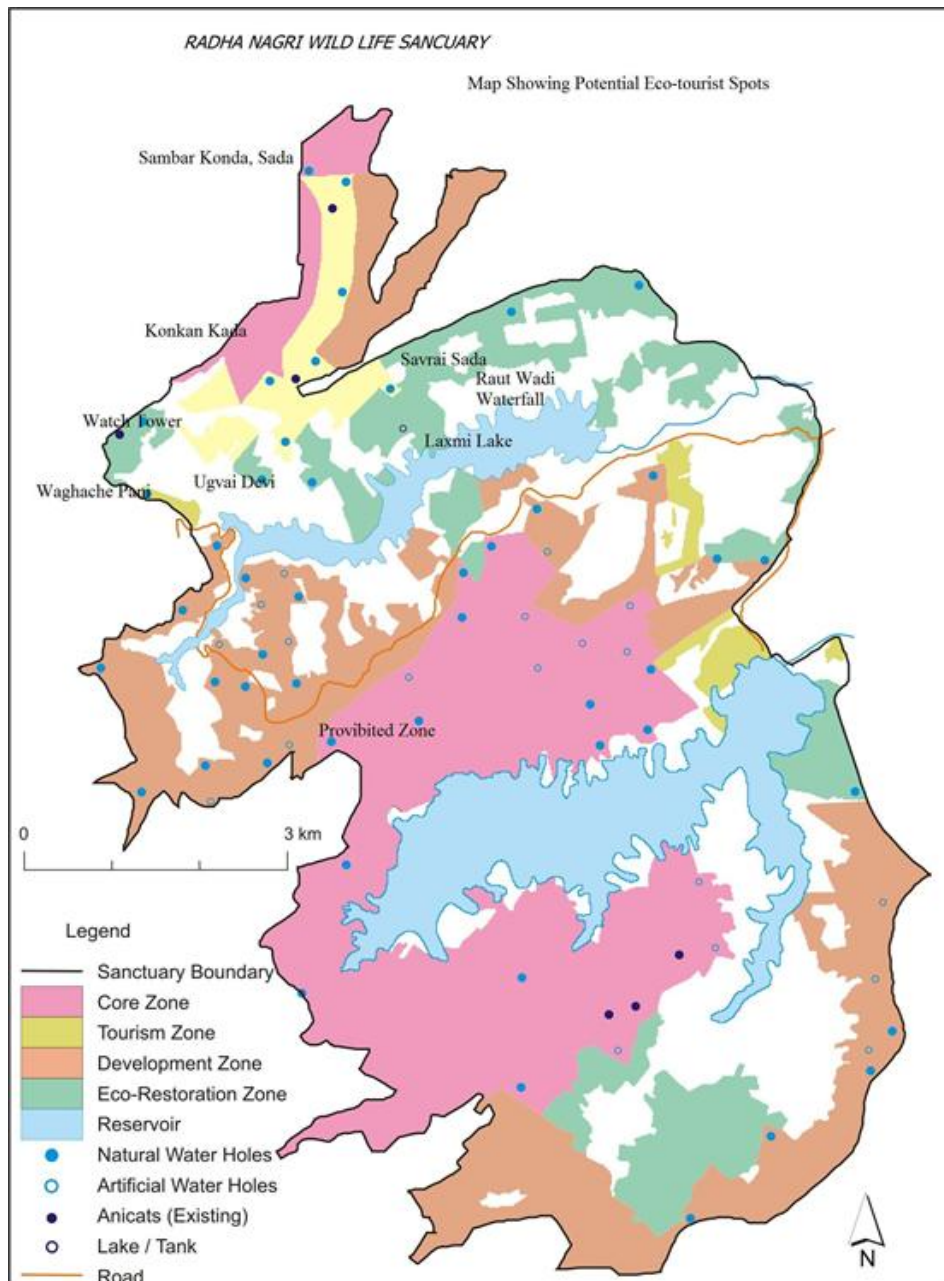
Manbet, Walwan, Hasne, Nidankhan, Savarde, Duplewadi area are under the Southern tropical semi evergreen forest. The main species over 700 m mean sea level,

species like kalvan, jambha, shisvi are common in the sloppy area. Jamun, Mango, Anjani, Hirda, Surangi and Par Jambul are found at plain area. The shrubs like Bhoma, Shendri, Jangli, Limbu, Pendri, Karvi etc. are seen in some mixwoods.



Southern tropical moist mixed deciduous forest occurs mainly at place like Taliye, Borbet, Shelap, Fejivade, Farale and Waki belt. The top canopy contains Ain, Kinjal, Hirda, Bibla, Nana, and Behada. The species like Jamun, Mango, Umbar, Assana, Kumaba, Kumkum etc. also found sparely. The under wood consist of Lantane, Rametha, Karavand, Murud, Sheng, Wavding, Chikni etc. plant species.

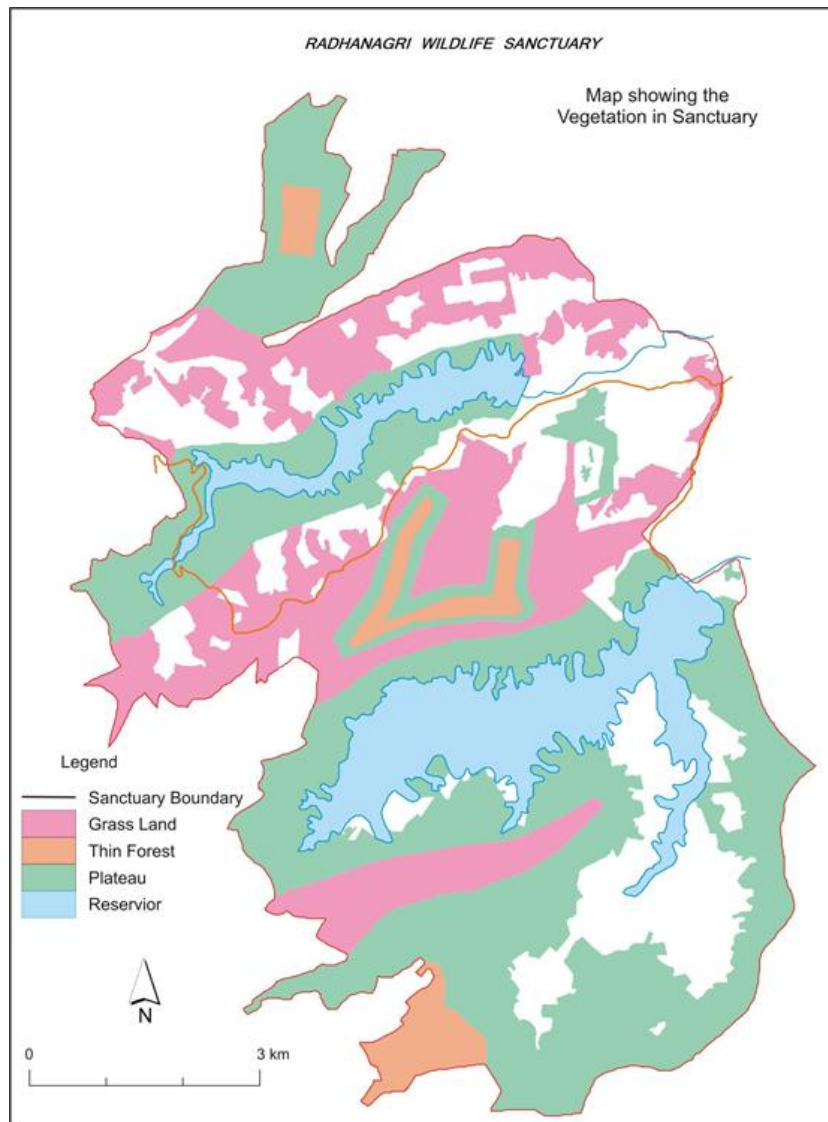




In the West Coast tropical evergreen forest, the common species like Zulumb in canopy at altitude under 700 mts. above MSL. Haldiya and Pandhara boke are dominated over 700 mts. MSL. Species like Kali, Shisvi, Kalvan, Jambha and Holigarna grahmil are common.

Majority of area is under thick forests locally known as Dangs. Grassland is in small patches but they are very important for herbivores. There is evergreen vegetation along the locations of perennial water sources. The plant communities in various habitats give rise to plant diversity in the area. The rich flora and fauna of the habitats need to be

studied. Under different plantation schemes, plantation activities are being carried out in the some pocket of sanctuary area.



Western Ghat is identifying as one of the 18 global bio-diversity 'Hot Spots' in India (Brij Gopal - 1997). By virtue of located in Western Ghats, Radhanagri Wildlife Sanctuary has diverse flora and fauna. The Bison is the flagship species of this sanctuary along with the presence of Tiger, Panther, Sloth Bear, Giant Squirrel, Mouse Deer, and Barking Deer. Radhanagri Wildlife Sanctuary is home of variety of wild animals. Out of the 47 species of mammals 7 species are recorded in endangered status namely Tiger, Leopard, Sloth Bear, Bison, Mouse Deer, Indian Pangolin and Giant Squirrel. There are as many as 264 species of avifauna recorded in the sanctuary. More over there are 59 species of reptiles, two of which are of endangered status namely Indian Python and Indian Monster Lizard. There are 66 species of Butterflies recorded from the protected area. Amphibians are generally found in

rainy season in most of the area and some times in decaying ground vegetation in the forest.

According to the wildlife survey of this region the records of animals are prepared from the study of pugmarks, actual occurrence seen by the field staff or visitors, some time water hole counting methods are used to collect the population data of animals and some time from the dropping of animals.

Based on the data of population estimation and observation by the fieldwork, the pattern of distribution of various major animals in the protected area is prevailed. Panther are found through out the protected area; Tiger is found in Geezekada, Nanivale, Surangee and Waghche Pani, Shelapche Pathar, Bamaber area only. Bison, Sambar, Barking eDeer, Wildboar, Mouse Deer are found through out the protected area in varying degrees. Sloth Bear is found in Geezekada, Nidankhan, Kaladang, Waghbamabar area of rocky broken country where they can get shelter in the caves and dens. Bison and Sambar are essentially animals of hilly area. Barking Deer prefers hilly and wooded country where dens undergrowth is available. Mouse Deer prefers grass covered rocky hill site. Giant Squirrel is found in Surangee area, Patacha dang and Kala dang.

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## **CHAPTER - III**

### **BIO-DIVERSITY AND ITS EXISTING STATUS**

#### **3.1 INTRODUCTION:**

'Earth is known to be the only living planet due to the life it supports. 'Biodiversity' or 'biological diversity' is referred to the vast range of life forms, from simple, microscopic, and unicellular to the evolved, complex and multi-cellular forms on Earth. These include the entire living organism i.e. millions of plants, animals and microorganisms' (Samant J., 2005).

Radhanagri Wildlife Sanctuary is abode of variety of wild animals and extremely rich flora and fauna. Some forest study of Radhanagri Sanctuary has revealed that there are 419 faunal species including 20 species of amphibians, 58 species of reptiles, 284 species of birds and 47 species of mammals. Similarly this area has a total 325 floral species, which includes 200 trees, 70 shrubs and herbs, 40 creepers and 15 epiphytes.

Plateau areas of Western Ghats are often considered as wastelands. However these areas have some grassy and bushy vegetation and are generally devoid of tree growth. Even if these areas have no vegetation and have only rocks and boulders, they serve as excellent environment to the wildlife. As such, this is a typical character of Western Ghats, where dense tree growth and other vegetation are found mainly on the slopes. This area has been found to be the prime habitat of Sloth Bear, Panthers, Bison, Pangolins and Mouse Deer etc. All these animals are under the wildlife protection Act 1972. Therefore from the point of conservation of biodiversity the area has great importance.

#### **3.2 BIO-DIVERSITY:**

India, the country of rich cultural and natural heritage is endowed with equally rich bio-diversity. All the bio-geographical zones of India possess their own peculiar floral and faunal wealth. The country possesses 372 species of mammals, 1175 species of fishes, 181 species of amphibians, 5000 species of mollusks, 60,000 species of insects and 15,000 species of flowering plants.

'Radhanagri Wildlife Sanctuary is home of variety of wild animals including 47 species of mammals, 59 species of reptiles, 20 species of amphibians, 264 species birds and 66 species of butterflies. This area also harbors endemic and threatened flora. Amba, Gaganbavada, Radhanagri, Patgaon are the important places of geographical, botanical interest on main ranges of Sahyadri. Similarly, there are over 200 sacred groves (Dev-Rais) helping in the conservation of bio-diversity of the district. Radhanagri Wildlife Sanctuary

forms an important area with rich bio-diversity. In addition, dams and lakes form an important feature giving shelter to number of aquatic and semi-aquatic plants'. (Yadav and Sardesai, 2002)

Tiger, Panther, Sloth Bear, Indian Pangolin, Mouse Deer, small Indian Civet and Jungle Cat are endangered faunal species in the sanctuary.

**Table 4: Population of Flora and Fauna**

Sr. No.	Animal forms	No. in India	No. in Maharashtra	No. in RWS
1.	Mammals	350	85	47
2.	Reptiles	408	100	59
3.	Birds (Avifauna)	1224	466-500	264
4.	Insects (Butterflies)	57548	30,000	66
5.	Fishes	2546	600	-
6.	Amphibians	197	29	20
7.	Plants	-	-	325

**RWS: Radhanagri Wildlife Sanctuary**

'Biological diversity or bio-diversity is the part of nature which includes the differences in genes among the individuals of a species, the variety and richness of all the plant and animal species at different scales in space, locally, in the region and the world and the types of ecosystems both terrestrial and aquatic, within a defined area' (Bharucha Erach, 2008).

In other words – biological diversity deals with the degree of nature's variety in the biosphere. This variety can be observed at three levels – the genetic variability within a species; the variety of species within a community; and the organization of species in an area into distinctive plant and animal communities.

According to the scientific definition of bio-diversity, the bio-diversity of Radhanagri Wildlife Sanctuary has been separated in genetic diversity, species diversity and ecosystem diversity.

### **3.2.1 Genetic Diversity:**

Genetic diversity defines the difference in a species in its genetic formation. This genetic variability is essential for a growth of species. Sometime due to the same natural and many times man made or anthropogenic interventions, causes the genetic make up

disturbed which leads eventually to the extinction of that particular species. In this area of Radhanagri Wildlife Sanctuary, many plants are declared as genetically endangered.

A famous non governmental organization 'ATREE' (Ashoka Trust of Research in Ecology and Environment) from Bangalore is intensively engaged in reproduction of a *Hubbardia heptaneuron* an extinct grass by genetic variables and from the view of a reproductive biology. Prof. Yadav S. R. dept. of Botany, Shivaji University, Kolhapur is also engaged with in situ and ex-situ conservation of such plants species. As far as concern with wild animals not yet genetically extinct but the Tigers are endangered.

### **3.2.2 Species Diversity:**

Different types (species) of plants and animals occur in region incorporate species diversity. In the Radhanagri Wildlife Sanctuary some areas are richer in plant species than others. Popularly they are called as Dangs, meaning thick forest. These are also categorized as Hot spots of diversity. Wagache Pani, Patacha Dang, Laxmi Talav, Kokan Darshan point, Zanzuche Pani, Shivagad etc. At present conservation scientist and many scholars have identified and categorized about 15000 species of flowering plants. Many new species are being identified specially in the flowering plants and insects. It is worthy to note that a extinct grass *Hubbardia heptaneuron* and *Ceropegia fantastica* are being reproduced through the conventional methods and biotechnological tools especially Tissue Culture, by Prof. Yadav S. R. and his enthusiastic team from Dept. of Botany, Shivaji University, Kolhapur.

Faunal species are incorporating 47 species of mammals, 59 species of reptiles, 20 species of amphibians, 264 species of avifauna with 66 species of butterflies. Gaur or bison is major animal found in this area whereas panther or leopard, sloth bear, Indian pangolin, mouse deer, jungle cat are endangered animal species.

### **3.2.3 Ecosystem Diversity:**

Ecosystem diversity can be described as a specific geographical region. Distinctive ecosystems such as forest, grasslands, deserts, mountains, which are landscape ecosystems where as aquatic ecosystems like rivers, ponds, lakes and seas.

Radhanagri Wildlife Sanctuary itself is amalgamation of many diverse ecosystems. By the landscape it comes into forest, grassland and mountain ecosystem where as by aquatic ecosystem it incorporates rivers, lakes and ponds ecosystems. There are thick reserve forest known as Dangs enriching many plant and animal species, moreover the area is famous for the 'Devrais' or sacred groves where many floral species has being

conserved from traditionally. Sadas occupied by grassland with variety of grasses. Mountain tops and flanks are accoladed with variety of plants and animals habitat. e.g. Shivgad, Zanzuche Pani, Savarai Sada, Hadakyché Sari, Kokan Darshan Kada, Plateau of Shelap etc. Aquatic ecosystem like rivers, lakes and ponds are contributing into the bounty of nature in Radhanagri Wildlife Sanctuary. River ecosystem like Bhogavati and Doodhganga are major rivers who shaping the landforms in the area with several tributaries and nalas. Many water tanks are forming individual pond ecosystem providing habitat for many distinguished plants, animals and amphibions. However, Shahuagar and Laxmi Lake are major lakes ecosystem which help to symbiosis of varieties of plants and animals.(Table: 5)

### **3.3 VALUE OF BIODIVERSITY:**

Forests are the storehouses of diversified ecosystem, which are vital at the local, regional and global levels. The production of oxygen, depletion of Carbon dioxide, balancing the water cycle, protection of soil are some vital services conducted by the forest and jungles. It is therefore clear that biological diversity is essential for present ecological processes. Directly or indirectly all daily needs of man such as food, clothing, housing, energy, medicine are all linked with biological variance. (Biodiversity) The tribal community fisher man, Agricultural communities are closely related with the forest, marine or fresh water ecosystems. Therefore it is cleared that each element of biodiversity has its different value or importance such as:

#### **3.3.1 Consumptive Use Value:**

In the present study area all these communities are directly related with Radhanagri Wildlife Sanctuary for their livelihood. The biodiversity from this area provides forest dwellers all their daily needs such as food, fodder, building material, medicines and variety of other products. These people know the qualities and different uses of variety of plant i.e. trees, shrubs, herbs, climbers and grasses etc.

Moreover non-wood forest products such as Hirda fruits, Kadipatta, Tamalpatra, Shembisal, Amsul, Honey, Wax, and grasses as fodder medicinal plants were seasonally collected. Now this practice has been stopped. Instead of this species of trees and fruits consumed by Bison or Gaur, Sambar, Barking Deer, Giant Squirrel, Mouse Deer and other herbivores.

Table : 5 Plant Species in diversified ecosystems.

Grasslands	River and stream banks	Stream and river beds :	Pond and Lake	Formation on Rocks	Insectivorous Plants	Epiphytic plants	Parasitic plants
Andropogon pumilus, Apluda mutica, Aristida adensionis, A. redacta, A. stocksii, Bracharia eruliformis, B. ramosa, chloris virgata, D. cariccosum, digitaria ciliaris, sehima, nevosum.	Carallia, brachiata, Diospyros nigrescens, Homalium ceyalanicum, Myristica malabarica, syzygium cumini, S. beyneanum. Common shrubs are: Ardisia, solanacea, barleria cristata, Melastoma, malabathricum and phyllanthus lawii. Common climber are: Anodendron manubriatum, Bidaria cuspidata,.	A. tenella, Bacopa monnieri, Conscora decurrens, Cleome viscosa, Dentella repens, Eclipta prostrata, H. Schulli, Lagenandra ovata, polygonum plebejum, Rotala serpyllifolia.	Blyxa aubertii, B. Octandra, Hydrilla verticillata, N. indica, P. nodosum, Pistia stratiotes, Rotala, malampuzbensis and serpyllifolia.	Aerva lanata, Hybanthus enneaspemns, Justicia glauca, Cyanotis cristata, Drimia indica, Eria exilis, Sonerila scapigera etc.	D. indica, V. aurea, V. exdeta, U. stellaris etc. Sacred groves (Dev-rais) : Aporosa, lindleyana, Blachia, denudata, Capparis tenera, Knema attenuata, Myristica malabarica, Syzygium lactum etc.	A campe pracmorsa, Bulbophyllum fimbriatum, Eria spp., Hoya spp., Molaxis rbecdii, Porpax reticulata and Vanda testacea etc.	Aeginetia indica, B. fungosa, Orobanche cernua var. nepalensis S. asiatica, uscuta chinensis, C. reflexa, H. obtusata, Scurrula parasitica, Viscum angulatum etc.



### 3.3.2 Productive Use Value:

The productive use value category comprises production of marketable goods such as timber, high value fruits, leaves etc. From 1985 this practice has been stopped and banned permanently to conserve the existing status of biodiversity of Radhanagri Wildlife Sanctuary. However it is recommended strongly that, forest department can produce and do marketing of medicinal plants occur in the region. In India there are over 2000 medicinal plant species of which 443 species have been recorded in the state of Maharashtra. However 600 plant species are enumerated in Kolhapur district. *Acacia concinna*, *Abutilon indicum*, *Asparagus racemosus*, *Var. javanica*, *Biophytum sensitivum*, *Bombyx micranthus*, *Cassia fistula*, *Dillenia indica*, *Emblica officinalis*, *Jasminum auriculatum*, *Jatropha curcas*, *Mangifera indica*, *Sesamum orientale*, *Tamarindus indica* etc. are the medicinal species among various medicinal plants. In the other view i.e. from agricultural practices, it is worthy to note that there are various economically important plants which may categorized as follows:

#### 3.3.2.1 Cereal Crops:

*Eleusine coracana* (Nachani), *Oryza sativa* (Rice), *Sorghum spp.* (Wheat), *Triticum aestivum* and *Zea mays* (Maize)

#### 3.3.2.2 Pulses:

*Arachis hypogaea* (Groundnut), *Cajanus cajan* (Tuwar), *Cicer arietinum* (Gram), *Lablab purpureus* (Chavali), *Psophocarpus tetragonolobus* (Gavar), *Vigna aconitifolia* (Mataki), *V. mungo* (Udid), *V. radiata* (Mung), *Pisum sativum* (Vatana)

#### 3.3.2.3 Fruits Vegetables:

*Abelmoschus esculentus* (Bhendi), *Benincasa hispida* (Kohala), *Capsicum annuum* (Chilli), *Coccima grandis* (Tondli), *Cucumsmelo var. melo* (Kalingad), *C. sativus* (Cucumber), *Cucurbita maxima* (Bhopala), *Laganaria siceraia* (Dudhi Bhopala), *Luffa acutangula* (Dodaka), *L. eylindrica* (Gilka), *Lycopersicon lycopersicum* (Tomato), *Momordica charantia* (Karle), *Moringa oleifera* (Shevaga), *Solauum melongena* (Wangi)

#### 3.3.2.4 Leaf Vegetables:

*Amaranthus cruentus* (Tandulka), *Brassica oleracea* (Kobi), *Cicer* (Chana), *Colocasia esculenta* (Alu), *Hibiscus* (Ambadi), *Raphanus sativus* (Mula), *Sesbania grandiflora* (Hadga), *Spinaeia oleracea* (Palak), *Trigonella foenum* (Methi)

### 3.3.2.5 Root and Tuber Vegetables:

*Beta vulgaris* (Beet), *Daucus carota* (Ginger), *Ipomoea batatas* (Ratalu), *Solanum tuberosum* (Potato)

### 3.3.2.6 Fruits:

*Anacardium occidentale* (Cashew), *A. reticulata* (Ramphal), *A. squamosa* (Sitaphal), *Artocarpus heterophyllus* (Phanus), *Carica papaya* (Papai), *Citrus spp.* (Limbu), *Cocos nucifera* (Coconut), *Embllica officinalis* (Awala), *Ficus carica* (Anjir), *Garcima indica* (Amsul), *Mangifera indica* (Mango), *Malinilkara zapota* (Chikku), *Meyna laxiflora* (Alu), *Musa pradiasiaca* (Banana), *Pithecellobium dulce* (Vilayati Chinch), *Psidium guajava* (Peru), *Semecarpus anacardium* (Bibba), *Spondias pinnata* (Ambada), *Syzygium cumini* (Jambhul), *Tamarindus indica* (Chinch), *Ziziphus mauritiana* (Bor) are the plants having some economic and productive use of value.

### 3.3.3 Social Value:

The biodiversity always has a social value as it provides life supporting resources to the society. The consumptive and productive value of biodiversity is closely related to the social value of biodiversity because these values are utilized by traditional communities to the modern society. Social value of biodiversity is always related with cultural and religious sentiments. In the concern study area, there are some pockets of the thick forest are kept conserve in the name of God and popularly they are known as Devrai, it means sacred groves. There are more than 200 sacred groves in the Kolhapur district. In the Radhanagri Wildlife Sanctuary, several such Devrais are present. These sacred groves are directly or indirectly help to conserve the biodiversity. Some Hindu religious festivals are directly related to the biodiversity which are being practiced in this area e.g. Vat Pornima, Naga Panchami, Dashara, Navratra, Bendur etc. Moreover, agricultural practices by mass community which assure the sustainable supply of food to the mass society. Beside these, Radhanagri Wildlife Sanctuary provides employment to the local people. It also controls drought and floods in the area.

### 3.3.4 Ethical and Moral Value:

Our ancestors always have ethical & moral values of biodiversity. By the several generations, the nature has been conserved by local tradition it may be through the various festivals, may be by mythological traditions. The people were well aware and sensitive about the conservation and protection of the jungles. Various species of plants were sacred

value e.g. Bell tree, Peepal tree, Audumbar tree, Tulsi herb, even grass like Harali offered to Shri Ganesha idol.

Many animals also have some sacred value e.g. King Cobra, Cow, Tiger etc. This region therefore also under the impact of such types of ethical and moral value.

### **3.3.5 Aesthetic Value:**

Aesthetic value is concerned with panoramic & spectacular views of the forests and jungles. Aesthetic value is always important for the tourist's attraction. Biodiversity is a beautiful and wonderful creation of nature unlike from the other forests & jungles. Radhanagari Wildlife Sanctuary has got panoramic multidimensional and spectacular scenic views. Radhanagari Wildlife Sanctuary has a spectacular location at the rim of Sahyadri Mountain and Konkan. Several passes are there, which precipitates in Konkan. There are several tourist attraction spots located. e.g. Konkan Kada, Watch Tower, Indarganj plateau, Ugavadevi Mandir, Rautwadi waterfall, Savrai Sada, Patyacha dang, Sambar kond etc. The Radhanagari Wildlife Sanctuary always called as tourist's heaven particularly from the adventure tourism point of view. There are some tracking routes i.e. Gaganbavada- Borbet – 18 km, Gaganbavada-Watch Tower -Dajipur – 25 km., Padli –Digus- Dajipur- 22 km. etc.

### **3.3.6. Option Value:**

Option value describes possibilities of future uses of the natural resources. It further clarifies the expected uses of the natural resources. This area as a sanctuary having importance in Indian Biotic Environment. India has been divided into 10 biotic or biogeographic regions based on geography, climate, and types of vegetation, mammals, birds, reptiles and other Fauna. The Western Ghats in Maharashtra is one of them incorporating Radhanagari Wildlife Sanctuary.

### **India's Biotic Zones:**

- 1) The cold mountains snow covered Trans Himalayan region of Ladakh.
- 2) The Himalayan ranges and valleys of Kashmir, Himachal Pradesh, Uttarakhand, Assam and other North-Eastern states.
- 3) The Terai, the lowland where the Himalayan Rivers flow into the plains.
- 4) The Gangetic and Brahmaputra plains.
- 5) The Thar desert of Rajasthan.
- 6) The semi-arid grassland region of the Deccan plateau, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu.
- 7) The North-Eastern states of India.

8) **The Western Ghats in Maharashtra, Karnataka and Kerala.**

9) The Andaman and Nicobar Island.

10) The long Western and Eastern coastal belt with sandy beaches, forests and mangroves.

**3.4 THREATS TO THE BIODIVERSITY:**

The forest & Jungles are depleting due to the unwanted anthropogenic intervention which lead to the fatal disturbance of biodiversity. Forests and grasslands have turned into barren lands & deserts. The major parts of the jungles have been cleared for fuel wood & fodder illegal cutting of medicinal plants, shifting cultivation is proving to decrease in the habitat loss of the many rare species of Flora & Fauna.

According to the revised IUCN red list categories prepared by the IUCN species survival commission (SSC) and approved at the 40<sup>th</sup> meeting of the IUCN Council, Gland, Switzerland in 30<sup>th</sup> November 1994 are as follows:

1. Extinct (Ex), Possibly Extinct (PE): *Synnema Nomatum* (Blatt) Sant.
2. Extinct in the Wild (EW): None
3. Critically Endangered (CR): *Maluaceae*, *Alutilon ranadei*, *cyperaceae- eleocharis lankana*.
4. Endangered (EN): *Asclepiadaceae-cerupegia huberi*, *C. Lawii*, *Poaceae- Isachne bicolor*.
5. Vulnerable (VU): None
6. Low Risk (LR): *Niligirianthus Reticulatus* (stapf) *The Bremek*, *Ceropegia Evansii* McC.
7. Data Deficient (DD): None
8. Not Evaluated (NE): None

The Radhanagri Wildlife Sanctuary though under control of mighty forest department, it is not free from the acute problems such as encroachment, poaching, habitat loss, illegal cutting of trees, domestic livestock grazing, wildfires, unwanted growth of grassland, wildlife health, man/wildlife conflict etc.

**3.4.1 Encroachment:**

The problem concern with encroachment is not existed in this protected area. However, some sporadic cutting of the trees is occurring specially at the border of forest and private farms. Such practices we have noticed during the intensive fieldwork. In this concern, some farmers are interviewed, they always grievance regarding the force full acquire of the land by the government. Temporally, encroachment especially during the rainy season is occurred. At the time of extension of Radhanagri Wildlife Sanctuary it was proposed to exclude 14 villages from Radhanagri Wildlife Sanctuary, whereas 11 villages

with 30 hamlets are included into the Radhanagri Wildlife Sanctuary. According to government policy there is a provision to migrate & rehabilitate such settlements. However, there is dispute of 14 villages namely Radhanagri, Banachiwadi, Fejiwade, Adoli, Gaonthanwadi, Dublewadi, Sawarde, Vadachiwadi, Chaphodi, Rajapur, Savardhan, Padali, Manbet etc. (Daily Sakal, 30/08/2008).

#### **3.4.2 Poaching:**

The poaching of the wild animals is not practiced. However, some sporadic cases of illegal killing of Sambar, Hares, Peacock, Wild boar. Hunting and shooting of any wild animal is prohibited but possessing firearms by the farmers to protect their crops is proving a danger to the wild animals specially herbivores animals such as Wild boar, Porcupine, Rabbits, Deer and birds like Painted Partridges, Jungle fowls, P. fowls, Peacocks for their meat. However, from every now & then one can read news about the illicit killing of some wild animals e.g. There was a killing of Sambar in Sawarde range of forest. (Daily Pudhari, 30/03/2008)

#### **3.4.3. Habitat Loss:**

There are many cases of the loss of wild habitats are prevailed this takes place due to the fast population growth and greedy short term beneficial so called economic development projects which lead to the complete destruction of biodiversity. This area is the unique characteristic habitats of the many rare plant species and wild animals. Habitat defines a natural home or place of occurrence of plant or animal. Radhanagri Wildlife Sanctuary, as stated earlier is having a ecosystem diversity, where the landscape ecosystems like thick forest (Dangs), grasslands, rocky exposed surfaces, hill tops and slopes, deep valley floors and aquatic ecosystem like rivers and streams, lakes and ponds, waterholes are nothing but the wild natural habitat of Flora & Fauna. The thick forests (Dangs) are exclusive habitat of Gaur (Bison) and some wild animals (Image No. 7) where as grasslands are the habitat of some herbivores and some avifauna like Jungle fowls, P. fowls, Painted Partridges, Peacocks, and Hares etc. The habitat of these Flora and Fauna is a seldom disturbed by the temporarily encroachment of undisciplined tourists. The passing of a State Highway through the dense forest is also a great disturbance to the fear free migration of the wild animals. Incase of land mining Inderganj Bauxite mining area comes under RWS. About 770-hector area of land has been given to the INDAL Company for the lease of 30 years. The company had built 6 km. of the road, office building, pump house,

storehouse that has distrusted the habitat of rare Flora & Fauna. Some Rare Flora and their Habitats are as follows:

**Grasslands:**

*Andropogon pumilus, Apluda mutica, Aristida adescensionis, A. redacta, A. stocksii, Brachiaria eruliformis, B. ramosa, chloris virgata, D. carricosum, digitaria ciliaris, sehima, nevosum* (Image 6)

**River and Stream Banks:**

Common trees are; *Carallia, brachiata, Diospyros nigrescens, Homalium ceylanicum, Myristica malabaricea, syzygium cumini, S. beyneanum*. Common shrubs are; *Ardisia, solanacea, Barleria cristata, Melastoma, malabathricum* and *phyllanthus lawii*. Common climber are; *Anodendron manubriatum, Bidaria cuspidata, Hisbiscus hirtus, Luvunga eleutherandra, Paramignya monnophylla, Schefflera elliptica*

**Grasses:**

*Arthraxon, jubatus, A. spicat, Bhidea burnsiiana, Coelachne minuta, Dimeria hohenacheri, Glyphochloa divergen, Isachne bicolor, Paspalum canarac* etc.

**Stream and River Beds:**

*A. tenella, Bacopa monnieri, Conscora decurrens, Cleome viscosa, Dentella repens, Eclipta prostrata, H. Schulli, Lagenandra ovata, polygonum plebejum, Rotala serpyllifolia*

**Pond and Lake:**

*Blyxa aubertii, B. Octandra, Hydrilla verticillata, N. indica, P. nodosum, Pistia stratiotes, Rotala, malampuzbensis* and *R. serpyllifolia*

**Insectívoros Plants:**

*D. indica, V. aurea, V. exdeta, U. stellaris* etc.

**Sacred Groves (Devrais):**

*Aporosa, lindleyana, Blachia, denudata, Capparis tenera, Knema attenuata, Myristica malabarica, Syzygium lactum* etc.

**Formation on Rocks:**

*Aerva lanata, Hybanthus enneaspemns, Justicia glauca, Cyanotis cristata, Drimia indica, Eria exilis, Sonerila scapigera* etc.

**Parasitic Plants:**

*Aeginetia indica, B. fungosa, Orobanche cernua var, nepalensis S. asiatica, Cuscuta chinensis, C. reflexa, H. obtusata, Scurrula parasitica, Viscum angulatum* etc.

#### **3.4.4. Illegal Cutting of Trees:**

The peripheral part of the RWS around the villages and human habitat is affected by illegal cutting of the trees. Generally, this happens to procure firewood and fodder. Moreover same illicit removal of leaves of Kadipatta, Tamalpatra, Palas, Hirda fruits and grass as a fodder takes place which also distribute micro level ecosystem and wild habitat.

#### **3.4.5. Domestic Livestock Grazing:**

Domestic livestock grazing has been banned but the total grazing control has become extremely difficult because the cattle of villagers are frequently grazing into the jungle and disturbed the wild habitat.

#### **3.4.6. Wildfires:**

By virtue of semi-evergreen and moist deciduous forest, fire is not a serious menace. However, some patches of grasslands are not free from the forest fire. Some time grasslands near villages are deliberately burns down by the villagers.

#### **3.4.7. Karvi Plethora:**

The plethora or uncontrolled growth of Karvi is an unprecedented threat to the sanctuary. Karvi is observed rapidly encroaching forestland, which is proved as a major obstacle to the growth of a grass, legumes & other herbs and shrubs. Other stray species of grass, weeds or herbs like congress grass is also observed in this area which is main cause of reduction of meadows.

#### **3.4.8. Soil Degradation:**

Soil degradation is another problem facing by Radhanagri Wildlife Sanctuary. Particularly in rainy season, the fluvial type of erosion degrades the land along the rills, streams, tributaries and river. However, soil conservation work like Nala bunding, gulli plugging has checked little bit.

#### **3.4.9 Wildlife Health:**

Some years before, there were sudden death of 5 to 6 Bison were occur. It has later declared as an epidemic. Therefore, the mortality in wild animals in this area is at large scale. This may due to the encroachment of domestic animals into the sanctuary.

#### **3.4.10 Man-Wildlife Conflict:**

During the extension of Radhanagri Wildlife Sanctuary, 25 villages and 30 hamlets (Wadis) are including under the protected area of Radhanagri Wildlife Sanctuary. In the core area i.e. inside the outer boundary of Radhanagri Wildlife Sanctuary, there are 29 Wadis where people live moreover on the rim of the sanctuary. There are several Wadis

where day to day life of villagers depends upon forest for their needs of fuel wood and grazing of their domestic livestock. The Radhanagri Wildlife Sanctuary is infested with wild animals having many incidences of cattle lifting by carnivorous, wild animals. Sometime man/wildlife conflict also occur the destruction of crops by Bison, Sambar, Wild boar is very common in this area. It is the common problem of villagers that their crops especially Paddy and Nachani crops are destructed by wild animals mostly Bison, Sambar and Wild boar. Some remote area of Yeni, Farale, Bhandane villages of Radhanagri Taluk threat of wild tuskars has been experiwnced. The sugarcane and paddy cultivation is run over by the herd of wild tuskars. There are some sporadic incidence in which people were attacked by Tiger, Bison and other wild animals.

Recently some wild tuskars are frequently visiting the southeastern part of sanctuary i.e. near Kalamawadi dam. The Tiger is also sighted at Kitewadi (Chandgad) area. However, there is government provision to give compensation in such cases. In the case of human killing by the wild animal one has to see the total account of Kolhapur district in which cbout five such incidents were ocuuerd in which descesead killed by the elephants , however one person is killed by the bison till year 2007 whereas two persons were seriously injured by the attack of eliphants. By the attack of the bison seven persons were injured till year 2006. Two persons injured by panthers, one person by wild boar and one person by hyena in the same year. In other incidents 1323 cases of crop destruction by the wild tuskars were registered since 2003 till 2007. 1291 cases of crop destruction by the bison were registered. The total loss of Rs. 48.69 lakh was resulted. Chandgad and Ajra taluk are mostly affected by the raids of eliphants and Radhanagri taluk is affected by the attacks of bisons (Wildlife Report, 2007).

#### **3.4.11 Undisciplined Tourism:**

Radhanagri Wildlife Sanctuary is open for tourists. Many tourists visit the sanctuary particularly in the month of October to March. It is estimated that around 2000 to 8000 tourists visit the sanctuary every year (Graph: 3) However, only stipulated area is opened for them to visit i.e. from checkpoint of Dajipur to the 1<sup>st</sup> and 2<sup>nd</sup> watch tower over the hill. Visitors are allowed to use their motor vehicles. In such cases, due to the noise of their vehicles and smell of diesel, Petrol and gas irritate the wild animals they are getting disturbed. Some time they change or flee from their habitat. Moreover, the junk of food packets, plastic carry bags, pet bottles, beer cans is left behind in jungle by tourists. There is



always danger of consuming these junks by wild animals, which can be hurt to the wild animals. We have many times noticed this during our intensive fieldwork.

### **3.4 CONSERVATION OF BIODIVERSITY:**

The overall degradation of biodiversity in India is a burning problem. It is very dangerous to humankind the destruction of very delicate and fragile ecosystems in Indian jungles. Therefore, it is need of hour to preserve, conserve the balance of biodiversity.

Biodiversity can be conserved by In-situ and Ex-situ methods.

#### **3.5.1 In-Situ Conservation:**

Preservation of biodiversity in its all forms i.e. genetic biodiversity, species biodiversity & ecosystem biodiversity in its natural habitat, where it is existed at present. e.g. in reserve forests, protected forests, wildlife sanctuaries, national parks etc. In the program of In-situ biodiversity conservation, the individual species can not be conserved or protected, as it is conglomeration of diversified species of Flora & Fauna. Each species habitat is inter-linked with each other; it is really a symbiosis of all living creatures in mass. Therefore, it is to be preserved, conserved amass in form at reserve forest, protected forest, national park or wildlife sanctuary. However, some breeding programs of endangered Fauna and reproduction of some rare Flora can be hold near their habitat. E.g. in Radhanagri Wildlife Sanctuary, breeding of Bison, Sambar, project Tiger can be implemented.

In the sanctuary, restoration programs of some important plant species are required. e.g. *Adenoon indicum data (Motha sonaki)*, *Achryanthes malbamica* (Herb), *Bombax insigne* (Tree) (*Deo savan*), *Clelistanthus malbaricus* (Tree), *Clematis smilacifolia* (Herb) (*Devasi*), *Griffithella hookeniana* (Herb), *Iphigenia stellata* (Herb), *Solanum bigeminatum* (Herb), *Saccopetalum tomentosum* (Tree), *Wagatea spicata* (Climber) *wakeri*, *Pygeum gardneri* (tree) (*Gapsunde*).

Besides these habitat development for some faunal species should taken into consideration. Dangs i.e. thick vegetation patches, valley floors, waterholes, some rock cuts, pits should be created. There is an opportunity to accommodate Indian Tiger, Panther and considerable scale. Project Tiger should important here to conserve some wild animals at In-situ. There should be integrated protection program of this geographical region. Radhanagri Wildlife Sanctuary represents fragile ecosystem with highly species diversity. There should be free corridor maintained within Karnataka, Chandgad, Radhanagri, Gagan

Bawada, Koyna, Chandoli etc. to fare free migration of wild animals. The other boundaries of the sanctuary should use for re-plantation of fodder tree (Image 5).

### **3.5.2 Ex-Situ Conservation:**

In-situ conservation species are conserved at their own natural habitat. However, there are situations in which some species are about to extinct. In such cases, unless we don't try to conserved and reproduce. Such species in laboratory i.e. outside its natural habitat in scientifically controlled environments. e.g. Botanical garden, Zoological parts etc where an attempt is made to multiple reproduction of species. Off course the method is expensive, sometime in Western countries such rare species of plants and animals are preserving by their germplasm in gene banks.

As far is concerned, ex-situ conservation some rare species of plants and grasses are being conserved and reintroduced in their wild habitat by some non governmental organization from Bangalore.

### **3.6 EXISTING STATUS OF FLORA:**

This area is abode of several endemic and threatened Flora and Fauna also. The rare species of plants seems to be on destruction. So to conserve them is to be total protection of ecosystem.

The area falls under the Western Ghat. The plateau tops in this region are lateritic in origin, small grasses and stunted vegetation of syzygium and mimoxyion is common on such plateaus have got very good vegetation. According to the Champion and Seth's classification the major three types of forests are seen over this area such as Southern Tropical Semi Evergreen and West Coast Semi Evergreen Forest which occurs in and around the places like Manbet, Walwan, Hasne, Nidankhan, Sawarde, Dubblewadi with the main species like Jamun, Mango, Anjani, Hirda, Surangi and Par Jambul. The shrubs like Bhoma, Shendri, Jangli Limbu, Pendri, Karvi. Southern Tropical moist mixed deciduous forest this occurs mainly at places like Taliye, Borbet, Shelep, Fejivade, Farale and Wakibelt. The species like Ain, Kinjal, Hirda, Bibla, Nana, Behada. The species like Jamun, Mango, Umbar, Assana, Kumaba, Kumkum etc. also found to a lesser extent. The underwood consists of Lantana, Rametha, Karvand, Murud Sheng, Wavding, Chikni etc. West Coast Tropical evergreen forest where Zulumb is a common species. Species like Kali, Shisvi, Kalvan, Jambha and Holigama Grahmil are common (Map 12).

**Table 6: Flora of Radhanagri Wildlife Sanctuary**

<b>Botanical Name</b>	<b>Vernacular Name</b>
<i>Memecylon umbellatum</i>	Anjan
<i>Syzygium cumunii</i>	Jambhul
<i>Randia dumetorum</i>	Gel
<i>Terminalia chebula</i>	Hirda
<i>Terminalia tomentosa</i>	Kinjhal
<i>Gnidia glunca</i>	Narkya
<i>Bambusa arundinacea</i>	Bamboo
<i>Carissa congesta</i>	Karvanda
<i>Carvia callosa</i>	Carvi
<i>Plaeocaulis ritchii</i>	Bahara
<i>Acacia concinna</i>	Shikekai
<i>Ixora brachiata</i>	Lokhandi
<i>Lagerstroemia parviflora</i>	Nana

Besides these, there are many other trees like *Manquifera indica* (Aamba), *Memecyclon edule* (Anjani), *Bauhinia recemosa* (Apta), *Phyllantus emblica* (Avala), *Aeque marmelos* (Bel), *Semecarpus anacardium* (Biba), *Zizyphus jujuba* (Bor), *Michelia champaea* (Chafa), *Machilus macrantha* (Gulab), *Terminalia belerica* (Behada), *Terminalia chebula* (Hirda), *Pongamia glabra* (Karanj), *Anacardium occidentale* (Kaju), *Feronia elaphantum* (Kavath), *Ficus tsiakela* (Kel), *Acacia catecha* (Kheir), *Terminalia paniculate* (Kinjal), *Lagerstroemia lanceolata* (Nana), *Azadirachta indica* (Neem), *Erythrina indica* (Pangara), *Olea dioica* (Jambhul), *Ficus religiosa* (Pimpal), *Sapindus emarginata* (Ritha), *Tectona grandis* (Sag), *Phoenix sylvestris* (Shindi), *Dalbergia latifolia* (Shissam), *Borassus flabellier* (Tad), *Ficus glomerata* (Umbar). Common shrubs are – *Adhatoda vasica* (Adulsa), *Hamidemsus indicus* (Anantmul), *Strobilanthes ciliatus* (Davana), *Aqave sisalana* (Ghaypat), *Loranthus longiflonis* (Bandgul), *Carissa carandas* (Karvand), *Strobilanthes callosus* (Karvi), *Glisqualis indica* (Chameli), *Mimosa pudica* (Lajalu), *Opuntia dillen* (Nagphani), *Vitex nequundo* (Nirgudi), *Vitex trifolia* (Nigdi), *Euphorbia noriifolia* (Nivdung), *Catsoopia gigantea* (Rui), *Euphorbia turuealli* (Sher), *Zizyphus ruqosa* (Toran), *Ocimum sanctum* (Tulus), *Embelia ribes* (Vavding), *Capparis zeylanica* (Wegati) etc. (Ref. govt. management plan)

### 3.7 EXISTING STATUS OF FAUNA:

India has rich heritage of species and genetic strains of flora and fauna. Overall 6% of world species are found in India. It is estimated that India is 10<sup>th</sup> among the plant rich countries of the world, 11<sup>th</sup> in terms of endemic species of higher vertebrates and 6<sup>th</sup> among the centers of diversity and origin of agro-diversity. The total number of living species identified in India so far is 1, 50,000. Out of the 18 biodiversity hotspots in the world, India has two, the 'Western Ghats' and the 'North Western Himalayas' (Samant, 2005)

The whole area is interrupted with human habitation and the state highway passes through the sanctuary and they are the main barriers for forest migration of wild animals. Animal in the present context refers to the faunal life of the protected area. Sanctuary has diverse wildlife, though no scientific wildlife survey of this region has been made so far, the records are prepared from the study of pugmarks droppings and actual sighting by the field staff and reports from local people. There is no uniform method for population estimation of different species. Considering the hilly terrain, scattered water holes, biotic interference on the periphery, it is not possible to follow a particular technique to estimate the number of wild animals within the sanctuary. Hence the pugmarks technique as well as water counting methods is followed simultaneously for the Tiger and Panther. The population estimation of other wild animals such as Gaur, Sambar, Barking deer, Wild boar, Mouse deer, Sloth bear etc. is done by using the water hole counting method and 20% block counting method in the month of May every year since 1994.

The sanctuary is home of variety of wild animals. Out of the 47 species of mammals recorded in this area, 7 species of mammals are endangered status, namely Tiger, Leopard, Sloth bear, Gaur, Mouse deer and Pangolin. There are as many as 264 species of avifauna recorded in the sanctuary. There are 59 species of reptiles, 2 of which are of endangered status, namely Indian Python and Indian Monitor Lizard. There are 66 species of Butterflies recorded from the protected area. Amphibians are generally found in rainy seasons in most of the area and some times in decaying ground vegetation in the forest. All together 20 species from second orders, 5 families and 10 genera are listed in the sanctuary. The status of species found in the the sanctuary is as follows:

**Common Mammals of Western Ghats are,** *Pteropus giganteus* (Indian Flying Fox), *Manis crossicaudata* (Indian Pangolin), *Vulpes bengalensis* (Common Fox), *Cuon alpinus* (Indian Wild Dog), *Melursus ursinus* (Sloth Bear), *Felis chaus* (Jungle Cat), *Panthera pardus*

(Panther), *Panthera tigris* (Tiger), *Sus scrofa* (Wild Boar), *Tragulus meminna* (Mouse Deer), *Muntiacus mutjak* (Barking Deer), *Cervus unicolor* (Sambar), *Bos gaurus* (Gaur), *Ratufa Indica* (Giant Squirrel), *Rattus rattus* (House Rat), *Mus musculus* (House Mouse) etc.

**Reptiles like**, *Crocodylus palustris* (Indian Crocodile), *Sitana ponticeriana* (Fan Throated Lizard), *Typhlina acutus* (Blind Snake), *Python molurus* (Python), *Naja naja* (Indian Cobra), *Vipera russelli* (Russell's Viper) etc.

**Amphibians like**, *Bufo melanostictus* (Common Indian Toad), *Bufo stomaticus* (Marbled Toad), *Rana tigerina* (Indian Bull Frog), *Polypedates maculatus* (Common Tree Frog) etc.

**Birds like**, *Accipiter nisus* (Sparrow Hawk), *Ictinaetus malayensis* (Black Eagle), *Gyps bengalensis* (Indian Whitebacked Vulture), *Circus cyaneus* (Hen Harrier), *Falco biarmicus* (Lagger Falcon), *Columba livia* (Blue Rock Pigeon), *Columba elphinstonii* (Niligiri Wood Pigeon), *Sterptopeila decaocto* (Indian Ring Dove), *Cuculus micropterus* (Indian Cuckoo), *Eudynamys scolopacea* (Koel), *Tyto alba* (Barn Owl), *Alcedo atthis* (Common Kingfisher), *Tockus griseus* (Malabar Grey Hornbill), *Dryocopus Javense* (Indian Great Black Woodpecker), *Dicrurus adsimilis* (King Crow), *Acridotheres tristis* (Common Myna), *Acridotheres fuscus* (Jungle Myna), *Corvus splendens* (House Crow), *Hypsipetes madagascariensis* (Black Bulbul), *Orthotomus sutorius* (Tailor Bird), *Copsychus malabaricus* (Shama) etc.

**Butterflies like**, *Argyannis hyperbius* (Indian Fritillary), *Danis plexippus* (Common Tiger), *Papilia demoleus* (Lemon Butterfly), *Udaspes folus* (Grass Demon), *Anaphaeis aurota* (Pioneer), *Cyntarucus plinius* (Zebra Blue) etc.

Bison is the flagship species of this sanctuary however many distinguished wild animals are found in this area. Tigers and panthers are seldom sighted in the area but gaur, sambar, wild boar, barking deer, mouse deer, are found through out the sanctuary in varying numbers. Sloth bear found in Geazekada, Nidan Khan, Kaladang, Waghache Pani of the dense forest and undulating surface where the caves and den are found. Barking deer take refuge in the hilly and woody area where its fodder will easily be available with assured shelter. On the rocky hillsides mouse deers are located where growth of grass is very vigorous. Giant squirrel has been sighted at Patyach Dang, Kala Dang and Surangee area. Radhanagari Wildlife Sanctuary also harbors some endangered fauna species such as Indian Pangolin, small Indian Civet, Jungle Cat, Wild Dogs etc. these wild animals are very rarely sighted in this area.

### 3.7.1 Tiger/ Panther:

India is the home of 60% of world's tiger population and therefore is the only place of hope for the survival. The Indian tiger is in a vulnerable state because of habitat reduction and poaching for Chinese Medicine. With only 2000-3000 tigers left in severely damaged habitats in India, there is a distinct threat that the wild tiger could collapse into the extinction zone in the near future and disappear forever.

In the Radhanagri Wildlife Sanctuary there is a rare occurrence of the Indian Tiger however leopards or panther has been seen or sighted by the forest staff or some villagers. Every now and then there is news that some unidentified animal has attacked the domestic animals like cow, goat, sheep, dog etc.

#### Range and Habitat:

The possible tiger or leopard habitat in the dense forests or Dangs. Tiger is sighted at Geazekada, Nanivale Surangi, Waghache pani, Shelap, and Bambarde. There is a list of tigers occurred in these area acquired by the regular population survey which was taken from the year 1998 to 2007 the graph shows the tiger population during these years. From 1998 to the year 2003 there is a same population which has some speculation and doubt only four tigers are spotted in these years. The population of Tiger is constant from 1998 to 2003. i.e. 4. In the year 2004 & 2005, the population of Tiger unfortunately decreased. In the year 2006, the Tiger is not found in the sanctuary area. (Graph No. 4, 5)

**Table 7: Population Estimation of Wild Animals**

Sr. No.	Year	Tiger	Panther	Bison	Sambar	Barking Deer	Sloth Deer
1	1998	4	7	400-610	95-130	110-150	20-30
2	1999	4	8	410-620	90-130	150-160	20-30
3	2000	4	8	500	115	165	25
4	2001	4	11	510	120	170	26
5	2002	4	1	530	135	180	40
6	2003	4	8	599-892	47-155	150-249	40
7	2004	3	22	395-610	78-195	187-298	15-102
8	2005	2	13	532-840	85-210	157-289	38
9	2006	0	11	413-639	219-392	295-516	38
10	2007	4	11	273	42	48	4

### **Gaur (Indian Bison):**

The Gaur or Indian Bison is a large endangered herbivore, and can be seen in protected sanctuaries in India. In the wild its young are preyed upon by tigers and leopards and the loss of its habitat due to human encroachment has led to the reduction in its population across India. The gaur is very famous in this area even the sanctuary is well known for this animal only.

### **Physical Characteristics:**

The Gaur or Indian Bison is a large animal. Male Gaurs are black in color, while female Gaurs are brown. Both the hide of male and female Gaurs is white below the knee of each leg, giving the gaur an appearance of wearing white stockings. Gaurs calves are light brown and do not have "stockings." Adult Gaur bulls can grow almost 2 m tall and weigh from 650 to 1000 Kg. Female Gaur are smaller in size. Older male Gaurs have a big dorsal ridge along the length of their backs and huge dewlaps.

### **Range and Habitat:**

The Gaur lives in grassy clearings and in evergreen and deciduous forest. The Gaur or Bison is the flagship species of this sanctuary. Gaur usually spends the night in a forest. the population of Bison is in range of 273 to 892 in the sanctuary area (Graph:6) In the year 1999, the population of Bison is 410-620. In the year 2007, the population of Bison is decreased to 273. (Image: 1)

### **Diet:**

Gaurs are herbivores. They feed mainly on grass. During times of drought Gaurs will eat leaves, creepers and plants. Some tree species browsed by gaur are terminalia alata, terminalia tomentosa, dalberkis latifora, calicarpa lanata, ficus species etc. , fruits consumed by gaur are vanquira spinosa, ficus comerata, cassia fistula, terminalia bellerica etc. Being ruminant animals they usually feed during the morning rest and ruminate in the afternoon, feed some more in the evening and return to the forest cover to rest at night.

### **Behavior:**

Gaurs usually live in herds of around 10 animals. However herds of more than ten be seen. Herds are led by an adult male bull. Bulls fight amongst themselves to establish dominance over a herd. Male bulls may also live in bachelor herds. Gaurs vocalize to warn the herd of danger and to communicate among themselves. Licking is another means of communication among Gaurs.

### **Indian Pangolin (Ud-Manger):**

The **Indian Pangolin** (*Manis crassicaudata*) is a pangolin that is found in many parts of India and some parts of Sri Lanka. Like other pangolins, it has large, overlapping scales on the body which act like armour. It can also curl itself into a ball as self defense against predators such as the tiger. It is an insectivore and feeds on ants and termites, digging them out of their mounds using its long claws that are as long as its forelimbs. It lives mainly in burrows and is known to climb trees. It is also considered to be a curious animal and has been killed for so-called medicinal value.

In the area of Radhanagri the Indian pangolin is rarely sighted by the forest staff and some tiome by the visitars mainly in deep forest of waghche pani and sarounding area. However from here and after the occurance of sambar, barking deer and sloth bear is recognized. From 1998 to 2007 the population of the samber is increasing considerably but in 2007 it came downen surprisingly (Graph: 7). After exploring the resion behind this, it is informed that because of migration their number has slacken downen, however it is dubious it is same in case of the barking deer and sloth bear(Graph:8,9). There is a wide scope to investigate the real numbers of these animals.

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## **CHAPTER – IV**

### **MANAGEMENT AND PLANNING**

#### **4.1 INTRODUCTION:**

All over the world today there is a growing concern for the protection of wildlife which is fast disappearing due to man's triumphant technological civilization resulting in large scale clearance of forests to provide land for crops and for settlement, industries and transport networks. There has been a progressive deterioration of our planetary environment, which now demands a most careful look at the way man uses his habitat and adopts conservation policies. These areas of wildness are the natural habitats of wild life and they need a careful management to maintain small communities of plants and animals, which establish their own ecosystem in them. Nature maintains the vast diversity of animals and plants in a complex organization in which the various life processes of production and consumption of food and the disposal of waste are maintained in well-balanced ecological cycles. If these cycles are disturbed then the effects are far reaching. (Robinson, 1982)

The management plan deals with the areas included in Radhanagri Wildlife Sanctuary. The total area included in this plan is 351.16 km. For the purpose of administrative and management convenience the total area is divided into two ranges, six rounds, seventeen beats. The sanctuary is situated at about 55 km. from Kolhapur. The main activities of tourism are at present concentrated at Dajipur. Camping facilities are available at Dajipur and Radhanagri. People living in this area are mostly labour and farmers practicing dry land farming and shifting cultivation.

The success of preservation and protection of wild life would predominantly depend upon the extent of the problems involved in the management of wildlife and the active support of the people. This can be best achieved by education, publicity and close co-operation between the public and management. With a view to preserve the fauna of India and preventing the extinction of any species of national importance and with a view to affecting protection in balance with natural and human environment, the Govt. of India during 1983 adopted a national wildlife action plan. This action, plan apart from other objectives, includes the establishment of network of scientifically managed protected areas such as national parks, sanctuaries and biosphere reserves, development of appropriate management system for protected areas with due regard to the needs of local people and ensuring their support and involvement, promotion of wildlife education and

interpretation aimed at wider public appreciation of the importance of wildlife to human betterment and development and to provide a scientific understanding of wildlife population and habitat.

#### **4.2 MANAGEMENT AND PLANNING:**

To conserve the vulnerable and delicate bio-diversity of the area scientific method of management and planning is needed with special attention on preservation and conservation of endangered floral and faunal species. There is a separate need to give special emphasis on conservation of wild habitat of the wild animals such as bison, panther, tiger, sambar, sloth bear etc.

'Management is a distinct process consisting planning, organising, activating and controlling performed to determine and accomplish the objectives by the use of human beings and other resources' (George R. Terry)

While 'planning is deciding in advance what is to be done. When a manager plans, he projects a course of action for the future, attempting to achieve a consistent, co-ordinated structure of operations aimed at the desired results' (Theo Haimann)

#### **Objectives or priority of management and planning:**

In the national forest policy (1988) the objectives of the national wildlife are to maintain the environment and conserving the natural heritage of the country. However unless a simple and clear objectives of the management and planning, development of the sanctuary can't prevail effectively. Therefore following objective may consider while management and planning.

- 1) Conservation and preservation of Biodiversity of the Radhanagari Wildlife Sanctuary.
- 2) Abating awareness, affection and attention about the biodiversity among the mass native people.

These objectives are to be implemented for the conservation and development of the area. However the likely problems while management and planning which could hamper the whole management and planning phenomena. The vast extension of the Radhanagari Wildlife Sanctuary and vicinity of the villages in and around the sanctuary area are the major problem which can hurdle the management and planning. However occurrence and potential of bauxite mineral is also one of the problems. The major problem is of funds available for the management and planning. In year 2001-2002 the budget was 134.495 lakhs which goes up to 780.595 lakhs in year 2004-05 but it astonishingly came down up to 132.80 lakhs in year 2007-08. The proposed budget for the next two year is

about 232.81 lakhs only which is very less. Therefore provision for the budget for the proposed management and planning should increase sufficiently. So the need can be met properly. The inadequate staff available in the field is also one of the problems phasing while management and planning. Therefore there should be sufficient recruitment of the staff for actual implementation of the management and planning process.

#### **4.3 MANAGEMENT AND PLANNING FOR CONSERVATION AND PRESERVATION OF BIODIVERSITY:**

Due to the exorbitant pressure from the human element as well as the natural elements the forests of the Radhanagri Wildlife Sanctuary is depleting day by day. Human interference by various ways such as illegal cutting of the vegetation, unplanned farming practices, shifting cultivation, grazing by domestic live stocks and other illicit practices such as killing of the animals for meat, skin, horn some time for so called medicine extracted from the blood of an animal, smuggling of endangered plants species for its medicinal utility such as *Nothopodytes nimmoniana* which is popularly called as 'Narkya', *Asparagus racemosus* 'Shatavari' and many alike is illicitly taken place in the study area.

In other hand nature it self is proving some time as a doom to the biodiversity of the area. Severe land erosion by the numerous streams, land erosion by extensive mass wasting process are helping to the destruction of plants, destruction of wild habitat etc. however in spite of the all adverse factors the biodiversity of the area is blooming because the unique characteristics of the terrain, wild animal habitat, remoteness, governments law and regulations etc. it is therefore bound to think in that way to conserve the biodiversity of the area.

As stated above while formulating the management and planning of the area from the view of conservation and protection of the biodiversity there are some problems which hurdle the process of development therefore one should have think to overcome these problems.

The extensive area of the Radhanagri Wildlife Sanctuary is itself a problem. From the management point of view at the outset there should have some segregation of the area in some zone or limits. Core zone or no mans land, protected zone, reserve zone, transition zone, tourism zone and public zone.

Core zone is strictly for the wildlife habitat and conglomerated plant species therefore in this zone no human should be permitted to enter besides the forest employee. In the protected zone the various treatments in the form of the project to develop the

wildlife. Reserve and transition zone will be kept for the free migration or sojourn of the wildlife. Tourism zone will be allotted for the tourism development and other social activities whereas the public zone includes human habitation and accommodation for the tourist. Each zone which is discussed above should be clearly separated from the other zone by the permanent boundary. These boundaries should be maintained strictly. At present it is a very arduous task to maintain the status of existing boundaries, because they are frequently altered and sometimes destroyed by the local peasants. At present there are three entry points where check posts are present. To control the whole area it requires more such check points because many times local villagers, stray persons, aggressive tourists, smugglers, and others who have ill intentions get entry into the sanctuary and cause some problem to the biodiversity. In this regard Shelap, Radhanagari, Digas, Rajapur and other places should be considered. (Image: 3)

There should be a master plan for the conservation, protection and development of the whole sanctuary in which there should be clear demarcation of the core area of the forests, reserve forests, agricultural areas, natural anicuts and springs to protect natural water resources for conservation of the habitat of the wildlife. There should be a clear notification of the ban on— unless it is used for conservation and protection— any infrastructural development in the whole area which is in the form of any building construction, road construction, or similar raising of any modern amenity which would disturb the natural environment. This planning should be implemented within the stipulated time. Many sites in the sanctuary are sensitive and important. Such sites are nothing but the natural heritage of the country.

Ecosystems and Habitat development is another major management aspect which includes checking the erosion of the terrain, grassland development, and control on the growth of Karvi and other weeds, natural water holes development, and plantation of fruit plants.

Water management and wetland conservation and development have inevitable importance in the management and planning. The Laxmi Lake and Rajarshi Shahu Sagar are two principal pond ecosystems located in the sanctuary. There should be control on the utilization of the water from these reservoirs because the entire area is dependent on the storage of the water of these reservoirs. There should be some perennial water sources in the form of water holes to feed the water to wildlife. The existing water holes should be maintained and cleaned every now and then. Number of anicuts should be increased to facilitate the wild animal.

In this sanctuary thick forests and plateau tops are locally called as Dangs and Sada respectively (Image: 4) which are the unique habitats of the endemic flora and fauna. Gaur and many other herbivore wild animals are use these areas as resting sites during early mornings and late evening. The Sada of Iderganj in the southern part of the sanctuary is important place from the point of view of wildlife existing in that area. This plateau separates the catchment areas of Rajarshi Shahu Sagar and Laxmi Talav. So that from the management and planning view this habitat development is an important task to conserve and protect the biodiversity of the area. Kala dang, patyacha dang are the major core zones of the area. As these areas have got a rich dense forest with fragile ecosystem. The protection and development of existing grasslands is also equally important to keep conserve the habitat of the herbivores. The unwanted growth of Karvi and any weeds is proving disturbance to the grass land ecosystem so that it required some management and planning to restore and development of the grass lands. Soil conservation works like Gali plugging, Nala bounding, Gabriel structure are very important in the view of soil conservation and management.

While keeping in view the management and planning have ample scope in the area of wildlife health and wildlife population estimation by census.

#### **4.4 MANAGEMENT AND PLANNING FOR ABATING AWARENESS, AFFECTION AND ATTENTION ABOUT THE BIODIVERSITY AMONG THE MASS NATIVE PEOPLE:**

It includes nature awareness camps and workshops, participation of local people and implementation of programme like eco-development, which will help to create co-operative and helping attitude towards protection and conservation of the biodiversity. Development of tourism zone, interpretation centre and development of scenic spots will help in this regards.

Human resource development, infrastructure development are the other aspects of management and planning. Human resource development includes proper training to the staff, some rewards, upgradation and increments for the employee who is exelent in his duty.

Infrastructure like wireless sets, motor vehicles, rain coats, gumboots, and other gears should provide to the staff. Study on different aspects of wild life with more emphasis on Bison and vegetation should be taken.

There should be special scope for the management and planning of the threats to the biodiversity such as jungle fire, cutting and poaching of the plants species, overgrazing,

man animal conflict, encroachment etc. Protection of the forest and poaching is at all not possible without the co-operation of local people. The staff will create awareness among the local people with the help of wildlife conservation message, posters, articles, and exhibitions etc. on the days like world forestry day, world environment day, Earth day and during wildlife week.

Development of ecotourism is also having importance in management and planning. Every year on an average of about 2,000 to 8,000 tourists visit the sanctuary area. If we see the graph focuses light on the number of Tourist visited at Radhanagari Wildlife Sanctuary during period from 1999 to 2008. In the year 2001-2002, there are 8640 tourists visited to Radhanagari Wildlife Sanctuary, which is highest in numbers. In the year 1999-2000, the number of visitors decreases i.e. only 2000 tourists visited the sanctuary. This shows shifting in test of tourists (Graph 3).

**Table 8: Number of Tourist Visited RWS**

<b>Sr. No.</b>	<b>Year</b>	<b>Tourists</b>
1	1998-1999	4834
2	1999-2000	2002
3	2000-2001	7557
4	2001-2002	8640
5	2002-2003	4045
6	2003-2004	4164
7	2004-2005	4057
8	2005-2006	4833
9	2006-2007	3339
10	2007-2008	5074

Tourist who knows nothing about the conservation should leave the place with good experience. Ecotourism should not only benefit but also local community. In this case the Botswana(Africa) model is high value low volume tourism which bring good revenue without putting too much pressure on fragile habitats, it is specialised wildlife tourism with the help of local people. Forest department should apportion the areas of wilderness into different blocks. Instead of concrete houses there should be ecofriendly cottages to

accommodate the tourists. There should be the licence holder guide become after several written and oral examinations pass before being certified as a guide. They expected to be able to identify all the birds and animals in the wilderness. There should have small fleet of all terrain vehicles specially outfitted for the wilderness maintained in excellent condition to keep noise and pollution to the minimum. When the sun sets and darkness descends it is as if you have been dragged millions of years back in the wilderness. Therefore at night sky watching camp are welcomed for the tourist attraction. Walking safaris should arrange for those who are interested these can be of different durations from a half days stroll to two or three days of rigorous walking with spending of nights in the wilderness. Trekking routes like entrance point of the Dajipur to Waghachevani which cover about 25 kms, Waghachevani to Sawraichasada about 10 km is good in this regards. Jeep safari will also do some interest among the visitors. Two huge water reservoirs are calling audacious tourists for the water games. Motor launch safari will also create some thrill among the tourists. As the gorgeous bounty of nature Radhanagari Sanctuary foster the scope for adventure and eco-tourism. The versatile geographical environment composing, undulating rugged surface, narrow passes, woody deep valleys, steep sloped plateaus, salubrious climate, rich bio-diversity the Radhanagari Sanctuary provoke the nature lover to experience the nature adventurously (Map: 11).

Every winter, flocks of migratory birds visit the region. To unfold the potential of adventure and eco-tourism of Radhanagari Sanctuary, visitors can join the jungle safari and have a stroll to see the Bison, Sambhar, Chital staying in a unique tree-tops or watch towards and riding a power or sail boat on the lake.

#### **4.5 LEGAL PROVISION FOR THE PROTECTION AND CONSERVATION OF BIOIVERSITY:**

Legal provisions available for protection of the area:

- 1) According to the Indian Forest Act – 1927 and Section 27(3) and 35 (8) of the Wildlife Protection Act – 1972. destroying or removing or any modification in the boundary marks of the forest is an offence.
- 2) According to the 33 (a) Wildlife Protection Act – 1972, grazing in the protected area of the forest is prohibited.
- 3) To control the threat of jungle fire there is a legal provision, according to the section 28(i), 26(i) C, I, F, G, 26(3) any kind of attempt to kindle fire is strictly prohibited.



- 4) Wildlife Protection Act. 1972, which strictly prohibit the killing and trading of the any part of any wild animal and birds.
- 5) Deforestation in any form is strictly prohibited by the Forest Conservation Act. 1980.
- 6) According to the forest strategy of India (1952), there is some stipulated percentage of the forest which is require minimum, it is sixty percent in mountainous area and twenty percent in other area of the country. In totality it should be 33.3% in country.

Beside legal control over the forest there are some government rules and resolutions which are of the conservation and protection of the forest. There is sound provision for the compensation of any damage made by the any wild animal to the farmer or any whome is affected by the wild animal.

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## **CHAPTER – V**

### **CONCLUSIONS AND RECOMENDATIONS**

In the present dissertation all concerns objectives are well recognized. The main objective of the present study is to recognize biodiversity of the area by identifying and demarcating the flora and fauna with their environmental set-up including physiography, soil, drainage pattern, climate, diversified species of plants and animals and its management and planning related to protection and conservation. Keeping in broad view of the biodiversity of the Radhanagri Wildlife Sanctuary, the following conclusions have been made.

#### **CONCLUSIONS:**

1. Radhanagri Sanctuary is well known among the 35 Sanctuaries in Maharashtra situated in the ranges of Western Ghat which has global and national significance in respect of vulnerable and delicate ecology. Sanctuary has a slight dumbbell shape with 23 km east-west and 31 km of north-south stretch. There are two ranges namely Radhanagri (WL) and Dajipur (WL) covering 18336.41 hectare and 9898.29 hectare respectively. Altogether it covers 28234.70 hectare which is 351.16 Sq. km. According to the area occupied by the forest it is 23147.50 hectare by Reserve Forest (RF), 4728.59 hectare area by Protected Forest (PF), whereas 358.61 hectare area is occupied by Unclassed Forest (UF).
2. The Radhanagri Wildlife Sanctuary is in the Western Ghats of Sahyadri mountain ranges. Geomorphologically the whole area is a rugged territory. Eastern part of the sanctuary is less rugged, however the area is undulating. The bare plateau tops are the main feature in this area. The main geological formation of the area is the Deccan trap. The rock mainly consists of basalt, which was formed due to volcanic activity. Bauxite is the main mineral ore found in the areas like Padli, Savardhan, Ramanawadi, Patpanhala, Dubblewadi, Savarde plateau.
3. Topographically Radhanagri Wildlife Sanctuary has many peaks, some of from 2400 to 3200 ft high. Savarai hill (3200 ft.) is the highest point in this area. If one can see the area as its altitude and percentage of occupied area the inferences come forward as 44% of the area is occupied by the hills which are having 2000 to 2500 ft altitude. The 40% of an area is occupied by the hills of 2500 to 2800 ft height, whereas the hills of 2800 to above 3000 ft occupy 16% of an area. Radhanagri Wildlife Sanctuary have 25 peaks such as Nanacha Dung, Ugavaidevi hill, Patpanhala, Kegadicha Sada are the

important hills. The rocky trap provides many interesting features which has influence on the land use, flora and fauna in the region.

4. From the study of satellite image IRS-1B LZA-1 BAND 234, the drainage network of the area is quite interesting. It is seen that the drainage network is structurally and litho logically controlled. Over all the fine network of dendretic type of drainage network has been seen, how ever at the north side of the area the radial pattern of drainage network primarily draining to words the south has particularly been seen. This is the highest point at 3232 feet. The majority of the tributaries are draining in to the back water of the Radhanagri and Kallammawadi dam which is constructed on Bhogavati River. The fluvial erosion is meajor geographical process which is shaping the area. The deep gorges, valleys, trenches are seen in the area.
5. Verifying the impact of water resources on flora and fauna the two major reservoirs with several minor and micro tanks and water holes have been cosider. These water bodies and their surrounding forests constitute prime habitat for the wildlife of this sanctuary. Water bodies scattered all over the sanctuary provide drinking water to wildlife. Bhogavati and Dudhganga rivers are the main sources of water. There is one percolation tank in the old Dajipur Sanctuary at 'Savarai Sada' which is effimeral besides; there are two Kolhapur Type bandharas in the old Bison Sanctuary, which provide water to wildlife throughout the year. In addition to this, there are some water holes on perennial nalas, which are maintaining by the forest staff. Wild animals frequently visit these water holes especially during the summer season. It is supposed that the wild animal can wonder the distance of 2.5 km to pecify the thirst. More than 80 percent water holes are in the circumfearance of this specification.
6. In case of plants it is obvious that at the places where water availability is more are having more growth of vegetation e.g. most of the vally floors are nothing but the water supplying channels of the rivers, and tributaries. These channels provide good and suitable habitat for the plant species. Dangs or dense forest patches are another such habitats where the growth of big trees, shrubs, climbers is flourished. The shrubs like Bhoma, Shendri, Jangli, Limbu, Pendri, Karvi are most common species. The places with less water availability particularly bare rocky lands, plateau tops and some hill slopes are deprived of vigorous growth of vegetation, only some seasonal shrubs and herbs with good growth of grass and weeds are seen.

7. Growth of flora and habitat of fauna has also revealed the impact of physiography. Topographically the region has undulating surface. The plateau tops are with vigorous growth of grasses and stunted vegetation like *Jansenella griffithiana*, *Pogostemon deccanensis*, *smithia*, *Uricularia*, *Eriocaulon*, *Burmania colestis*, *Cyprus compressus* are common especially in rainy season. It really a spectacular experience to see the flowering of such plants in mid rainy season. By virtue of deposition of weathered soil on flank slopes of the hills and plains the vigorous growth of species like *Kalvan*, *Jambha*, *Shisvi* seen on the slopes. Plain areas and valley floor are shown good growth of all kinds of trees forming mix woods with *Jamun*, *Mango*, *Anjani*, *Hirda*, *Surangi* and *Par Jambul*. *Zulumb* is a common species of plants at altitude under 700 m above mean sea level. *Haldiya* and *Pandhara boke* are dominated over 700 mts.
8. The Bison is the flagship species of this sanctuary along with the presence of Tiger, Panther, Sloth Bear, Giant Squirrel, Mouse Deer, and Barking Deer etc. Based on the data of population estimation and observation by the fieldwork, the pattern of distribution of various major animals in the protected area is arrived. Panther are found through out the protected area, Tiger is found in *Geezekada*, *Nanivale*, *Surangee* and *Waghche Pani*, *Shelapche Pathar*, *Bamaber* area only. Bison, Sambar, Barking Deer, Wildboar, Mouse Deer are found through out the protected area in varying degrees. Sloth Bear is found in *Geezekada*, *Nidankhan*, *Kaladang*, *Waghbamabar* area of rocky broken country where they can get shelter in the form of caves and dens. Bison and Sambar are essentially animals of hilly area. Barking Deer prefers hilly and wooded country where dens undergrowth is available. Mouse Deer prefers grass covered rocky hill site. Giant Squirrel is found in *Surangee* area, *Patachadang* and *Kaladang*. If we see the biodiversity gradient of the sanctuary, it is found that the core areas have more faunal habitat and it is less towards the flanks of the sanctuary.
9. Genetic diversity defines the difference in a species in its genetic formation. In this area of Radhanagri Wildlife Sanctuary, many plants are declared as genetically endangered. A famous NGO ATREE (Ashoka Trust Research in Ecology and Environment) from Bangalore is intensively engaged in reproduction of a *Hubbardia heptaneuron* an extinct grass by genetic variables and from the view of a reproductive Biology. Prof. Yadav S. R. dept. of Botany, Shivaji University, Kolhapur is

engaged with in situ and ex-situ conservation of such plants species. As far is concern with wild animals not yet genetically extinct but the Tigers are endangered.

10. Different types (species) of plants and animals occur in region incorporate species diversity. In the Radhanagri Wildlife Sanctuary some areas are richer in plant species than others. Popularly they are called as Dangs, meaning thick forest. These are also categorized as Hot spots of diversity. Wagache Pani, Patacha Dang, Laxmi Talav, Kokan Darshan point, Zanzuche Pani, Shivagad etc. At present conservation scientist and many scholars have identified and categorized about 15000 species of flowering plants. Many new species are being identified specially in the flowering plants and insects. It is worthy to note that a extinct grass *Hubbardia heptaneuron* and *Ceropegia fantastica* are being reproduced through the conventional methods and biotechnological tools (Tissue Culture) by Prof. Yadav S. R. and his enthusiastic team from Dept. of Botany, Shivaji University, Kolhapur. Faunal species are incorporating 47 species of mammals, 59 species of reptiles, 20 species of amphibians, 264 species of avifauna with 66 species of butterflies. Gaur or bison is major animal found in this area whereas panther or leopard, sloth bear, Indian pangolin, mouse deer, jungle cat are endangered animal species.
11. The fore going study of the Radhanagri Wildlife Sanctuary has unfold the some problems some are acute and will take some time to mend and some problems can be eradicated by little efforts. The problems like encroachment, Karvi plethora, soil degradation, wild life health, man wildlife conflict, undisciplined tourism are acute. While the problem of poaching, habitat loss, illegal cutting of trees, domestic livestock grazing, wild fires etc. can be reduced by strict vigilance and disciplined management.
12. Radhanagri Wildlife Sanctuary itself is amalgamation of many diverse ecosystems. By the landscape it comes into forest grassland and mountain ecosystem where as by aquatic ecosystem it incorporates rivers, lakes and ponds ecosystems. There are reserve forest known as Dangs enriching many plant and animal species. Sadas occupied by grassland with variety of grasses. Mountain tops and flank with variety of plants and animals habitat. e.g. Shivgad, Zanzuche Pani, Savarai Sada, Hadakyche Sari, Kokan Darshan Kada, Plateau of Shelap etc. Aquatic ecosystem like rivers, lakes and ponds are contributing into the bounty of nature in Radhanagri Wildlife Sanctuary. River ecosystem like Bhogavati and Doodhganga are major rivers who shaping the

landforms in the area with several tributaries and nalas. Many water tanks are forming individual pond ecosystem providing habitat for many distinguished plants and animals. However, Shahusagar and Laxmi Lake are major lakes ecosystem which help to symbiosis of varieties of plants and animals.

13. When we see the value of biodiversity forests are storehouses of valuable diversified ecosystems, which are vital at the local, regional and global levels. The production of Oxygen, depletion of Carbon dioxide, balancing the water cycle, protection of soil are some vital services conducted by the forest and jungles. It is therefore clear that biological diversity is essential for present ecological processes. There are many such values of biodiversity of Radhanagri Wildlife Sanctuary. At the instance consumptive use value by providing forest dwellers all their daily needs such as food, fodder, building material, medicines and variety of other product, making available some species of trees and fruits consumed by Bison or Gaur, Sambar, Barking Deer, Giant Squirrel, Mouse Deer and other herbivores. Productive use value such as production of marketable goods e.g. timber, high value fruits, leaves, medicinal plants like *Acacia concinna*, *Abutilon indicum*, *Asparagus racemosus*, *Var. javanica*, *Biophytum sensitivum*, *Bombyx micranthus*, *Cassia fistula*, *Dillenia indica*, *Embllica officinalis*, *Jasminum auriculatum*, *Jatropha curcas*, *Mangifera indica*, *Sesamum orientale*, *Tamarindus indica* are the common. It is worthy to note that there are various economically important plants which may categorized as cereal crops, pulses, fruits vegetables, leaf vegetables, root and tuber vegetables, fruits, etc. are uncommon agricultural value. Besides these social value, ethical and moral value, aesthetic value and option value which describe possibilities of future uses of natural resources.
14. The Radhanagri Wildlife Sanctuary though under control of mighty forest department, it is not free from the acute problems such as encroachment, poaching, habitat loss, illegal cutting of trees, domestic livestock grazing, wildfires, unwanted growth of grassland, wildlife health, man/wildlife conflict, undisciplined tourism etc.
15. Biodiversity can be conserved by In-situ and Ex-situ methods. In-situ conservation species are conserved at their own natural habitat. However, there are situations in which some species are about to extinct. In such cases, unless we don't try to conserved and reproduce. Such species in laboratory i.e. outside its natural habitat in scientifically controlled environments. e.g. Botanical garden, Zoological parks etc where an attempt is made to multiple reproduction of species. Offcourse the method

is expensive, sometime in Western countries such rare species of plants and animals are preserving by their germplasm in gene banks.

16. When we see the existing status of the flora According to the Champion and Seth's classification the major three types of forests are seen over this area such as Southern Tropical Semi Evergreen and West Coast Semi Evergreen Forest which occurs in and around the places like Manbet, Walwan, Hasne, Nidankhan, Sawarde, Dublewadi with the main species like Jamun, Mango, Anjani, Hirda, Surangi and Par Jambul. The shrubs like Bhoma, Shendri, Jangli Limbu, Pendri, Karvi. Southern Tropical moist mixed deciduous forest this occurs mainly at places like Taliye, Borbet, Shelep, Fejivade, Farale and Wakibelt. The species like Ain, Kinjal, Hirda, Bibla, Nana, Behada. The species like Jamun, Mango, Umbar, Assana, Kumaba, Kumkum etc. also found to a lesser extent. The underwood consists of Lantana, Rametha, Karvand, Murud Sheng, Wavding, Chikni etc. West Coast Tropical evergreen forest where Zulumb is a common species. Species like Kali, Shisvi, Kalvan, Jambha and Holigama Grahmil are common.
17. The sanctuary is home of variety of wild animals. Out of the 47 species of mammals recorded in this area, 7 species of mammals are endangered status, namely Tiger, Leopard, Sloth bear, Gaur, Mouse deer and Pangolin. There are as many as 264 species of avifauna recorded in the sanctuary. There are 59 species of reptiles, 2 of which are of endangered status, namely Indian Python and Indian Monitor Lizard. There are 66 species of Butterflies recorded from the protected area. Amphibians are generally found in rainy seasons in most of the area and some times in decaying ground vegetation in the forest. All together 20 species from second orders, 5 families and 10 genera are listed in the sanctuary.
18. Bison is the flagship species of this sanctuary however many distinguished wild animals are found in this area. Tigers and panthers are seldom sighted in the area but gaur, sambar, wild boar, barking deer, mouse deer, are found through out the sanctuary in varying numbers. Sloth bear found in Geazekada, Nidan khan, Kaladang, Waghache pani of the dense forest and undulating surface where the caves and den are found. Barking deer take refuge in the hilly and woody area where its fodder will easily available with assured shelter. On the rocky hillsides mouse deers are located where growth of grass is very vigorous. Giant squirrel has been sighted at Patyach dang, Kala dang and Surangee area. Radhanagri Wildlife Sanctuary also harbors some

endangered fauna species such as Indian Pangolin, small Indian Civet, Jungle Cat, Wild Dogs etc. these wild animals are very rarely sighted in this area.

#### **RECOMENDATIONS:**

While keeping in the view for the appropriate protection and conservation of the biodiversity of the Radhanagri Wildlife Sanctuary and for the minimal degradation of the elements of biodiversity the following recommendations are made.

#### **For the Conservation and Protection of the Flora:**

1. Conservation of the plant species should be practiced by in-situ and ex-situ conservation process. For the monitoring and more scientific survey of the all elements of biodiversity the help of non governmental organizationa, Private Institutions, and Universities should undertake.
2. Hill slope protection programme should be implemented by aforresting, plantation of some plants.
3. Ban on extraction of ground water, restriction on digging new wells, only bonafide farmers are permitted to use of chemical fertilizers and chemical pest controllers or pesticides.
4. Each and every employee should be instructed to keep records of Sighting of any wild animal, condition of the roads, any damage to the plants, trees, flowering stages of the plants, fruits, water level in the anicuts and water holes, grass growth , status of any unexpected event etc. by which there will be updated check list of flora and fauna.

#### **For the Conservation and Protection of the Fauna:**

1. For the fear free migration and sojourn of the wild animal there should be free continuous corridors within the forests of Chandgad, Kallamawadi, Inderganj, Radhanagri, Dajipur, and Gagangad to the Chandoli snctuary.
2. Breeding programme of the bison, sambar, deer etc. should be taken by the forest department. Habitat development programme should implement more intensively.
3. The number of watch tower should incresed. Presently there are only two watch towers, one is at Waghache pani and second is at Sawarsisada (laterite plateau). More over scaffoldings (Machan) should be knoughted on the high grown trees to watch the wildanimals. In this regard shelap, inderganj plateau, samberkond, umbrachepani are the ideal location where hideout of the wild animals occure.



4. There should be more legal restrictions on the licensed fire arms holders. Every bullet has to be accounted for and every shot must be reported and justified in great detail in writing. Recently the population of tigers and leopards is estimated by the pug mark estimation method which has some flaws and errors. The direct close monitoring system should apply.
5. The methods of population estimation of the wild animals should modify, more scientific and correct method should be adopted.
6. The tranquilising gun with sufficient doping cartridges should be provided to the wildlife management staff. This can be utilized in case of man animal conflict.
7. It is supposed that the wild animal can wander the distance of 2.5 km to quench the thirst. The distance between the most of the water holes is more than that this specification. Therefore it is required to create more water holes in the circumference of 2.5 km of location of each habitat.

**For the Management and Planning:**

1. The Radhanagari Wildlife Sanctuary should be declared as an ecologically sensitive zone by the central government. The Protected, reserve and transition zone open for the visitors and villagers only after issuing an entry pass or entry ticket.
2. Traffic through this ecologically sensitive zone should be controlled and a toll levied against the damaging ecosystem by air and noise pollution. The highway should be transferred to the forest department (Image: 2). There should be a restriction on seeking prior permission for any addition, alteration, repairs, renovation, demolition or any structural change in dwellings in villages which will disturb the sensitive zone.
3. Monitoring and patrolling squad should be equipped with good quality of all terrain vehicles, wireless sets, powerful binoculars, torches and fire arms.
4. The proposed budget of management for the next two years is about 232.81 lakhs only, which is very less. Therefore provision for the budget for the proposed management and planning should increase sufficiently so the need can be met properly.
5. Maintenance and protection of the forest boundary is a challenging task in front of forest employees it therefore should be maintained very strictly and kept under continuous vigil.
6. At present there are three entry points where check posts are present. To control the whole area it is required to have more such check points because many times local villagers, stray persons, aggressive tourists, smugglers, and other trespassers who have ill

objective are get entry in to the sanctuary and cause some problem to the biodiversity. In this regard Shelap, Radhanagri, Digas, Rajapur and other places should consider.

**For the Development of Ecotourism:**

1. Waterfalls, pools, anicuts, springs, gorges, groves, cave, ridges should declare as a natural heritage to abate their importance.
2. No plastic in the area, no person shall use plastic bags, pet bottles, tetra packs, or any artificial packging if found, should be fined heavily.
3. There should be staff recruitment which can be utilised for the proposed management of tourism and research monitoring.
4. Employment outsourcing particularly for vehicles hire, tourist accomodation, lunch houses, guides, photographers etc. should made availabe to minimise the pressure on core staff of the forest.
5. Revenue can be generated by production and marketing of the medicinal plants, ecotourism, providing services like guide, vehicles, tourism packges, trekking trails, photographers, launch ferry, some water games, selling artifacts etc.

# **Radhanagari Wildlife Sanctuary: A Geo-Environmental and Biodiversity Study**

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