

KARNATAKA FOREST DEPARTMENT

REVISED MANAGEMENT PLAN

FOR

KUDREMUKH NATIONAL PARK

(2003-13)



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FOREWORD

ACKNOWLEDGEMENTS

Management plans are central to anything related to formulations of policies and programmes. Kudremukh National Park is one of the most valuable and diverse forest wealth in India. It is one of the 24 bio-diversity hot spots in the world. It is one of the two identified in India. It gives me immense pleasure to revise the management plan of Kudremukh National Park.

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STATEMENT OF SIGNIFICANCE

Kudremukh National Park has magnificent landscapes of the least disturbed wet evergreen forests and shola-grassland biome. It is a sample of world's major habitats and eco-systems. It is a signpost of tropical biological richness. It is a living museum and a natural laboratory. It is the fountainhead of Tunga, Bhadra and Netravathi rivers, which serve the humanity in diverse ways. The unique evergreen eco-system performs many regulatory functions of the biosphere in terms of biogeochemical cycles. We know very little of the complexity and functioning of this eco-system.

Kudremukh National Park is a place to return man to the eve of nature and make him realize that he just one species among millions and that he should continue to be so for his own well being and survival in perpetuity.

PART – I

THE PROTECTED AREA : THE EXISTING SITUATION

CHAPTER – I

INTRODUCTION

1.1.1 - Name and location :

Kudremukh National Park is located at the tri-junction of Dakshina Kannada, Udupi and Chikmagalur districts. It falls approximately at the middle of mid-Western Ghats (the stretch between Goa and Nilgiris). It lies to the south - west of Karnataka state and is just 50 kms. from the west-coast between the $75^{\circ} 01'$ to $75^{\circ} 25'$ east longitude and $13^{\circ} 01'$ to $13^{\circ} 29'$ north latitude. The national park is a part of Sahyadri hill ranges and constitutes a geographic barrier between the coastal areas and the hinterland. For ages this has segregated people and gave protection to the coastal areas, its wealth, its culture and traditions from casual invasion by the strong ruling polity of the maidan areas.

The park derives its name from the highest hill peak known as the Kudremukh Peak having an altitude of 1892 meters from the sea level. It is the queen of many fascinating hill peaks in Karnataka. The name of the peak, meaning horse-face, is descriptive of its appearance seawards, whence it was a well-known mark for navigators of yore. Such an appearance is hardly evident from anywhere on the land surface. It is a popular peak and its name has become an acronym for whatever important landmarks that springs up around this place. So are the names Kudremukh town and the Kudremukh National Park born. This industrial-cum-mining township is now tucked into the national park. The township is entirely owned by the Kudremukh Iron Ore Company for housing its staff. Due to the preeminence of mining related activities, the region did not develop into a hill resort, which otherwise it is fully qualified to be. The national park is rosetted by a host of holy places such as Dharmasthala, Udupi and Sringeri, best known not only in Karnataka but the whole of South India. It is also studded by a host of places such as Kigga, Valikunja, Narasimhparvatha, Gangamoola etc, which have mythical leanings. The national park represents the lap of all the places. The tract is replete with fascinating natural beauty. It is clad with thick forests, delightful dales, shining streams and brooks, narrow valleys and glades and abundant iron ore deposits.

1.2.1 - Constitution and extent :

The park was initially notified in G.O.No.AHFF.42.FWG.87, dated : 2nd September 1987. Five reserved forests, viz., Naravi, Andar, South Bhadra, Tunga Bhadra and Narasimhparvatha were brought together to constitute the national park. All the five reserved forests themselves were constituted very early in the 20th century as under :

Table - 1 : List of reserved forests :

Sl. No.	Name of the district	Name of the reserved forest	Notification no. & date	Extent (in acres)	Remarks
1	Udupi	Andar Reserved Forest	G.O.No.26 Rev., dated : 14-03-1891	19445.22	U/S 16 of Madras Forest Act, 1891
2	Udupi & Dakshina Kannada	Naravi Reserved Forest	G.O.No.96 Rev., dated : 28-02-1900	58954.85	
3	Chikmagalur	South Bhadra State Forest	R.1777-80-FT-87-13-14, dated : 29-08-1914	20914.78	U/S 17 of Mysore Forest Regulation, 01-09-1914
4	Chikmagalur	Tunga Bhadra State Forest	G.O.No.R.296-9-FR.96-15-6, dated : 07-07-1916	49838.60	U/S 17 of Mysore Forest Regulation, 01-08-1916
5	Chikmagalur	Narasimhparvatha State Forest	R-8426-29-FR 94-15, dated : 01-03-1916	16745.00	U/S 17 of Mysore Forest Regulation, 01-05-1916
		Total		165898.45	

These forests were settled providing for a good number of revenue enclosures and honoring a variety of rights and privileges for the local people. A map of the national park showing different reserved forests and their distribution range-wise is furnished at **Plate – 1**.

Final declaration of the national park was issued in G.O.No. FEE.270.FWL.99, dated : 16th June 2001 wherein all rights and privileges except the right of way and

water came to be extinguished. Facsimile of the notification is furnished at **ANNEXURE - I**. Human settlements in revenue enclosures have also been kept outside the purview of the national park. Consequently, a hundred human enclaves pigeonhole the entire national park. More was added by deleting a portion of South Bhadra state forest over 35 Sq. Kms. in favour of the Kudremukh Iron Ore Company. Consequently at the time of final constitution, the extent of the national park was reduced to 563.29 sq kms from the original 600.32 sq. kms. Remote sensing images indicate that the park is wider than declared. Orthogonally (two dimensional scale) it measures 736.28 sq. kms. In addition to the reserved forest areas, there are a few well-wooded gomal and unassigned government lands, which naturally add up to the national park. Kudremukh town ship spread over 20 kms and Kerekatte spread over 21 kms are the largest enclosures within the national park. Area statement of the national park village survey number wise is furnished in **ANNEXURE – II**.

1.3.1 - Approach and access :

The national park can be approached from Chikmagalur or Hassan via Mudigere or from Mangalore/Udupi via Karkala. It is 110 kms from Chikmagalur; 130 kms from Hassan; 70 kms from Mangalore and 50 kms from Udupi. The nearest airport is at Bajpe near Mangalore. Udupi is the nearest railhead (45 kms). N.H.no.13 connecting Mangalore to Sholapur and S.H.no.66 connecting Kottigehara to Padubidre pass through the national park dividing it into three pieces. A large number of route buses from Mangalore to Kalasa, Mangalore to Sringeri, Mangalore to Shimoga via Sringeri, Udupi to Hornadu and vice-versa traverse the national park. Age-old footpaths crisscrossing the national park existed much before the modern civilization descended. Some of them were pilgrim routes, some haulage routes on the back of oxen, some were adventure routes to the lofty hill peaks and a great majority were routes connecting one settlement to the other. Except the haulage routes, rest of them remain even today and some are regularly used. Almost all tracks connecting the settlements got upgraded to motorable roads. Except very steep slopes, some road or other has reaching almost every area. Some of these roads have fallen into disuse for very long time and many have been badly eroded due to heavy rains. Flat surfaces are revegetated. Some are now revived as patrolling tracks.

CHAPTER – II

DESCRIPTION OF THE TRACT

2.1.1 - Boundaries :

Starting from the northern tip of Narasimhaparvatha, the boundary runs along the eastern side, traverses along the boundaries of Tunga Bhadra and South Bhadra State Forests and joins Naravi State Forest at Guntakalgudde. Then it moves eastwards up to Samse coffee estate and then takes a southward turn along the ridgeline. The boundary then moves upto Bandaje falls and takes an inverted U-turn around Didupe valley and runs along the Naravi State Forest on the southern and western side till it touches Andar State Forest. From here it moves in north - west direction and touches the Someshwara road (S.H.No.25) at Bachappu near the Durgaparameshwari temple. Then it retreats making a detour of Kabbinala village along the hill ridge until it goes and touches the tip of northern boundary at Narasimparvatha. With its present boundaries, the national park has the shape of a brooding rabbit facing east. Because of 'limb-like' extensions, the national park has a very long perimeter of about 420 kms.

The national park boundaries were maintained in bits and pieces. It has never been gone round fully in one go for maintenance purpose. The national park has a continuum of very similarly composed geo-morphological areas and therefore of similar forests beyond its present boundaries. Some of them have been constituted into extension-reserved forests on its west and south. Some are yet to be so constituted. Some parcels of forests have gone into the hands of private parties - religious, charitable or commercial (coffee/tea estates) institutions. In a number of places, the national park boundary is indistinct. Retracing the boundary often proved contentious because of malafide misplacement/displacement of cairns. A tentative boundary description in the original reserved forest notifications has complicated the issue. So, help of the Survey of India was solicited in re-delineating the boundary and the work is nearly complete. By now the reserved forest boundaries from the northern junction of Someshwara and Narasimhaparvatha State Forests has been traced up to Thanikodu, then to Horanadu and Samse. The boundary between Varanga Jain Math's estate and Andar reserved forest, which remained indistinct, was also surveyed. The boundary has been cleared along the entire length and RCC demarcation slabs of the national park have been planted. With this reserved forest boundary has been delineated and

permanently demarcated over 50%. The remaining areas have been maintained in the usual course and there is not much room left for any confusion on this account.

2.2.1 - Geology, rock and soil :

Ghat forests are principally of gneissic composition interspersed occasionally by quartzite, mica-schist and granite, outcrops of which occur in long stretches along the sharp edges of the ghats. Rock formation in the entire region belongs to the earliest period of the earth's history – the Achaean epoch. Older metamorphic rocks constitute mainly Dharwar schists, which occupy almost 80% of the area of national park. They are represented by banded ferruginous quartzites, which are highly folded and form a series of ridges. The individual layer varies in thickness. Kudremukh-Gangamoola is one of the three well-defined formations of this kind. This belt runs from Kudremukh to Gangamoola and northwards for a length of 96 kms with an average width of 3.2 kms. Extensive beds of magnetite-quartzite ranging in thickness from 120 to 200 meters are found in the area. The magnetite-quartzites, which are seen overlying amphibolites are black in color and friable to a depth of 30 meters. Beyond this depth, they are dark, compact, hard and massive. This belt comprises hornblende schists, amphibolites, chlorite schists, mica schists and thick beds of magnetite-quartzites. The hornblende schist and amphibolites form the oldest units. Major parts of hornblende schists are dark and fine-grained and very often grade into dark chlorite and biotite schists. The amphibolites are entirely composed of matted aggregates of actinolite and tremolite, and are often intimately mixed up with fine-grained dark hornblende schist. The chlorite schists are exposed prominently near Malleshwara, Sitabhume and Gangrikal ridges. The mica schists are usually found developed at the contact zones of the belt, with granite gneisses. The magnetite-quartzite forms a striking unit in the belt and is intricately folded. Quartzite is frequently found as separate nodules or small crystals. The foothill portions on the coastal side are characterized by soft laterite formed by the decomposition of original gneissic rock. The brownish friable loam found in the valleys often reaches to a considerable depth and is an indication of the suitability of the soil to support good deciduous or semi-evergreen forest. The underlying rock is invariably gneiss, sometimes outcropping in the form of boulders.

Soil conditions vary in quality, depth and consistency. On the ghats, soil is dark or brownish loam of moderate depth, admixed with gneissic or quartzite boulders.

Humus and un-decomposed vegetable molds are plentiful. The foothill portions contain fairly deep brownish friable clayey loam covered by a moderately thick layer of decomposed and partly decomposed vegetable matter, which is rich in organic constituents. Soil contains good amount of nitrogen and iron but is deficient in phosphorus, lime and magnesium. Valleys contain mineral and humus rich loam and support good agricultural crops. They also support rich evergreen vegetations at higher elevation and timber forests of tall and straight boles down below. In these areas, humus and un-decomposed vegetable matter is plentiful. It is a paradox that abundant and luxurious forest growth rests, nearly in every case on soil, which is slightly acidic and somewhat poor in nutrients. In the neighborhood of villages, forest soils are much impoverished by the heavy demand of farmers for leaves - both dry and green, as a source of manure. Removal of foliage and leaf humus together with frequent forest fires or excessive grazing and consequent rapid loss of all organic material seriously reduces the fertility and crop-bearing value of the soil in and around the habitations.

2.3.1 - Terrain :

The national park is largely a mountainous country. It consists, for the most part, of a huge amphitheatre, some 30 kms in length and 0.25 kms in width and is hemmed in by hills running in from all directions, but sending spurs tangentially. One of the longest spurs is the Chibbidri ridge which runs from Ballalarayanadurga to Dharmasthala and this represent the south - eastern part of the national park. This is connected to the national park by a very narrow but a critical kink near Elaneer. Here the national park is at its narrowest - of 3 to 4 kms width across the steep slopes criss-crossed by a number of traditional paths. Another spur from the Kudremukh Range is terminated by a towering rock on which once stood the fort of Jamalabad. A third spur originates from the Valikunja and ends up near Kabbinala village. Fourth starts from the same point and terminates at Narasimhaparvatha. These ghats hold aloft a raised tableland, which forms the watershed for the Tunga, Bhadra and Netravathi rivers. All the mountain ridges are more than 1000 meters mean sea level. Some of the well known hill peaks within the national park are :-

Table - 2 : List of hill peaks :

Sl. No.	Name of the peak	Altitude (in meters)	Sl. No.	Name of the peak	Altitude (in meters)
1	Kudremukh	1880	6	Narasimhaparvatha	1150
2	Kuranjal	1489	7	Manikyabetta	1041
3	Valikunja	1039	8	Ballalarayanadurga	1506
4	Gangrikal	1455	9	Gangamoola	1210
5	Kyathanamakki	1439	10	Jamalabad	510

Ballalarayanadurga abutting the national park on the southeast is a highly fortified hill in the Western Ghats region. Hoysalas recognized it and this place was known as one of their strong holds. These hill ranges rise almost abruptly from the coastal plains from an average elevation of 100 meter mean sea level. The upland is a congerly of mountains that loop around within the national park in different directions. One can clearly distinguish saucer shaped valleys studded with big and small hills from the top of any of these lofty peaks.

Terrain of the national park falls into two distinct categories. Southern and western parts are scarp-edged and thickly clothed with evergreen forests. Northern and eastern parts are a series of undulating hills and ridges, covered mostly by grasslands. A 3-D view of the national park is furnished at **Plate – 2**.

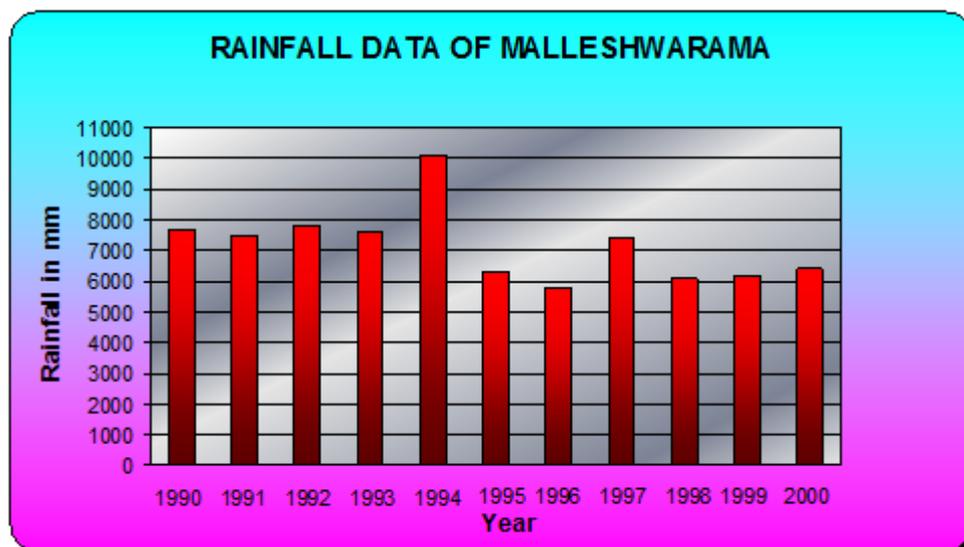
2.4.1 - Climate :

Climate in the national park, the whole of which is of hilly terrain, is very agreeable and cool for most part of the year. Slight distinction can be made of generally hot weather conditions on the sea facing slopes where cold is hardly felt. Otherwise the park faces cold season first during the height of south-west monsoon and later during December and January. It is followed by hot weather during February, March and April. Pre-monsoon “blossom showers” accompanied by lightning and thunder are received from the middle of April till the end of May. The southwest monsoon lasts from June to September. The mountain ranges present to their west a surface almost perpendicular to the horizon and by their height intercept the clouds of the southwest monsoon. Extraordinary moisture during monsoon is not only favorable to the growth of the peculiar products of west coast, but also covers the face of the country with most luxuriant forests. Onset of the southwest monsoon is the time to see

these mountains at their grandest. Rains set into motion innumerable number of gorgeous waterfalls that roar hither and disappear into the river. October and November are the post monsoon or retreating monsoon months with cloud cast skies. The park is always covered by haze during the brief interludes of rain in September. This is the best time for photography.

2.4.2 - Rainfall pattern and distribution :

Rainfall is very heavy and evenly distributed in the park area. Almost 90% of the rain is received from southwest monsoon. Northeast monsoon becomes very weak by the time it traverses the deccan plateau and it rarely drizzles in the national park. A slight gradation in the rainfall can be felt from the highest rainfall at the crest of 'giant wall' standing across the main direction of monsoon winds as one moves towards east. Monsoon winds from the Arabian sea, which come saturated with water vapour, cool on ascending the steep hill slopes and call forth during the rainy season almost incessant precipitation. Some part or the other of park is heavily cloud-cast during the whole of monsoon. July and August months receive highest precipitation. Rainfall details of the last ten years is furnished in the following bar chart :



On an average, there are about 125 rainy days in an year. There are records of as much as 45 cms of rain being received on a single day. Leaching of soil is

particularly prominent in the elevated parts of the hilly land. Therefore vegetation is often poor on high hills and ridges.

Towards the coast, heavy rains alternate with short dry spells for a number of times in a day. Rainfall increases gradually from the foothills to the ghat crest, which perhaps receives the highest rainfall and then as the clouds move fast, the amount of rainfall gets reduced slightly. Consequently, festoons of reindeer moss – *Usnea* and other bark algae and liverworts in the crowns and on the bodies of the giant trees are relatively more dense and conspicuous at the ghat head. Most of the rain gauges are located away from the ghat crest and therefore record slightly lower rainfall than actual. Monsoons are generally steady. Annual fluctuations are common but not very large compared to the quantum of rainfall received. Belated monsoons and long brakes in the monsoons are seldom recorded but complete failure of monsoon is unknown. The lowest annual rainfall never goes below 75% of the mean annual rainfall. Consequently drought is unknown to this region.

2.4.3 - Temperature :

There are very few stations where temperature is recorded within the national park area. Generally temperature is within agreeable and pleasant limits. Southwest monsoon season is the coolest part of the year especially during day while night temperature is the lowest in the cold season in December and January. Temperature rises rapidly from mid January but gets attenuated by the frequent pre-monsoon showers by mid April. The highest day temperature in summer hardly crosses 35⁰ C while the lowest winter temperature is around 10⁰ C. The mean daily temperatures hover around a minimum of 18⁰ C and a maximum of 30⁰ C for grater part of the year. Drop in the night temperature is very appreciable throughout the year.

2.4.4 - Humidity :

Air is humid at all times, especially under the evergreen cover. Humidity is rarely below 80% except on hilltops and ridges exposed to high velocity winds. During rainy season, water drips from the leaf surface of trees constantly and the humidity of atmosphere remains almost at the point of saturation. Atmospheric water vapour does not swerve far from the saturation point at any time of the day or night. Early morning

precipitation arising out of condensation of the excessive moisture on the leaf surface due to fall in temperature is quite heavy and some times results in continuous drip on the forest floor during November, December and January. Fall in night temperatures in the uplands results in wide spread formation of dense mist, especially in the valleys. Mist is common even at the height of summer and is greatly helpful in subsiding fire in the grasslands. Heggan valley and Bhagavathi valley experience cloud like mist almost daily.

2.4.5 - Wind :

Wind is an important factor that determines the distribution of vegetation within the national park. Wind is strong and mainly westerly or southwesterly from April to October. Wind blows with little abated vigour for about seven months in a year and its whipping effect reaches a velocity of about 100 kms per hour at the ghat head during monsoon. One has only to go into any open area overlooking the seaboard to appreciate the effect of wind. Though laden with rain bearing clouds and surcharged with water vapor and floating minute particles of water in free state, wind is inimical to the development and expansion of woody vegetation. Consequently it hugs the leeward side of the hills where the tree limit is placed considerably higher. It is not the elevation or aspect that sets a limit to the tree growth but the wind. Its effect is very pronounced. A large part of the high elevation valleys and hills have grasslands on the windward as well as leeward side, rendering the park fascinating in the entire Western Ghats of Karnataka. High velocity winds in association with strong western sun have a desiccating effect on the grasslands in summer and this takes the fire danger rating to one of the highest in the state. In the wind-protected localities, where wooded vegetation exists, crowns are stunted and bushy with diminished leaf size and the leaves are borne on short branchy boles.

2.5.1 - Water sources :

There are innumerable streams and nalas well distributed throughout the park. All of them finally drain into Tunga, Bhadra, Netravathi, Gurupura and Swarna rivers. During monsoons, all the rivers and streams become swollen and occasionally overflow the banks. A great volume of water is discharged at high speed. Consequently they have all rocky beds on the slopes inside the national park. Streams scour deep into

the beds forming steep, often nearly vertical walls standing up to a 100 feet height. Small leaps of water locally called 'abbi' are consequently common in the park and some of them are popular picnic spots. Well known among such abbis are the Suttanabbi, Belthikalabbi, Narasibyle, Bandaje, Kadamagundi, Bolle, Barengadi, etc.

Water resources, though relatively abundant, start dwindling from December. Most of the small streams and nalas go dry by March. . Even rivers are reduced to trickle. Springs are confined. This is the only time when animals would be found covering considerable distance for water. All the higher elevations, especially the grasslands go totally dry. By January/February, the demand for irrigation water in and around the national park is very high and whatever stream/river flows are found downstream at the edge of the national park are diverted through open drains or piped out on to the farmlands. The drinking water needs to the settlements inside the national park are met by gravitational water supply schemes. Effectively the discharge of water from the national park to its surroundings is reduced to the minimum because of the demand from the huge number of areca nut gardens in and around. If the pre-monsoon showers are not good enough, only the Tunga, Bhadra and Netravathi rivers will be in flow and all others practically dry up.

Measurements of stream and river discharges are not available. However, water resources are an important bye-product of the national park, which is strategically located in one of the highest rainfall regions of the state. Part of the net worth of the park can be easily realised in the long run from the water resources, which serve a great number of causes down stream within the state of Karnataka and also outside.

CHAPTER – III

PAST HISTORY OF MANAGEMENT AND PRESENT PRACTICES

3.1.1 - General history :

Western Ghats were known for their luxuriant vegetation and reputed timbers from very early history. Timber was exported from west coast of India in large quantities to Arabia and Persia for many centuries. Indents were made on these forests for supply of teak, satin wood, ebony, black wood etc., in addition to sandal wood and oil which were supplied regularly by the coastal traders. Ownership of forests, as a tradition, was claimed by the de-facto rulers of the time. From the available historical records, it does not appear that there was a separate establishment any time to look after forest management nor there was any system in operation in felling of trees until the British time. Free access to hack and burn forests at will for kumri cultivation appears to be a wide spread practice through out the ghats. A careful eye can definitely see the large number of such kumri sites on the west and south faces of the national park in higher elevations and protected valleys. Huge protective boulder walls distinguish the boundaries of each kumri area. Within these boundaries a very large number of terraced lands exist. Because of their location, soil from such sites was completely washed off and even today the floor is a heap boulders. However valleys are filled with rich soil up to the stream banks. Going by the account of such kumri sites throughout the ghats, it appears that a huge population did exist as primitive cultivators within the national park area distinct from those who inhabited the Konkan coast in historic times.

Ruling classes generally exercising power over selected species of trees by reserving them to the crown and prohibiting public from felling them. Different rulers exercised this prerogative in different ways. To a large extent, this prerogative was sold in auctions and leases to traders who were then given access to forests to cut and remove timber. They also sold blocks of forests for a certain sum down or rate per tree and the timber merchants were allowed to fell trees as they pleased. Some rulers attempted, through a specially established setup, to extract timber of reserve kinds, float them down the rivers, organize depots and conduct periodic sales. The best-known case of this type, pertaining to the tract dealt, is of Tippu Sultan. He reserved teak and sandal for himself. He put into force a number of restrictions and regulations and enforced them with an iron hand.

At the beginning of the 19th century, an immense, almost unbroken forest covered the Western Ghats from near the sea front to the most elevated ridges. The tract was thinly populated and was abounding in wild animals. All the hills were covered with timber. However, coastal plains and foothills were robbed of the best timber and vast greenery in these areas was in reality a sea of less valuable and rejected trees. Unregulated fellings were rampant. Until this time, it is stated that, there were no class contractors but only a multitude of greedy rogues operating with the aid of elephants. Notorious among them were the Maplahs and the Prabhus. Illicit felling and smuggling were rife during the early days of British raj. Within the 30 or 40 years of the 19th century, forests receded from the coast to within a few miles of Western Ghats. Control proved difficult due to the absence of clearly defined rights of private individuals. People asserted claims to private forest property if there is any chance of its being conceded by the government of the day. Forests were free for all, to cut and carry, to hack and burn to raise food crops or for pasture lands. This practice was at its peak at the time of arrival of British especially around the ghat regions and large areas were laid waste.

On takeover, the present national park portion of the ghats did not immediately attract the attention of the Britishers due to the non-existence of teak. However, demands began to be made on them for railway sleepers as well as timber for ship making gradually. First British operations were mainly confined to regions near the seaboard. They saw forests as an obstruction to agriculture and therefore a limiting factor to the prosperity of the country. The whole policy was to extend agriculture and therefore the watchword was to destroy the forests to make way. Additionally large areas were set apart for the rights and prerogatives of cultivators and to meet the bonafide requirements of graziers and villagers. As a general rule, farmers were permitted to fell and carry any wood required other than teak and sandal on payment of seignorage of rupee 1 per cart load. By the middle of 19th century, there was a great fall in the extent of forests, owing chiefly to improvidence. Therefore a rudimentary setup for the management of forests began to figure. Kumri cultivation received serious attention of the government but however was permitted in scantily populated and inaccessible areas. Timber prices at Mangalore were very high because of the traders from Bombay, Karachi and other places who were lining up for purchase. So a formal department for conservation began to appear around the middle of 19th century, both in

Madras presidency and Mysore state. Initially the forest department was preparing two lists of reserved trees. The first contained about 15 kinds declared to be the absolute property of state government and to fell which, wherever growing, either the farmer or the trader has to obtain a license on payment of a certain fixed rate. The second list contained more than 25 kinds of trees reserved from the trader but free to the farmer for his own use. All kinds of trees not named in the two lists were free to ryots but traders have to pay rupees 1 per cartload. Permit system continued in some form or other till 1900. Towards the end of this century, a formal forest policy and first forest acts were enunciated. As an outcome of this act, forest conservation began to take shape at the turn of 19th century. Records up to this stage are very poorly maintained and seldom available.

Forests belonging to the Chikmagalur portion had a slightly different history because of remoteness and lesser demands being made on them. Extensive forest tracts available to the east of national park areas met the timber requirements of the district. In this district, demand was mainly for lands to cultivate coffee, which was introduced in the year 1670. Coffee requires cool sheltered rich forest tracts, which receive March and April 'blossom' showers. Virgin forestlands were available in plenty in Mudigere and Koppa taluks and therefore much of the focus to utilize forestlands for coffee cultivation remained confined to these areas. Coffee cultivators had all the encouragement and free access to forests to develop estates, which they did utilize. Coffee estate owners enjoyed great privileges and therefore were the main cause for overrunning the forests. But it was soon found that not all lands are able to support coffee cultivation. A large number of estate owners abandoned the lands shortly after a few years of establishment. Abandoned coffee estates were metamorphosing into thorny wilderness in due course of time and it was reaching alarming proportions. Many coffee estates were no better than kumri because soil erosion and denudation was very rapid. So this practice later came to be prohibited. Grant of unoccupied land for coffee cultivation came to be regulated towards the end of the 19th century. Unorganized and destructive fellings for timber were comparatively less in Chikmagalur district part of the park. More species were reserved to the crown. Importance was attached to the protection of watersheds of Tunga and Bhadra rivers and forests of the tract were looked after with particular reverence.

3.2.1 - Management in 20th century :

During this century, forests came to be organized very systematically. Elaborate reporting by eminent officers about the wasteful destruction of forest wealth preceded this. Reservation of large areas of forest began. Working plans of sorts were prepared for very small and commercially attractive pockets of the reserved forests. Technological developments such as steam engine, the diesel locomotive and two great world wars had debilitating effect on the forests. Government monopolized the timber to the exclusion of local people who had sufficient resources in unorganized forest areas. Every act of the local public including removal of thatch grass, leaf mulch for agriculture, grazing, collection of minor forest produce etc., were closely scrutinized and several unsuccessful attempts were made to bring down the pressure on the forests.

There were detailed studies into the silvicultural aspects of prized timber species. Programs to convert 'less important' forests into high value forests by conversion were taken up in some pockets. Teak was the first to be tried. Later *Eucalyptus*, Cashew, *Ailanthus*, Bamboo etc., were added to the list. It met with a very limited degree of success on account of mismatch of sites and species. Extensive areas were clear felled for extending agriculture under 'Grow More Food' campaign following independence. Large areas were also clear felled purportedly for regeneration. Simultaneously selection fellings to feed the open market also continued. Timber extraction was dictated largely by economic and political considerations. Therefore working plans were not strictly adhered to. In spite of this, attempts were made to bring more and more forest areas under working plans and work them under selection, conversion and coppice systems. Very limited scientific data was available on productivity, rate of growth, silviculture of tropical forests etc., and therefore most prescriptions were arbitrary. Areas, which were inaccessible, were relegated to protection working circle. Demand for railway sleepers was the first major Industrial demand on forests. Initially only a few species were tapped for this purpose but the list got expanded to meet the large requirement. Patches of forests, which had a good stock of mature trees, were worked very intensively. Sleeper extraction was really callous. Nearly 60% of utilizable timber was laid waste at the site and some times the debris took heavy toll of forests in the summer fires. A separate establishment was created to supervise the sleeper works. Railway sleepers were the single largest demand on the forests of the tract till 1970.

En-route to the 'modern development', a number of new demands for telephone poles, electric poles, ply wood, match wood, pulp wood etc, also got added after independence. Forests were thrown open to private agencies but forest department did the marking. Many agencies were operating in the forests at the same time. The same areas were gone over again and again, each time with a different demand, until almost all the standing trees were exhausted. Royalties were unbelievably low – Rs.1 per cft of plywood timber and Rs.1 per ton of bamboo for pulp. The agencies were also given several other concessions such as opening of their own depots, formation of roads as required, extraction and utilization of damaged trees etc. Many coupes were allotted annually under schemes, which were prepared outside the working plans by several independent agencies. Supervision on the working of the private agencies was very inadequate. Companies and contractors abused concessions and several forest areas were thoughtlessly destroyed. They also helped many people to get forestland to plough by completely eliminating the vegetation on chosen sites. This has attracted many new settlers. As a sanitary measure, woody climbers, old growth forests and bamboos were removed in regeneration areas. Consequently the forests were robbed off their grand growth and high complexity.

Highlights of recent forest history of Kundapur and Koppa Forest Divisions, which contributed major part of the land to the national park, are furnished in the **Plate No.3 and 4.**

There were two bouts of mass flowering of big bamboo - once around 1920s and second time around 1960s and it could not re-establish to the original extent due to severe pressure – both biotic and fire. Reeds flowered in 1990.

Two great world wars of the last century did cast a spell on the forests of Western Ghats. Huge extraction was carried out to meet the wartime needs. But records are not available to say to what extent the track dealt with was affected by the wars. The bye-products of war such as the insecticides and pesticides had a terrible impact on the carnivores such as tiger later. Follidol and other pesticides reached interior areas and were liberally used for poisoning the animal carcasses. As a consequence the "King of the Jungles" nearly vanished from the scene. Otherwise tigers were known to roam freely in the wild, often reaching out to human habitations and lifting cattle from the byre. The second major consequence was the penetration of

outside population deep into the jungle due to the general economic recession and displacement of tribals who were in possession of rich fertile valleys.

Realizing the consequences of multiple agencies working recklessly on the evergreen forests, restrictions began to be clamped in the last two decades of the 20th century. Initially ceiling was imposed on the number of trees to be felled per hectare and gradually the leases were phased out. Departmental operations were also restrained and finally the areas were declared as a national park. Extraction of every kind was put to a halt since 2000 AD. Thus the tract went through a century of “organized” and chequered history to achieve what was just the initial objective of forest conservancy.

A number of working plans in Chikmagalur, Koppa and Kundapur divisions covered the tract dealt with. In essence, all of them were exploitation schemes. Emphasis was on marking and felling. There were very few prescriptions for regeneration of the forests and it was generally presumed to be automatic. Accounting for details of the extractions made under individual working plans is of no great relevance in the present context and therefore not gone into. The most significant output of all working plans and working schemes is that there are no prime forests left any where in the tract except the high elevation sholas which do not have any commercial species. Newfound enthusiasm with versatile exotics like *Acacia* snuffed out and dismembered the extensive grasslands thus putting the domestic cattle and wild ungulates in direct competition for whatever is left out. Wild animals are also susceptible to communicable diseases more than ever.

3.3.0 - Events of significance to the forest tract :

There are a few historical events, which have altered the course of the forest development of the tract especially in the last 300 years. These events have an overwhelming effect and are very important to the future development of the national park. The details are as under :

3.3.1 - Kumri cultivation and cattle ranching :

Wide spread kumri cultivation was prevalent until it was forcibly terminated by the rulers. A large part of the ghat section was repeatedly stripped of the natural vegetation. These sites are still to recover and remain very poor in terms of species

diversity. Even the form of trees is not as robust as the other areas. Only seasonal crops seem to have been raised on kumri sites. There is no evidence of orchards. The terraces are very narrow and uneven. There are no sign of any permanent settlements either. Rarely one does come across a dilapidated well or a dwelling unit. People seem to have shifted in and out of the forests, often depending upon the political and economic circumstances of the time but the tribals remained stay put. They also went on shifting from location to location and gradually got settled in valleys where they started cultivating wet paddy. They were the only inhabitants until the Second World War, which was followed by a great recession. At this point of time, a number of outsiders, unable to survive, reentered the forests, displaced the tribal populations and resorted to settled farming. Tribal lands were cornered and they were forced to shift further interior. Tribals looked for a perennial unused stream source and located themselves in the highest possible upper reaches. It is thus; we have today, a large number of small tribal settlements distributed in the upper catchments. Kumri sites situated on the hill summits and leeward sides were grabbed by the grasses and got converted as permanent grasslands.

Cattle ranching were a historic practice of great significance to the region. Owing to poor road communications in the ghat section, bullocks remained the chief mode of transport for a long time in history. There was a great demand for “heru yettu” and it became a profession to rare cattle in large numbers and sell the bulls annually for the traders. The park area was suitable as the trade was mainly between the coast and the hinterland and the ranchers were on the borders. But pastures were hardly available to support the large livestock. So extensive forests were set on fire repeatedly to reduce them to permanent grasslands. Several ranchers lived on the eastern side of the national park area. They were dependent solely on the proceeds of the cattle sale for lively hood. They regularly practiced burning of grasslands to generate new flush of grass for the cattle. A large part of the vegetation was thus destroyed and extensive grasslands were created. Cattle ranching were a flourishing trade for a long time. However, demand for bullocks fell with the opening of permanent roads. So they switched over to settled agriculture but continue to maintain the cattle herds for manure. Impact of ranching is very telling on the landscape of the national park.

3.3.2 - Fire in Bhagavathi valley :

Bhagavathi valley is dominated by Balige (*Poeciloneuron indicum*) in contrast to the general nature of evergreen forests where no single species will form more than 10% of the crop. This species is highly fire prone and is known to catch fire even in green standing condition. Its crown fire is comparable to the coniferous temperate forests and once in place fire goes on till the patch of forests is completely gutted. Hill meadows, which extend from these forests, are a potential fire hazard to the balige forests. There were three significant and extensive accidental fires once in 1962, then in 1967 and in 1973 when infernal fires broke out in Bhagavathi valley and devastated extensive areas. There were judicial enquiries and parliamentary questions on the subject. The entire Bhagavathi valley acquired notoriety and came to be called as Bhagavathi Burnt Valley (BBV). There were extensive damages to the standing as well as converted materials as under :

Table - 3 : Damages to the standing and converted materials :

Sl. No.	Particulars of loss	1967	1973
1	Area of fires spread	300 acres	500 acres
2	Balige poles burnt	6000	-
3	Balige sleepers lost	20965	-
4	Standing green trees charred to death	5860	-
5	Charcoal prepared in the subsequent years from the dead materials	-	1,24,000 bags

(Note: Details of 1962 fire are not available)

Fires were so devastating and widespread to solicit the help of adjoining forest divisions as well as fire brigade from Mangalore and Chikmagalur. Anecdotal accounts reveal that the sky was overcast with smoke and fog for weeks and that fly ash was reaching Karkala, Sringeri, Kalasa and even beyond. It completely killed all the life forms within the fire-affected area. No original growth was left even of trees. The charred remains were converted eventually into charcoal and supplied to Vishveshwaraiah Iron and Steel Company Limited, Bhadravathi. The cause of fire could not be traced in spite of judicial enquiry. Huge loss and permanent damage to the site totally altered the ecological conditions and a fresh succession cycle is now on.

These places are of great value as study sites but unfortunately no scientific investigations have been taken up.

3.3.3 - Development of new highways :

The uplands of the national park represent the southwest corner of Chikmagalur district and historically were the remotest. No communication facilities whatsoever were available to these areas. Forest department opened up coupe roads from Kalasa side as well as Sringeri side and kept extending them deeper and deeper into the jungles. But these roads were not interconnected nor were they connecting any major habitation. Therefore the ecological integrity of the area was fully protected. Around 1970s these coupe roads were transferred to the Public Works Department and eventually developed into state and national highways. They are now great cultural links between Udupi and Chikmagalur district.

3.3.4 - Mining in Kudremukh :

Kudremukh holds one of the worlds largest iron ore deposits which were identified in 1913 by Sampath Iyenger of the Department of Mines & Geology of erstwhile Mysore State. Ore is mainly of two types, namely, weathered ore and primary ore. Upper part of ore deposit constitutes the weather ore at an average depth of 80 meters below which is the primary ore, which is hard and compact. It was estimated that there is a deposit of 362 million tons of mineable weathered ore in Airoli range. 4605 ha. of forest land (3203 ha. of reserved forest and 1402 ha. of government wood land) was leased initially to NMDC in the year 1969 and a company called the Kudremukh Iron Ore Company Limited was established in the year 1970 as a 100% export oriented unit to exploit the iron ore. The company started mining from 1980 and first shipment of concentrate was dispatched in October 1981. Actual mineralized area is 500 ha. The mining company has an annual capacity of 22.5 million tons of crude ore, which on processing yields 7 million tons of concentrate and 3.5 million tons of pellets. As of today, more than 280 million tons of ore has all ready been extracted. The original lease of 30 years expired in the year 1999. Thereafter the company secured renewal for a period of five year – up to December, 2005.

Originally the project was conceived to exploit only the weathered ore but the company intends to extract even the primary ore, which was initially estimated to be 247 million tons. The iron content of the ore ranges from 34 to 38 % and by a process of beneficiation; it is raised to 70%. The waste tailings are dumped into Lakya reservoir. This reservoir initially had a storage capacity of 90 million M³ and after raising the dam height to 100 meters the capacity was upgraded to 245 million M³. It is almost full by now. The reservoir also provides plant process water requirement. Concentrated ore and pellets are exported to Japan, China, Indonesia, Turkey, Australia, and Iran to earn foreign exchange of 150 million U.S. dollars per year. The principal component of the ore is a magnetite (Fe₂O₃). In the process of establishing the unit, entire landscape of the area got modified with a huge township of about 1600 permanent houses, massive administrative offices, labour colonies, school, factory, lakya reservoir etc. The entire area is now known for mining and the mining company than for anything else. Mining operations were preceded by extensive forest clearance for roads, electric lines, town ship, reservoir and so on using a large fleet of vehicles and a herd of elephants. Meeting the dead line dates was considered more important than any thing else. Mining operations were planned and carried out without any regard to the ecology of the region. The environmental impact of mining has been studied after 20 years of pounding by reputed institutions like the National Environment Engineering Research Institute, Nagpur and the Indian Institute of Science, Bangalore. These reports though attended by critical shortcomings, have highlighted several adverse impacts of mining on the local ecology. Consequently extension of iron ore mining to Nellibeedu and Gangrikal hill ranges was ruled out. Some ameliorative measures have also been initiated.

3.3.5 - Corporate plantations :

Extensive grasslands of the park were assumed to be wasteland and several agencies tried to 'utilize' them by rising commercial plantations. In addition to the forest department, the Kudremukh Iron Ore Company Limited, Cashew Development Corporation and the Mysore Paper Mills Limited, Shimoga carried out extensive plantations of *Eucalyptus*, *Acacia* and *Casuarina*. List of plantations raised by different agencies and forest department is furnished at **ANNEXURE – III**. List of plantation raised as per Remote Sensing Data report is furnished in **ANNEXURE – III (a)**. A map showing the plantations situated within national park area is furnished at **Plate – 5**.

Accessible roadside areas were the first targets. The Mysore Paper Mills, however, gyrated into the interiors by making fresh roads. Corporate plantations were raised by ripping with bulldozers on slopes of every description without regard to the rainfall, soil erosion or the requirements of mega fauna. There was very limited experience with this kind of plantations in such zones. It was later discovered that *Eucalyptus* is highly susceptible to pink disease. *Acacia* did not put on the expected growth rates mainly because of poor soil, low temperatures and razing fires. As a consequence nearly half of the plantations are lost and the remaining are stagnating except in sheltered localities. As per remote sensing data, a total of 3195 ha. of acacia plantations exist within the national park. Details are furnished in the section wise area breakup figures at Annexure –III (a). Performance of *casuarinas* was modest but the survival rates are somewhat poor. It is most vulnerable to fire. Plantation trees get easily uprooted during monsoons and do not lend themselves habitable to the wildlife. Nor the wood degrades easily enough. Luckily all the exotics are non-invasive.

3.3.6 - Industrial demands on the tract for forest products :

Role played by different timber agencies has already highlighted in para 3.2.0. Mentioned should be, here, made of industries such as the Vishveshwaraiah Iron and Steel Company, Bhadravathi which needed huge quantity of charcoal every year and the same was partly supplied by the plan tract in Chikmagalur district. There was also one industry, which was working exclusively on *Lophopetalum wightianum* alone. Large quantities of reeds were also extracted occasionally to feed the paper mills. The net effect of industrial working was an internal weakening of the stature of the forest and rendering habitat – specialist fauna homeless.

3.4.1 - Review of the working of previous management plan :

Sri Ambadi Madhav prepared the first Management Plan for Kudremukh National Park for the period 1996-2001. Being the first and having to consolidate areas drawn from different backgrounds, the plan was heavily oriented towards basic works like boundary demarcation, creation of water resources, habitat improvements, creation of infrastructure etc. The plan programs were funded through different sources and a modest part of the prescribed programme has been achieved. At this point of time, all the officers have been provided with necessary buildings, vehicles, wireless sets, arms and ammunition. Boundary demarcation in the disputed portions is being carried out

with the assistance of Survey of India. Planting and extraction programmes have been terminated totally. A nature camp is established at Bhagavathi. More than a dozen antipoaching camps have begun to function. About 258 kms of patrol track and about 107 kms of trekking path are developed. Overall, the plan went through a good measure of success. It has addressed the basic requirements of national park and set the stage for consolidation.

Then Sri K.N.Murthy prepared a management plan, which was very modest and it addressed basic requirement of the national park. Now as a lot of stress is on eco-tourism, role of communities in conservation it has been revised and the present plan has been written as a revised management plan.

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CHAPTER – IV

FLORA, FAUNA, ECOLOGY AND HUMAN SCAPE

Tropical forests are celebrated for their diversity. They constitute less than 10% earth's land surface but contain 90% of all plant and animal species. Millions of years of evolutionary pressures shaped these ecosystems into the most complex in the world. There is an intricate web of life, which is the essence of forests themselves. Very few habitations on earth contain such a profusion or weight of plant life per hectare. Hidden by the vegetation from all but a trained eye are a multitude of plants and animals, rare, strange and beautiful.

Biogeographically, Kudremukh National Park is a representative of the mid-Western Ghats stretching from Goa to Nilgiris. It also represents a range of altitudes from 135 meters mean sea level to uplands 1900 meters mean sea level and accordingly has a wide range of vegetation and attendant fauna. The word 'ghat' has a special significance. As one moves up the ghat, the vegetation exhibits a bewildering and exhilarating variety. The thick evergreen woody vegetation that covers the foothills and the western slopes like a sponge is impeded and confined to rich valleys immediately above the ghat head. Further east, it is just a gallery in a sea of grassland (typical of Tholali, Sitabhumi, Kyatanamakki etc.). The north-south variation in vegetation is negligible in terms of diversity while that of east - west is highly significant. There are many interesting intermediate formations; most noted being the balige facies of Bhagavati valley (Facies = Structural and floristic modifications of a type induced by certain special conditions : crest, steep slope, talweg, exposure, depth and humidity of the soil, etc). The French Institute, Pondichery studied the vegetation type of the national park in Naravi State Forest as well as South Bhadra State Forest and a book titled "Wet evergreen forests of the western ghats of India – Ecology, structure, floristic composition and succession" was brought out in 1988. Several others have studied flora in general, the grasslands, the orchids etc. A number of conservation biologists have just begun their studies.

4.1.0 - Forest types :

For an untrained eye, the forests are of evergreen type throughout the national park. On a close scrutiny, the forests reveal themselves and one can easily distinguish

several forest types. A false colour composite and a vegetation classification map is furnished in **Plate – 6 & 7**. As per the supervised classification, various types of forests and their extent are as under :

Table - 4 : Types of forests :

Sl. No.	Forest type	Total (in Sq.Kms.)
1	Evergreen (Poeciloneuron indicum – Hopea Canadensis – Elaeocarpus tuberculatus series)	48.32
2	Evergreen (Poeciloneuron indicum – Palaquium ellipticum – Myristica sp. Series)	58.57
3	Secondary evergreen	110.27
4	Semi evergreen	121.10
5	Moist deciduous	55.92
6	Shola	36.81
7	Grasslands	187.78
8	Sparse grass / rocky	23.01
9	Scrub	22.19
10	Forest plantation	5.85
11	Areca plantation	0.03
12	Coffee plantation	0.18
13	Tea plantation	0.00
14	Agriculture / fallow	8.37
15	Mine / mine dump	0.28
16	Water	2.61
17	Unclassified	0.37
	Total	681.66

Each of the forest types is briefly described hereunder :

4.1.1 - Southern hill top tropical evergreen forests (1A/C₃) [Sholas] :

Locally this type of forest is known as Shola. This is a more or less inferior edition of the typical wet evergreen forest, diminutive in physical stature but species rich. Exposure to heavy wind round the year and generally less favorable condition of

soil and climate favour this type of forests. It is found at an elevation of about 1000 meters and above in mountainous country. Rainfall is usually high; 5000 to 6000 mm per year. Humidity is quite high almost round the year. Canopy forms a richly varied mosaic in which every shade of green and red colour of the new flush is represented in summers. Growing and flowering seasons correspond to the drier part of the year. Growth varies sharply according to elevation and aspect but the wind and soil substratum generally set the limits to growth. Tree line altitude is variable with aspect and exposure. It stands 100 to 200 ft. higher on northern and eastern aspects than on the windswept, sunny, western or southern side. A garland of impenetrable thickets of *Nilagirianthus callosus* (syn. *Strobilanthus callosus*) surround the sholas and provide a “wall effect” at the interface with grasslands. Advancing fire may scorch the fringe of this type of forests thus checking its spread in spite of abundant seeding annually. Some of these sholas give birth to perennial streams. The species found here are *Lagerstroemia lanceolata*, *Sterculia foetida*, rosewood, *Spondias mangifera*, *Mangifera indica*, *Calophyllum elatum*, *Holigarna grahmii*, *Eugenia* sp., *Cedrela toona*, *Canarium strictum*, *Persea macrantha*, *Elaeocarpus tuberculatus*, *Bischofia javanica*, *Myristica malabarica*, *Alstonia scholaris*, *Litsea*, *Cinnamomum iners*, *Garcinia cambogia*, *Oroxylum indicum*, *Symplocos racemosa*, *Glochidion* spp., *Memecylon edule*, *Macaranga peltata*, *Garcinia* sp., *Leea indica*, *Leea asiatica*, *Callicarpa lanata*, *Psychotria dalzelli*, *Terminalia bellirica*, *Pterocarpus marsupium* etc. The tree fern *Cyathea gigantia* is also found along the stream courses and cut edges. Herbaceous plants are scanty in the denser portions of forest where practically no light reaches the soil. Where some light reaches the floor there appears a multitude of herbaceous plants, among which are the wild plantain, wild turmeric, wild ginger, cardamom, *Alpinia galanga*, *Clerodendron infortunatum*, *Peperomias*, *Amorphophallus*, *Commelina*, *Aneilema*, *Cyanotis*, many *Gramineae* and a number of ferns. The shrubs *Osbeckia chinensis* and *Melastoma malabathricum* are also frequently seen with their pretty reddish flowers at such spots. Canes also occur very commonly especially along the water courses.

4.1.2 - Tropical wet evergreen forests (1A/C₄) :

These are lofty dense evergreen forests, 40 meters or even more in height, characterized by large number of species, which occur together. Except Balige and *Hopea ponga*, consociations (*gregarious dominants*) are rarely met with. No single

species contributes more than 10 to 15% to the entire population in the locality. Top storey trees have clear boles of 20 meters and above. Tree bark is thin and colored in various patterns and hues. Distinction into different canopy layers is difficult to see. Epiphytes are numerous, especially aroids, ferns, mosses and some times orchids. Climbers vary greatly from place to place. Ground vegetation is generally absent except on the fringes and in the openings. Rarely one may find canes. Lumpy roots writhing across the soil surface, dusting of fallen leaves and shining shafts of sunlight characterize these forests. Plank buttressing of trees especially the dominants is pronounced. Leaves are thick and glossy. This type of forests occurs from about 300 to 1000 meters mean seal level, extending further up the valleys to 1200 meters mean seal level or more. The common tree species found here are :

Poeciloneuron indicum, *Mesua ferrea*, *Dipterocarpus indicus*, *Hopea parviflora*, *H. ponga*, *Palaquium ellipticum*, *Aglaia barberi*, *Schleichera oleosa*, *Canarium strictum*, *Hopea wightiana*, *Dysoxylum malabaricum*, *Bischofia javanica*, *Dimocarpus longan*, *Calophyllum elatum*, *Persea macrantha*, *Gordonia obtusa*, *Lophopetalum wightianum*, *Garcinia indica*, *G.morella*, *G.xanthochymus*, *G. gummigutta*, *Myristica malabarica*, *Litsea* sp, *Diospyros* sp, *Holigarna* sp, *Mesua ferrea*, *Eugenia*, *Ficus*, *Elaeocarpus*, *Euonymus*, *Knema attenuata*, *Mangifera indica*, etc.

Among the palms are *Pinanaga dicksonii* (Rama adike), *Caryota urens* and *Arenga wightii*. No less than six species of cane - *Calamus thwaitesii* (Handibetha), *C. lakshmanae* (Haalubetha), *C. karnatakensis*, *C. nagbettai* (Naagabetha), *C. prasinus* (Vontibetha), *C. stoloniferus* (Jedubetha) sp. occur and occasionally form cane brakes along water courses. Canes, along with the screw pines of which there are two species – *Pandanus furcatus* and *Pandanus canaranus*, often choke up the beds of streams and make human passage across them nearly impossible.

Two sub sets of evergreens are discernable – one on the western aspect and the other on the eastern aspect. The principle difference in these two being the presence of *Myristicas*, *Eugenia gardineri* and *Palaquium ellipticum* on the western aspect and *Hopea canarensis* and *Elaeocarpus tuberculatus* on the eastern aspect; *Poeciloneuron indicum* being a common factor and dominating the whole consociation in the higher elevations.

An inferior version generally known as secondary evergreen is occasionally found where the original growth has been heavily interfered but the conditions still favour the evergreen species. Here the species mix is less intimate. Dominance by one or two species is very common. There is a profusion of pole crop. Climbers and lianas are rare. Soil conditions are poor. The sub soil surface is generally exposed. There is very little leaf mold. There are no marshes left.

4.1.3 - West coast semi-evergreen forests (2A/C2) :

This forest type is found in lower altitudes (below 300 meters MSL) and at the foothills. It also occurs, as a degradation form, after the evergreen forests are heavily logged or disturbed. It includes a mixture of evergreen and deciduous trees. The number of species is much less compared to the evergreen type. Prominent trees belong to the genera *Sterculia*, *Holigarna*, *Eugenia*, *Diospyros*, *Garcinia* and *Chrysophyllum*. In the lower portions of this zone *Lagerstroemia*, *Grewia*, *Terminalias*, *Pterocarpus*, *Bombax*, *Diospyros*, *Holigarna arnottiana*, *Lophopetalum wightianum*, *Cinnamomum*, *Hopea parviflora*, *Artocarpus hirsutus* etc; appear. Bark tends to be thick and rough. Climbers are often found heavy. Bamboos are usually present. Undergrowth consists chiefly of *Nilagirianthus* (Syn. *Strobilanthes*) and *Holorhina*. Forest floor is bouldary and seldom contains thick leaf mold or the rich surface soil that is otherwise characteristic of high forest. Trees of good form have all been extracted and only crooked and gnarled stems are left. Rank weeds and a tangle of climbers occupy moist localities where fellings were excessive in the past. The species mixture is very intimate and *Terminalias* are found to dominate the crown especially around habitations and high disturbance zones. *Chromolaena adorata* (Syn. *Eupatorium odoratum*) invades regularly burnt sites.

4.1.4 - South Indian Moist Deciduous Forests (3B/C₂) :

This type is found mostly on the low elevation forests with sheet rock in the substratum. Here the dominant species are deciduous. A relatively small number of species together form greater part of the canopy. Big bamboo (*Bambusa bamboos*) is characteristic of this type of forests. Canes are rare. Climbers are abundant and large in size. Undergrowth is sparse and influenced frequently by fire. Canopy is irregular. Past fellings relegated patches to scrub. Trees remain leafless for a brief period of 3-4

months especially in summers. An appreciable number of deciduous trees come into new leaf and bloom before the monsoons. There are no fine big trees. Species found generally in this type of forest are *Terminalia paniculata*, *Lagerstroemia lanceolata*, *Terminalia tomentosa*, *Dillenia pentagyna*, *Schleichera oleosa*, *Xylia xylocarpa*, *Careya arborea*, etc. It is mainly distributed around Didupe valley in Belthangadi Wildlife Range and around Mutlapadi in Karkala Wildlife range. *Chromolaena odoratum* invades regularly burnt sites.

4.1.5 - South Indian subtropical hill savanna (8A (C 1/DS 1) :

This type is very predominant in the uplands especially in the Chikmagalur district part. The altitude varies from 800 meters to 1900 meters mean sea level. These savanna forests are dominated by tall coarse grasses, normally 30 to 50 cms in height but may go as high as 1 – 1.5 meters occasionally. These grasslands, which are also called as ‘shrub-savannas’ are characterized by a number of herbaceous and shrubby species mixed with grasses. Among shrubby elements *Berberis tinctoria*, *Gaultheria fragrantissima*, *Hypericum mysorense*, *Lobelia nicotianaefolia*, *Oldenlandia stylosa*, *Osbeckia wightianum*, *Pteridium aquilinum*, *Rubus fairholmianus*, *Phlebophyllum kunthianus* etc., are particularly frequent. Common herbaceous elements include *Anaphalis* sp., *Campanula fulgens*, *Cassia* sp., *Crotolaria notonii*, *Cyanotis* sp., *Impatiens* sp., *Indigofera pedicellata*, *Justisia simplex*, *Knoxia mollis*, *Leucas suffruticosa*, *Lilium neilgherrense*, *Oldenlandia articularis*, *Polygala sibirica*, *Striga asiatica*, *Viola patrinii*, *Wahlenbergia gracilis*, etc. In the swampy pockets *Commelina* sp., *Centella asiatica*, *Drosera peltata*, *Fimbristylis uliginosa* etc. are common.

Among grasses *Andropogon fouldsii*, *Anthristiria ciliata*, *Arundinella* sp., *Arundinaria villosa*, *Bothriochloa pertusa*, *Chrysopogon orientalis*, *Cymbopogon* sp., *Eragrostis nigra*, *Eulalia* sp., *Heteropogon contortus*, *Isachne* sp., *Themeda* sp., *Tripogon bromoides* and *Zenkeria elegans* are common. Scattered trees of fire hardy species such as *Randia dumetorum*, *Phoenix humilis*, *Buchanania latifolia*, *Zizyphus xylopyrus*, *Zizyphus rugosa*, *Ixora* sp., *Mallotus philippinensis*, *Plectronia didyma* (*Canthium didymium*), etc., are found here. *Phoenix humilis* is particularly characteristic of grasslands, which are run-over by fire almost every year. *Angiopteris evecta* (fern) appears in large number and make a fine show especially along road

cuttings, steep banks and occasional landslips. They colonise relatively better sites with in the grasslands. Mass death during heavy rains and profuse growth in the post monsoon under stress is a pronounced feature of this fern. A host of liverworts and mosses appear during rains along the open and cut surfaces, stream banks, rock faces, etc., and weather away with the receding rains.

While these are the major forest types of the national park, a few other minor types such as Lateritic semi-evergreen forests (2/E4), Cane brakes (1/E1), Wet bamboo brakes (1/E2), Ochlandra reed brakes (8A/C1/E1) etc., appear in small pockets all over the park. In addition, Myristica swamps characterised by mushrooming knee roots also can be seen occasionally in the ghat crest region or on mud flats in the mid ghats.

J.P. Pascal classifies the vegetation in accordance with the plant consociation (= association). According to him the park vegetation falls principally into four types, namely;

- a) *Dipterocarpus indicus* – *Kingiodendron pinnatum* – *Humboldtia brunonis* type which are found in the lower elevation of Naravi Reserved Forests
- b) *Dipterocarpus indicus* – *Humboldtia brunonis* – *Poeciloneuron indicum* type, *Poeciloneuron facies* type which are found in the lower elevation of Naravi Reserved Forests
- c) *Dipterocarpus indicus* – *Diospyros candolleana* – *Diospyros oocarpa* type especially in the higher elevations and in Andar Reserved Forest,
- d) *Mesua ferrea* – *Palaquium ellipticum* and its *Poeciloneuron indicum* – *Palaquium ellipticum* – *Hopea ponga edaphic facies* found north of Kudremukh Peak.

For details, his book on Wet evergreen forests of the Western Ghat of India may be consulted.

4.1.6 - Plantations :

National park was a place of experimentation for raising plantations of very unconventional species such as *Hopea parviflora*, *Veteria indica*, different species of bamboos, softwoods like *Ailanthus malabarica* as well as teak. Some of the oldest experiments in forest regeneration using seed dibbling was tried successfully at the beginning of the 20th century in the north-western part of the national park and today there is an impressive stand of *Hopea* and *Veteria* on the northwest of the park. Even today use of seed dibbling is being done with 90% success. It is planned to remove the exotic plantations by the use of seed dibbling and extraction of the exotic species. Teak, which was tried in a fairly big scale around Mudradi and Seethanadi in Andar RF was a modest success. Survival percentage was good but the growth was far from expected because of the unsuitability of soil and excessive rainfall. Teak plantations raised in Naravi State Forest were almost a complete failure and today there are no signs of these plantations. The teak plantations on the northwest are in reasonably good condition. All other plantations merged into the natural forests and there are no signs of their individual identity. Wet evergreen forests and hill savannas are the major components of national park. Their ecology is very significant and important in the management of the park.

4.2.1 - Ecology of evergreen forests :

It is occasionally contended that the forests in Kudremukh National Park are tropical rain forests. But in reality they are not, for, tropical rain forest is characterized by the following features :

- Round the year distribution of rainfall, minimum being a 100 mm per month.
- Mean temperature in the coldest month is 18⁰ C and warmest month, 36⁰ C.
- Diurnal temperature variation is not more than 6⁰ C any time of the year.

These climatic features do not exist in the national park and therefore the forests do not qualify for being called as rain forests. These forests became isolated

from the larger tropical rain forests to which they originally belonged long ago due to tectonic movements and consequent change of climate. Now there is a strong seasonality of 4 - 5 month long dry spell because of which they are also called as tropical monsoon forests. Consequently, although these evergreen forests are 'rain forest - like', they are lower, simpler in structure and poorer in comparison. Still they are structurally heterogeneous and have exceptionally high biological diversity at all the levels. 50 - 60 tree species, which occupy top canopy, hardly contribute more than one percent to the entire population. Individual species find their own niches. Plants and animals occupy specific strata. The degree of endemism is very high. Many species occur locally with only a few specimens surviving. These forests therefore have the characteristics of relics. The α (alfa) diversity (within an area diversity), β (beeta) diversity (between the area diversity) and γ (gama) diversity (regional level diversity) is very high. So these forests represent one of the best-known bio-chemical storehouses in India. They reveal considerable orderliness and system only after long observation and thought. Structural properties of these forests include graded heights of the trees, numerous lianas hoisted into the canopy and a profusion of epiphytes, which can still be observed in old growth forests. Physiognomic properties include copious growth of fine feeder roots in the soil, buttresses, slender and clear boles, thin bark, conical or rounded crowns, dark shining leathery leaves and drip tips. The root spread is surprisingly small and many giant trees do not have taproots.

Soils of these forests are inherently infertile. So the minerals are recycled through a hectic turnover of biomass. In a period of about 50 to 60 years, biomass equivalent to the standing growth is recycled. Dioecy and relay floristics (the same species flowering and fruiting at different times of the year at different places within the same region) are a common phenomena. Canopy is quite compact and hardly 5 to 10% of light is allowed to reach the floor. It forms closed layers shutting out the sun and shutting in the moisture. Therefore below the canopy, temperature and humidity remain more or less stable, both during day and night. Air within the forest is wetter than outside and therefore lichens, mosses, ferns and orchids are in great and varied profusion. Boles and branches of trees are swathed by sphagnum mass but they do not invade all the tree species. They are highly selective. A surprising range of variation in the vegetation exists at higher altitudes. The ground is for most part covered with molding leaf litter. The entire community is held in a state of delicate balance as each

component dies, the nutrients are recycled by a whole community of decomposing organisms and then reabsorbed by plants to provide new life to the forests. It is this system of recycling that enables the abjectly poor soils to support paradoxically luxuriant growth giving a false impression of high soil potential. In the whole process, fungi are the key to the leak proof and magically efficient mineral recycling. In reality the whole forest is enmeshed in a web of hyphae and careful observation reveals an impressive range of fungi. Forest food chain is highly complex and well knit. There is no room for waste. If the cycle is broken, precious minerals will be leached out by rain and the impoverished soil will no longer be able to support the wonder of the forest.

Wet evergreens are 'climax forests' of a mosaic of patches of different species. Because of a small number of individuals per species, elimination of a few individuals has a strong effect on the size of population and on various biological balances in which the species is involved. Many species are animal dependent for pollination, seed dispersal and germination. Pollination is not a chance event. It is a precise delivery of pollen over long distances through a variety of closely dependent fauna. Seed dispersal is also dependent on animals such as primates, deer, pigs, bears, civet cats, birds, bats, rodents etc. Therefore plants and animals are an intimately interdependent community and co-evolved. Each plant has its own ecological requirement, often involving one or several animal species. Forest diversity, therefore, depends on an equal diversity of animals. Neither of them can survive without each other. Some species are humidity dependent for survival. Loss of fauna or lowering of humidity, which are the inevitable consequences of human interference, will easily alter the course of regeneration. Being so complex but delicate, these forests are apparently devoid of adaptations such as fire/drought resistance, ability to colonize etc, which are required to live with man and his errands. Everything that evergreen forests are adapted to seem to be wrong – poor synchronization of reproduction, clumsy and big seeds, short viability, excessive dependence on animals for propagation, narrow tolerance of environmental change etc. Dioecy and graduated flowering combined with low population densities often leads to local extinction of species. External disturbance to evergreen forests have a compounding effect on its fauna. Trees continue to live for tens of years after the animals upon which they depend for reproduction disappear. If these animals are lost forever, then such trees are biologically dead. Therefore we have to be extra careful in dealing with evergreen forest and its fauna.

Canopy gaps are an important aspect of the evergreen forests. What grows up in the canopy gaps determine the composition of forests for a long time. So gaps, are in some respects, most important part of the growth cycle. A large number of shade bearing seedlings with little net growth and 'as dormant as seeds' can be found on the forest floor, waiting for an opportunity to grow. With the fall of a tree or a big limb, a furious race begins and life foams upwards to close out the sky once again. Natural fellings of this kind enriches the forests, encouraging colonization by different species and renders the forest canopy a mosaic of gaps and patches of juvenile trees. Huge herbivores like elephants, which occasionally stray into the park, do the same job and act as biodiversity managers. Almost the entire forest of the park has been worked at least once in the recent past. Evergreen forests are unusually fragile and once damaged recover too slowly for any human planning. Pioneer such as *Macaranga peltata* invade and swamp the suddenly exposed sites and gradually prepare the ground for takeover of more advanced species. Undergrowth aids this process. Regeneration after timber exploitation is not expected to achieve the height of the original forest, because, the lowered vegetational matrix will reduce the biological clear bole height of the developing canopies. Top height is reduced by 10 to 30%, which in turn reduces the living space of the forests by an equivalent amount. Additionally keystone species like the strangling figs disappear putting the dependent fauna to great disadvantage, not only temporarily, but also for long years till senile trees reappear. Habitat specialists fauna such as the Indian hornbill, flying squirrel, Lion tailed macaque, woodpeckers etc., virtually disappear from the scene. Greatest value of these evergreen forests lies in its unknown flora and fauna and the immense possibilities of bio-engineering in future. Man has only been successful in simplifying rather than reconstructing this kind of complex eco-system.

4.3.1 - Productivity :

Stocking in these forests range from 30 sq. meters to about 45 Sq. meters of basal area per ha. The above ground biomass is of the order of 250-300 tons/ha. The mean annual increment is about 2%. The net primary productivity ranges from 7.5 tons to 10 tons per ha. per year. Leaf litter itself ranges from 3 tons to 5 tons per ha. per year.

Evergreen forests have highest rate of rainfall interception (20 to 40%) and the porous soils below facilitate infiltration and percolation of rainwater. Evergreen forests have a vital role in resource development in watershed management. Because of high productivity and high turnover rate, the evergreen forests work as great carbon sinks. The average standing above ground biomass is about 250 tons per ha. and the ratio of dry total biomass to carbon is roughly 2:1. An equal quantity of carbon is held below the ground in the form of leaf litter, roots and organic soil carbon. Thus it is a huge storehouse of carbon and its potential will go on increasing with the spread of vegetation quantitatively as well as qualitatively. Secondly a hectare of this forest approximately transpires 50000 liters of water per day, which reduces the daily local temperature by 3^o to 5^o centigrade. Part of this moisture goes towards cloud formation. The amount of water released daily by the evergreen forest into the atmosphere is at least 10 times more than the amount contributed by sea from an equal extent of surface area. Thus ecologically, these forests are vital in regulating the local, regional and global climate.

4.4.1 - Ecology of grasslands and role of fire :

Grasslands are the second largest eco-type within the national park. Tropical savannas are considered unquestionably as a degradation stage derived from the evergreen forests by clearing or burning or both and maintained by high velocity wind and recurring fires. Therefore they represent a younger biome on a geological time scale. These grasslands are dominated by C4 plants, which are better adapted for high water stress, bright sunshine, high oxygen and low CO₂. They have an average annual above ground biomass production of about 800 grams per sq. meter (8 tons/ha). The mean annual underground biomass is estimated around 500 grams per sq. meter (5 tons/ha). Productivity of the grassland is dependent on its botanical composition. Ratio of mean underground plant biomass to the above ground biomass is > 0.6, which is very high compared to the forests. Consequently, grasses are much more efficient in conserving rainwater and charging it to the ground. Correspondingly there is a great reduction in the run off and soil erosion. Their transpiration rates are very seasonal unlike the trees and therefore very conducive to conservation of moisture. They transpire less during unfavorable period. During dry season, the standing crop of grasses is largely made up of dead material and most of the nutrients gets translocated underground into the root biomass. They start growing in the monsoons and put up

maximum herbage by the end of monsoon. Thereafter they flower and seed after which, the crop starts drying up. During this time (i.e. post monsoon period), there is a massive transformation of biomass from the live to the standing dead compartment. It lasts for considerable length of time and eventually gets transformed to litter. About 70% of annual above ground net production, equivalent to 85% of standing dead material is thus converted into litter each year. Thus grasslands contribute greatest quantity of litter to the otherwise impoverished soil. As the above ground biomass dries up, the roots become active. This is preceded by renewal of almost 50% of the root biomass each year, especially during summers. Thus it is to be seen that there is a very efficient seasonal circulation of nutrients into different compartments of the plant. Being C4 plants, their photorespiration is also much less. Overall the grasses are much more efficient in resource conservation.

Grassland not only contains grasses but a fair mixture of legumes called as forbs. These plants put the grasslands in a race for vertical growth unless smothered by repeated and destructive fires. The proportion of forbs varies from place to place depending upon the biotic pressure and fire. Faunal diversity in the grassland habitat is influenced by the variety in vegetation cover. Invertebrates occur in great numbers and feed intensely on the underground plant parts, young leaves and stems. There is a greater selection of food by them than the vertebrates. Thus there is a high correlation between the number of phytophages and the number of legume species in grasslands and the structure of grass cover. Generally grassland sites are poor in extractable nitrogen. Otherwise, the rate of elemental N, S, Ca, Mg etc., in grass lands is much higher than in the forest eco systems mainly because of the high turnover of biomass both below ground and above ground every year.

Although the grasslands are extensive, as a range ground, they are poor in quality. They give a false impression of abundance. In reality, a large majority of the grasses are coarse and non-browsable. The proportion of soft palatable grasses is surprisingly small. These grasses are very sensitive to fire, stress and grazing. Under pressure they disappear fast making way to *Nilagirianthus*, *heyneanus* and *Brachen* fern, which then monopolise the site. Animal biomass supported by a certain habitat is an index of range quality. Given the low percentage of forage grasses, it is not surprising that the wild herbivores are in such a small number. The health and stature of the domestic cattle, which use the range regularly, is a surrogate measure of the

range quality. The “malnad giddas” are one of the lowest grade cattle of the state, poor in quality but prolific in reproduction. So are the grasslands. Moderate grazing has a stimulating effect on the grasslands but overgrazing diminishes the species diversity - especially the dicots. Even the monocots are reduced to stubble initially and finally the land is laid bare. Such sites suffer severe soil erosion. Only non-palatable grasses, just a few centimeters in height from the ground, will be left thinly distributed among the ferns and *Nilagiranthus*. This is generally the prevailing situation in Mullodi, Karle, Kalkodu, Kyatanamakki, Balige, Kalgudde and Megur village limits, which form the eastern belt of the national park. In Kerekatte Wildlife Range, majority of the grasslands were utilized for raising *Acacia* plantations. Plantations as a result of which cattle are forced to go deeper into the forest suppress grass. Overall cattle traverse more than 50% of the available grasslands. Human intervention through fire to create green grazing grounds in summers is an insurmountable problem.

Fire has the biggest influence on the grasslands after grazing. Fire governs the flow of life in grasslands. Man made seasonal burning of grasslands is a tradition in the region. Almost all the fires within the national park occur in these grasslands. Depending upon the intensity and the frequency, it produces different effects. Occasional light fire has a sanitising effect and helps in synchronization of flowering thus ensuring and maintaining the genetic diversity within each species. If fire occurs at the end of winter by which time reserved food is translocated into the root compartment, it will have a stimulating effect. Raising temperature during the advance of burning front is very brief and therefore does not affect the below ground portion. If fire occurs in hot summer, it really devastates the entire grassland. Fire consumes every thing that comes its way and reduces the grassland to a localized desert. Oil bearing grasses burn right up to the roots and therefore will be lost totally. The ‘heat shock’ of the severe burnt immediately mobilises the nutrients stored in the root system as well as water retained in the underground tissues. New shoots appear with surprising promptness utilizing the available atmospheric moisture and within a month’s time, the above ground biomass averages one ton per ha. New flush of grass has higher crude protein content, calcium and phosphorus but 6 to 12 months after burning, tissue concentration of all nutrients in leaves of the burnt areas are significantly lower than that of unburnt areas. Diversity becomes low and the survivors persist at low resource levels. If grazing is quite heavy on the new flush, it has a serious detrimental effect on

the root system and very soon the entire stock reaches a state of exhaustion. If this is repeated year after year, the productivity of the site degrades steadily. Burnt areas suffer high diurnal temperature variations. Due to changes in soil structure, infiltration rates go down. Soil particles become loose, block the pores and form a surface crust. In this regard fire exhibits a remarkable parallel to floods. Role of ashes though transitory, is very important in regularly burnt savannahs. Generally the mineral rich ashes are blown off by air or washed down by water. So it really does not benefit the site. Ash goes waste, carrying with it vital minerals like potassium away from the site. Additionally as much as 150 kgs of soil per ha. per year gets washed off from the burnt sites compared to about 50 kgs from the unburnt sites. The erosion is accelerated greatly by relief and grazing pressure. So on a long-term basis, it is difficult to appreciate the impact of repeated fire.

Prevention of burning for many years puts plants in competition in vertical plane favouring legumes and other bushes. So prolonged fire protection changes species composition to the detriment of short nutritious grasses and may affect ungulates. So total protection of grassland from fire is not desirable in as much as regular annual fire.

Flora of the national park is furnished at **ANNEXURE – IV (a), (b), (c) & (d)**.

4.5.1- Fauna :

A casual visitor to the national park will be disappointed by the apparent absence of animals except for the raising and falling resonant trill of cicadas and the blood-sucking leeches in monsoon or the rapacious ticks in summer. Given that travel in the forest is never silent, most creatures are either in hiding or have vacated the area long before our arrival. In reality, the national park is fabulously rich in animal life. Tropical evergreen forests are crowded and confusing. Animals inside such forests are bigger, brighter, stronger and louder. They advertise their presence with unusually ostentatious colours, smells, movements or noises, which will penetrate the wall of the green and distinguish each animal from thousands of other species with which it shares the forest. Those fauna, which are susceptible, are celebrated for their extraordinary disguises and camouflages. They use distinctive signals to communicate. Many are adapted to nocturnal life. There is flamboyance of sights, sounds and smell. But the

entire forest gets mortified at the presence of any external element - be it man, vehicle, or even a large herd of cattle and restoration of normalcy, at the lowest level, would require at least an hour's uninterrupted absolute silence !

Just as the flora, the fauna are also highly specialized. Notable among them are the Lion tailed macaque, which is the flagship species of the national park. Perhaps the national park is the home of largest remaining population of the Lion tailed macaques in peninsular India. A map of their potential habitat is furnished at **Plate - 8**. Of late frequency of their sighting has gone up. Groups of 30 to 40 animals are reported in the interior localities of Panjala and Malige. Sizable groups are also seen near Kerekatte MPCA plot and around Valikunja. Lion tailed macaques are generally confined to mid-elevation forests having uninterrupted crown cover of lofty trees and great lianas. King cobras are confined to the banks of watercourses and surrounding area. Hornbills are found in old growth forests. Flying squirrels are seen on tall trees in the valleys or on the fruit trees. There are many little known endemic fauna. Insects represent the highest bio-diversity followed by birds. In addition, a large number of fauna which are generally found over a large part of the peninsula like tiger, panther, wild dogs, elephant, gaur, sambar, muntjak, chevrotain, wild pig, hanuman languor, bonnet macaque, giant squirrel, peacock, python etc, are also found here. Numerically sambars are the most important large wild prey species. They are widely distributed throughout the national park both in the open and wooded country but rare in the eastern tract falling in Koppa taluk and adjoining areas. It subsists on a variety of plants and young green grasses. It is therefore commonly seen in hill meadows close to water sources, which are not regularly frequented by domestic cattle. One will be able to see a good number of 'sambar stamping' grounds – circular bare patches, 5 to 10 feet in diameter, devoid of all vegetation in the open grounds along the high hill ridges. Presumably they are the signposts communicating the stag's presence to other stags and hinds. These grounds are used for wallowing by the stags as well as wild boar towards the end of rainy season. Stray domestic dogs frequently hound and cause considerable loss to the sambar population including their fawn.

Herds of guar can be seen in Kudremukh and Kerekatte Wildlife Ranges – especially around the high peaks and along the ridges. They are commonly sighted as herds of calves and females with or without bull, or as single/paired bulls. They mix freely with domestic cattle. Territoriality is very pronounced in these animals. Some

herds are known to frequently visit and raid selected agricultural fields that abound in soft fleshy grasses especially close to evergreen forests and cause extensive damage to the standing crop. Both sambar and gaur frequent recently burnt grasslands either to lick the ashes or to mow the new flush. Both the species avail themselves of the man made salt licks regularly. Spotted deer are found only in the low land forests and flat open country. Since this kind of forest is very negligible within the park, the population of spotted deer is very low. Elephants were known to be migratory visitors to the Naravi State Forests. But in the last couple of years, a family of three elephants has become residents and are making bouts in the entire national park. They travel along the ridges feeding mainly on the reeds and frequenting the near by watercourses. Caryota palm along their route has become a particular casualty because of these elephants.

List of fauna observed in the national park is furnished at **ANNEXURE – V (a) to (g)**.

A noteworthy feature of the fauna in the national park is their intimate association with the local flora. Flora and fauna exist as guilds and not as individual species or populations. Populations are generally divided between numerous rare species instead of fewer abundant ones. A relatively small number represents each species but the species diversity is large. Each animal species has a highly specialized niche and has a unique functional role. Low population density of animals is because of intense competition for specialized food or living space or due to the constant attention of predators. Adequate forage is available to the ungulates almost throughout the year. Those, which feed exclusively on mast (=seed/fruit), soft or hard, face shortages during August/September months when no species is in fruiting. The evergreen forests are lofty and provide a huge three-dimensional living space supplemented by a wide variety of foods to satisfy the needs of all the species. In fact the trees and animals are intimately interconnected in their life cycles. They all co-exist by specialization. Each animal species has a highly specialized niche and has a unique functional role. Many plants have undergone numerous modifications to elicit the response of an appropriate animal species for pollination or fruit/seed dispersal. Sequential flowering and fruiting (relay floristics) is found when a wide range of common species are depended upon. Plants and their insect predators fight some sort of 'chemical arms race' constantly. A large number of faunal species were threatened

when the forests were under intensive logging but the balance is fast returning because of a fairly long period of rest given since mid 80's. Present mammalian density of the park is hardly one or two animals per sq. km. which compares poorly with other established national parks within the state. So far, scientific census of any fauna is not conducted. Therefore there is a huge statistical void on faunal presence and abundance.

4.6.1 - Human scape :

The national park houses nearly 1300 families belonging to 98 settlements excluding Kudremukh township. 6250 people and 7000 cattle stay inside the national park. The size of revenue enclosures vary from single household to a maximum of 130 in Mutlapadi in Karkala taluk. Almost 90% of the houses are of Mangalore tiles. Thatched houses are hard to come by except as cattle sheds. There are very few RCC buildings. 95% of the people are dependent on agriculture. The cultivated land per capita is an important index on the pressure of land. Within the national park the per capita cultivated land holding is 0.18 ha. Another index of pressure on the land is the number of cattle per 1000 people. For Kudremukh National Park areas, the cattle pressure is > 1 . Okkaligas, billavas, bunts and brahmins are the main landlords. The other communities were largely agricultural labourers on these lands but have been awarded tenancy lands in the last two decades. Some of them have also been freshly granted revenue lands. About a third of the tribal families live exclusively on encroached forestlands. Demographic composition of communities inside the national park is furnished in **ANNEXURE - VI**.

Malekudiya, marathi naiks and gowdlu are the tribes traditionally living in interior forest area. Gowdlu are found in Sringeri, Koppa and Mudigere taluks. Malekudiyas are found in Belthangadi taluk. A few economically backward families of Marati naiks also live in interior forests especially in Karkala taluk. Of late, all these tribes own small parcels of land on which paddy, areca and banana are grown. Gowdlus were a hunting tribe and owned agricultural lands in fertile valleys, which were later appropriated by dominant caste groups reducing them to tenants. They also collect and sell a variety of forest products. In addition to these demands, people also encroached forestland mainly for cultivation purpose. Illicit felling of trees inside and outside the forests has come down drastically over the years and it is almost nothing now.

4.6.2 - Community festivals :

Festivals observed in other parts of the state are observed within the park also. Hunting on festive days was a tradition. Some times the whole community was involved in it. Fortunately, it is now relegated to history. On the western slopes paddy is harvested around Deepavali time and this is a time of great celebration. Whereas on the uplands, sowings are delayed and taken up some time in August as a consequence of which the harvest is delayed until November. Deepavali, Shivarathri, Souramana Ugadi, Ramzan and Christmas are the important events widely celebrated.

4.6.3 - Shandies :

There are not many recognized shandies within the park area. The biggest shandy of about 40 shops is held in Kudremukh township from the afternoon of Friday and the whole of Saturday. The produce for sale comes from Chikmagalur, Mudigere and Mangalore. Fresh vegetables and fruits sell the largest. A number of vehicles carrying different commodities will pass through the park for this sandy.

4.6.4 - Jatras :

These are location specific community celebrations on particular occasions. There are two very well known jatras - one of Kigga temple, which falls some time in April, and the second is Kajoor Darga Urus, which falls some time in February. Thousands of people assemble for these jatras. Of this, Kigga jatra is generally preceded by a hunting parade by all kinds of people and as a matter of tradition, they can only return home with the carcass of a wild animal. As a consequence of this tradition, a number of people will be found roaming in the national park as well as the adjoining forest areas with weapons and some times with trophies. They also set fire to the forests to ambush animals. Kajoor jatra is held outside the national park but the congregation is very huge and a section of this crowd ventures into the national park for recreation. Although hunting is not noticed on this occasion, people will be found wandering around Didupe valley carrying eatables etc., and litter the national park with huge quantity of plastic.

Gangamoola within the national park was an important religious place mythically known as the birthplace of Tunga, Bhadra as well as the Netravathi rivers. It

is therefore considered holy and during “Ellu amaavasye”, huge congregation of people assembles and performs pooja. However the significance of this place went down once the road access was created. Even so the occasion is celebrated in small scale, during which time considerable number of people assemble, take bath near Gangamoola, then in Varaha Theertha and perform religious rites at Nagatheertha and Gangamoola. Kolli Durga jatire is also an important occasion.

4.6.5 - State of Economy :

Almost the entire population in and around Kudremukh National Park is based on the farm sector. There are no established big, small or home industries. 80% of the population is small and marginal farmers. The proportion of work force to the total population is as high as 65%. Seldom people have disposable surplus income. Every family has a first preference to grow food grains for home consumption. Quite a number of families have abandoned growing of food grains, as it is uneconomical but lease out the lands. However garden lands are looked after well irrespective of the returns because it keeps swinging widely and there is hope that it would be profitable day. Economic slump laid off a large part of agriculture labour force and therefore some of the male members migrate to nearby towns for employment. But the number is small. The adverse effect of general economic situation is not harsh on the local people mainly because of stable monsoons and production of basic minimum food grains by each household. Traditional occupations such as carpentry, black smithy, fishing, weaving, handicrafts etc., are also very uncommon inside the park area. People prefer to do white or blue collared jobs or petty business to agriculture once they acquire school education. Leisure time is utilized for gathering non-forest products, pasturing cattle, flirting around, etc. If the people are purged from using the forests directly or indirectly, living becomes difficult.

A summary of estimated demands made on the national park by the resident and surrounding population is furnished hereunder :

Table - 5 : Summary of demands :

Nature of demand	Annual consumption or collection	Unit	Unit value (in Rs. '000)	Approximate total value (in lakh)
NTFPs				

a) Rampatre	5,000	Kgs	0.075	3.75
b) Murugana huli	20,000	Kgs	0.030	6.00
c) Honey	3,000	Kgs	0.025	0.75
d) Canes & reeds	25,000	Nos	0.005	1.25
e) Seegekai	10,000	Kgs	0.005	0.50
f) Others (Medicinal plants, grasses, fibres, etc.)	5,000	Kgs	0.010	0.50
Leaf mulch	6000	Tons	0.05	3.00
Timber	900	Meters	0.10	90.00
Firewood	3250	Tons	0.25	8.00
Water		TMC		
a) Domestic	-	-	-	Not estimated
b) Irrigation	-	-	-	Not estimated
c) Industrial	-	-	-	Not estimated
Soil	1000	Tons	1.0	10.00
Fodder for cattle grazing	6500	Tons	0.05	3.25
Ballies for fencing	3.0	Lakh (in Nos.)		3.00
Value of minerals (iron)	70 (KIOCL)	Million tons		70000.00

All of this except the mineral production is hardly accounted.

4.7.1 - The zone of influence (ZI) :

Technically all settlements and non-forest lands are outside the national park. People have been living in these enclosures and drawing upon the forests for their daily needs. Therefore there is a zone of interference around each of these enclosures. The width of the zone depends on factors such as the population size, extent of cultivated land, cattle population, size of land holdings etc.

In addition there are many villages and settlements in a radial distance of 5 kms. from the boundary of national park. List of such villages and demographic details are presented in **ANNEXURE – VII**. There is more pressure on the national park from outside because the number of people, cattle and cultivated land is many times more. They are also dependent on the national park resources, be it water, grass, climbers, reeds, fencing materials etc. Available forest cover within this zone is surrogate measure of the biotic pressure. Vegetation map furnished in Plate - 7 also indicate the status of this zone. Where the pressure is high and cannot be satisfied locally, it tends

to shift the national park. External pressure is very high on the southern, northwestern and northeastern sides of the park.

The national park is generally surrounded by good vegetation all around except Didupe valley. Population density in the fringes of national park is about 300-400 per sq. km. on the coastal side and about 200-300 per sq. km. in the up lands. The fringe populations are generally self sufficient in biomass and therefore do not interfere routinely with the national park areas. However, they run short of certain materials such as cane baskets, medicinal plants, thatch grass, fuel and fodder during monsoon etc. During summers the demand for irrigation water also encourages some of them to visit the nearest running streams to draw water. Otherwise the extent of influence of the outside population is very negligible. However the situation is completely different in Didupe where the entire valley consists of nothing but coconut and areca nut gardens or paddy fields and people do not own any woodlots. It is rather difficult to sight well grown non-horticultural trees. Consequently a large number of families - as much as 500 to 600, are entirely dependent on the valley forests of Kudremukh National Park for their mulch and other biomass needs. This is the area that suffers the worst in the entire national park due to removal of huge quantity of biomass both green and dry.

Life style in malnad region is such that people use fuelwood very liberally both for cooking and heating purposes. Sultry coastal weather condition forces people to bathe at least two to three times a day in summer. Fuelwood consumption is therefore quite high. As a preparatory to the monsoon, every household collects four to five cart loads of dry firewood, either round or split and nearly consumes the entire quantity by the end of monsoon. Just before the monsoon, every household is deployed exclusively on gathering of firewood and if the same is not available sufficiently in and around home steads, they sneak into the nearby forest and carry head loads. Dry fuelwood is one of the biggest demands just before monsoon. Muli grass which traditionally was the roofing material is no more collected but towards the end of the monsoon period people will be found gathering head loads of soft grasses which will be dried and stored as silage. In any case, people from outside the national park normally do not venture for more than 1 or 2 kms. into the park.

CHAPTER – V

ORGANISATION AND ADMINISTRATION

5.1.1 – Organisation of forest area :

Each of the state forests, which forms a part of the national park, is quite big in size. Except Tunga Bhadra State Forest, none of them have been organised into blocks and compartments on the ground. Earlier working plans, no doubt provided for blocks and compartments but only on the map with an intention to provide for fellings etc. With the change in the concept of management for these forests, it is felt necessary to reorganize the compartments in a manner consistent with the present administrative structure and working pattern. Accordingly compartments have been freshly laid out on the map, considering each range as one block. In all there are 86 compartments – 20 each in Karkala and Belthangadi, 21 in Kudremukh Wildlife Range and 25 in Kerekatte Wildlife Range. The compartments are bigger in size and delineated using permanent boundaries like hill ridges, prominent streams, game paths and highways. The beats and sections are reconstituted so as to be co-terminus with the newly constituted compartments. Description of all the blocks and compartments and their allotment to the beats and sections concerned is furnished in **ANNEXURE – VIII**. Maps showing the new arrangement have to be provided up to the beat level. A miniature map of the area organisation is provided at **Plate – 9**. Demarcation of compartment boundary and beat boundary has to be marked on the ground as per map.

5.2.1 – Administration :

The Deputy Conservator of Forests, Kudremukh Wildlife Division with headquarters at Karkala, administers the national park. This division was brought into being in G.O.No.AHFF.83.FNG-92, dated : 08-05-1992. There are four ranges located at Belthangadi, Karkala, Kerekatte and Kudremukh. There are two sub-divisions – one at Kudremukh and one at Kundapur. All these offices are newly created. The executive staff was drawn from the respective territorial divisions, which contributed the area to the national park. Sections and beats were since reorganized and as of today the national park is divided into 17 sections and 34 beats. In addition, one forester and three guards each are posted for monitoring the entry barriers on the state and national highways. Kudremukh Wildlife Division also administers the Someshwara Wildlife

Sanctuary and Mookambika Wildlife Sanctuary in Udupi district. A flow chart of the administration set up for the Kudremukh National Park is furnished at the **Plate - 10**.

5.3.1 – Infrastructure :

All the officers are provided with office and residential accommodation. Every officer is provided with a jeep. Majority of the subordinates are also provided official accommodation. In view of the reorganization and posting of more number of staff, some more quarters are required. Antipoaching camps are usually run in temporary/semi-permanent sheds. All the patrolling tracks have been provided with entry barricades. No patrolling track is allowed to be kept in open condition. Every range has a nursery. So far two wildlife watchtowers were erected – one close to a pond near Kurinjal and the second near the pond near MPCA in Kerekatte. The infrastructure facilities created so far are furnished at **ANNEXURE - IX**.

5.3.2 – Patrolling tracks :

A basic network of tracks have been developed utilizing and interconnecting the existing coupe paths. All these paths are meant to be patrolling tracks cum permanent fire brakes. List of patrolling tracks within the national park is furnished hereunder :

Table - 6 : List of patrolling tracks :

Sl. No.	Range	From	To	Total length (in Kms.)	Remarks
1	Karkala	Kanyalu	Bolkalgudda	12.00	
2	Karkala	Mullur	Haradi	17.00	
3	Karkala	Andar	Valikunja	9.60	Uranium corp. road
4	Karkala	Kanyalu	Bijjale	12.00	
5	Karkala	Abbas Cutting	Bijjale	15.00	
6	Belthangadi	Kolli	Gundalpade	9.50	
7	Belthangadi	Gundalpade	Manchadakallu – Malige	29.00	
8	Belthangadi	Malige	Gundi	8.00	
9	Belthangadi	Savanal	Manchadakallu	20.00	

10	Belthangadi	Navoor	Gundalpade	7.00	
11	Kerekatte	S.K.Border	Valikunja	15.00	
12	Kerekatte	Mundasar	Koragarakote	5.00	
13	Kerekatte	Urani	Manikyabail	8.00	
14	Kerekatte	Ganapathikatte	Sheerlu – Gangrikal	10.00	
15	Kerekatte	Matholi	Hadi – Badige gudda	12.00	
16	Kerekatte	Gulganjimane	Suttinagudda – Padmagudda	7.00	
17	Kerekatte	Manikyabetta	Valikunja	14.00	
18	Kudremukh	Bhagavathi	Sujigudda (Sunti Kumri)	15.00	
19	Kudremukh	Jamble	Kenganakonda	9.00	
20	Kudremukh	Bhagavathi	Kurinjal	8.00	Pipe line road of Kudremukh Iron Ore Company Limited
21	Kudremukh	Maseedi gudda	Sitabhumi & Karmane	12.00	Trekking path

This network, however, does not provide access to all parts of the park. The northern, eastern and southeastern parts of the park are still not easily approachable. No coupe paths exist in these areas.

5.3.3 – Wireless network and telephones :

The park is provided with a good wireless network. There are four static wireless sets at the range head quarters and eight mobile sets in the vehicles. All the officers, foresters and forest guards are provided with walkie-talkies. The communication system is networked with the help of eight repeaters as under :

Table - 7 : List of wireless repeater stations :

Sl. No.	Range	Location of the repeater	Coverage
1	Karkala	Parpalagudde	Central repeater at divisional head quarters
2	Karkala	Kovigudde	Naravi and Kuthloor sections

3	Belthangadi	Jamalabad	Entire Belthangadi range
4	Kudremukh	Samse	Samse and K'mukh sections
5	Kudremukh	Gangrikal	Bhagavathi, Singsar sections and Shirlu sections in Kerekatte Wildlife Range
6	Kerekatte	Valikunja	Kerekatte section and Kervase and Andar sections of Karkala Wildlife Range
7	Kerekatte	Sringeri	Kigga section
8	Kerekatte	Kyathanamakki	Menasinahadya and Kadekal sections

All the repeaters are powered by solar panels. The system works very efficiently and message emanating from any source is circulated over the entire network. The system has proved very helpful especially in fire season.

The divisional office and all the range forest offices are connected by telephones.

5.3.4 – Forest protection camps (FPCs) :

About a dozen FPCs have been working as temporary establishments at different locations inside the national park. Local youth are employed in these camps. But working of these camps is not yet systematized. They are used as support structures to make up the staff shortages.

5.4.1 –Tourism :

Quite a large number of tourists enjoy the national park as high way passengers and therefore do not register themselves as tourists. They rest and relax at several places along the highway and also enjoy the beauty and serenity of the park. People can be found throughout the day on the roadsides taking photographs, using the streams, watching the roadside waterfalls and panoramic scenes. Visitors to the park consist mainly of picnickers and hikers from the neighboring areas. About ten thousand people visit the park annually and most of them are school children and youth. There are not many tourist facilities. There is a nature camp at Bhagavathi having six tents, a two-suit rest house, a classroom and a kitchen. Most of the tourists are received at this

nature camp where special classes on flora, fauna, environment conservation etc., are held along with slide shows, live demonstration or with the support of TV films. Visitors are also taken for short treks on foot and brought back by evening. Generally the stay extends over two or three days. The Department of Youth Affairs conducts special classes and expeditions annually in the national park through Youth Hostels, General Thimmaiah Academy of Adventure Sports, etc. Some company-sponsored teams also visit the park occasionally. In these camps youth from all over the state participate. It is also accompanied by nature photography, experience-sharing session etc. A substantial part of visitors are trekkers to the Kudremukh Peak, Gangrikal ridge or Kuranjal peak. Batches of 20 to 30 people visit these places.

A documentary film featuring different aspects of Kudremukh National Park has been produced for the use of visitors. Basic facilities such as shelter, toilet, drinking water, etc., have been provided at the entrance of Jamalabad fort. Suthanabbi falls have been developed into a full-fledged picnic spot. Steps have been built for easy approach to the falls. Toilet, drinking water, changing rooms, etc., have been provided. This is one of the well known attractions of the national park and nearly 300 people visit this place on Sundays and holidays in the post monsoon and summer seasons.

There are no vehicles meant exclusively for tourists. Visitors to Kudremukh National Park are essentially interested in its landscapes and the natural beauty and therefore are generally content even if the animals are not sighted. The forest rest house at Kerekatte has only two suits.

Valikunja Peak and Narasimha Parvatha are also good attractions to the visitors. Trekking paths have been laid to all these places. The list of trekking paths and game paths available for the use of tourists is furnished hereunder :

Table - 8 : List of trekking paths and game tracks for tourist use *:

Route No.	Name of the Range	Name of the national park	Trekking path / game track		Total distance (in Kms)
			From	To	
C	Karkala Wildlife Range	Kudremukh National Park	Andar	Valikunja	10
D	Karkala Wildlife Range	Kudremukh National Park	Mullur	Kuringal gudda	16

E	Belthangadi Wildlife Range	Kudremukh National Park	Kasaravalli	Galigundi gudda	5
F	Kerekatte Wildlife Range	Kudremukh National Park	Kigga	Narasimha parvatha	4
G	Kerekatte Wildlife Range	Kudremukh National Park	Manikya betta	Kerekatte	6
H	Kudremukh Wildlife Range	Kudremukh National Park	Bhagavathi Nature Camp	Kuringal gudda	4
I	Kudremukh Wildlife Range	Kudremukh National Park	Kudremukh	Gangadikal Peak	6
J	Kudremukh Wildlife Range	Kudremukh National Park	Tholali	Kudremukh Peak	9
K	Kudremukh Wildlife Range	Kudremukh National Park	Lakya Dam	Karle / Kalkodu	20
L	Kerekatte Wildlife Range	Kudremukh National Park	Kigga	Manikya betta	15
(Game track)	Kudremukh Wildlife Range	Kudremukh National Park	Singsar	Ganapathikatte	10
(Game track)	Kudremukh Wildlife Range	Kudremukh National Park	Baghavathi	Kadambi to Ganapathikatte	6
TOTAL					111 Kms

* Fresh paths can be included in this list based on the requirement of the tourists / trekkers.

Maps showing all the existing communications, infrastructure, tourist facilities and trekking path routes are furnished in **Plate – 11, 11 (a) to (e)**.

5.5.1 – Research :

There is no in-house research programme. The academic institutions, under their schemes, undertake research. Permission for research work inside the protected area is accorded by the Chief Wildlife Warden under a set of conditions including sharing of the research findings. A list of research papers pertaining the national park published by different workers is furnished at **ANNEXURE – X**. A copy of these articles is maintained in the research dossier maintained at the divisional office.

The Silviculturist, South zone, Madikeri had five research plots near Mutlapadi. The research work relates to trial of local NTFP species like *Artocarpus lakoocha*.

These plots are now abandoned. There were some linear tree increment plots in Bhagavathi and elsewhere. No details are forthcoming.

5.6.1 – Monitoring :

The antipoaching camps established in each section monitor the animal movements and maintain a daily record, which is submitted to the divisional office monthly. The vehicle movements on the highways are monitored through the entry barriers erected at Mullur, Tanikodu and Basrikal. Every vehicle entering the national park is given a free pass for highway passage and the same is surrendered at the exit gate. Travel time is fixed and those who violate are penalized.

5.7.1 – Revenue and expenditure :

The revenue and expenditure of the Kudremukh Wildlife Division in the last 11 years is furnished at **ANNEXURE – XI**. It is not possible to segregate the expenditure incurred exclusively on the national park. The expenditure is mainly on habitat improvement, infrastructure development and fire protection. Revenue in the early years was largely from the sale of timber, poles, etc. Income is mainly from the entry fees, fines and forfeitures. At the gate, entry tickets are given to people free of cost to regulate movement in the park.

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PART – II

PROPOSED MANAGEMENT

CHAPTER – VI

BASIS OF THE PLAN

A general background of the prevailing situation in the national park has been narrated in Chapter – III and IV. In a recent study, it has been ascertained that the loss of forests in the Western Ghats of Karnataka region is 12% (at an annual rate of 0.63%). The study also indicated that the loss is substantial outside reserved forests (19%) and marginal within the reserved forests (4%). The district forests, which constituted 45% of the forest cover a few years before are disappearing gradually and the pressure is shifting to reserved forests, which has about 70% of the overall biodiversity. Habitat fragmentation, mining, fire, collection of NTFPs and grazing are the major threats. Traffic flows and encroachments are minor threats.

6.1.1 –Mining and habitat fragmentation :

Mining in Kudremukh enclosure is the biggest threat to the national park in a variety of ways whose consequences are indeed difficult to gauge because the pre-project benchmark data is not available. The National Environmental Engineering Research Institute (NEERI), Nagpur undertook a comprehensive environmental impacts assessment of the mine area and submitted a detailed report at the end of the year 2001. The project report goes in great technical detail and also prescribes a series of measures to mitigate the environmental problems. Following this, the Indian Institute of Science, Bangalore undertook a rapid assessment of the impact of iron ore mining on the flora and fauna of Kudremukh National Park and its environs. Both the studies missed out the critical monsoon data and therefore are very incomplete. Nevertheless the impacts have been outlined and a list is given hereunder. For more details, the project reports may be consulted.

6.1.2 – Impacts of mining :

- a) The habitat is fragmented by the mine, the Lakya dam and the industrial township all of which now constitute a separate and a new enclave within the national park with 3203.55 ha. of reserved forest land from South Bhadra and Tunga Bhadra State Forests, 1411 ha. of revenue land and 189 ha. of private land acquired by

the company. Together, the enclosure has occupied 51 sq. kms. of land at the heart of the national park. This is become the biggest enclosure within the national park.

- b) The surface mining operations lead to heavy siltation of Bhadra river during monsoons. The silt load in the 5-6 kms. stretch of the river immediately downstream of the mine site is so heavy that the company is forced to dredge it immediately following monsoon every year. This is the most significant factor affecting the aqua fauna down stream. From 2003, mining has been stopped during monsoon.
- c) The ambient air quality is affected. The suspended particulate matter has gone up from 70 ug/m³ to 260 ug/m³ (NEERI report, 2000 – page 2.3) and the noise level has gone up from 40 decibels to 80 decibels.
- d) There is an influx of nearly 10000 people into the township, which is now the park buffer zone. These people draw upon the resource of the park. Because of the township and its huge demands, the park suffers a great deal. For instance
 - 600 cattle reared in and around Kudremukh for milk supply to the town ship graze in the national park.
 - About 400 daily wage labourers employed in the company collect firewood, poles and small timber for their bonafide use from the park area.
 - About 150 families displaced by the company or those who came from far and wide, seeking greener pastures, have encroached about 50 ha. of forest land and denatured the land scape.
 - The company employees create a huge demand for rose wood and other high quality timber, which is stolen from the nearby forests by greedy carpenters housed in the company accommodation to make and sell furniture.

- e) A number of people providing services to the company or its staff have planted themselves on the environs of the national park and operate business establishments. Because of the scenic splendour and the facilities made available by the company, a sizeable floating population also visits Kudremukh township and sneak into the national park without proper authority.

Thus there is a landscape level fragmentation due to high-tension electric lines, mine related roads, storage of tailings and other ancillary activities.

6.2.1 – Fire :

Fire is a great threat to the national park especially in the upper reaches. It begins to appear by December in places such as Jamalabad fort, Kudremukh peak, Gangrikal, Kigga etc., which are popular trekking destinations. From January, fires are regular phenomena, especially around the habitations. By the end of January fire spreads to distantly located hill ranges and by February end almost 50% of the hills are bereft of their grass cover. Largest number of fires occurs during February and March. On a single day fire may be found in 10 to 15 places. They will also not be found wanting in late hours of the day. Greater part of the hill ranges is inaccessible and therefore remain unattended while on fire. As a result, fire spreads unchecked late into the night till the early morning mist snuffs it out. No less than 150 to 200 ha. of grassland gets burnt in each event of fire. Almost two third of grass lands will be gutted at one time or other of every summer season. Since new flush of grass springs up almost immediately, fire affected areas will bounce back to life within a short time. The charred remains are visible only for a few days. Therefore, although a large part of the grassland is run over by fire annually, only a small part of it will be visible at any time and this gives a misleading impression that not much of damage is done.

Time series remote sensing images on the spread of fire within the national park pertaining to April composed from mosaicing of FCCs of 1994, 1999, 2001 and 2002 is furnished in **Plate – 12**.

More than 100 people and five jeeps are deployed in addition to the regular staff strength during the fire season. Almost the entire regular establishment is devoted to fire protection work for a period of four months from January. The strategy of

locating groups of people to detect and put off the fire around fire prone locations has proved quite successful. Although it is not possible even to detect the offenders, given the vast grasslands and the time it takes to spot the fire. But it can reasonably be presumed that the local people, to get fresh green grass for their cattle, kindle fires in a large measure. There are a few retaliatory fires especially to scare away the wild pigs. The honey collectors also kindle a few.

During the previous plan period, advance burning was practiced which has no doubt reduced the intensity of fire, but has induced considerable changes in the grassland ecosystem. Nearly 50% of the plantations raised are lost. Repeatedly burnt areas are gradually being taken over by bracken fern. Fortunately fire subsides by the time it reaches the tree line and therefore there is no major damage to the natural tree vegetation in the last five years. However small extent of sholas on the backside of Seethabhumi and Gurige valley were effected. Given the present circumstances, the number of fires and their spread can be controlled to certain extent by better organization and communication but it cannot be eliminated totally.

6.3.1 – Collection of NTFP :

Huge quantities of NTFPs are collected for bonafide use as well as sale. Local agriculturists require a variety of resources such as leaf litter, forest soil, climbers, reeds, water, fencing materials, small timber, boulders, etc., are availed from the national park. There are 600 ha. of paddy fields, which have to be manured annually with about a ton of leaf litter per ha. every time. Thus in all 600 tons of leaf litter is collected annually and used for paddy alone. Four lakh areca nut trees exist inside the national park. The areca nut trees require mulching with green leaf. A head load of mulch (about 30 kgs) is used for a couple of trees. Mulching is done biannually. At this rate, total green leaf mulch required to manure the areca nut gardens amounts to 6000 tons/year. Of these, 80% comes from the park area. Mulch is collected by clearing the shrubbery, young regeneration on the forest floor and by lopping nearby trees. Consequently, forest areas 3 - 4 times the areca gardens get cleared of all ground vegetation throughout the national park. The leaf mulch combined with the forage for cattle is a huge demand, which is hardly accounted for in any of the calculations.

Rampatre, muruganahuli, vatehuli, honey, seegekai, dalchini leaves and canes are the important saleable NTFPs. Though they can't spin great economic returns at source, the NTFPs are very significant to the local economy as they are available at critical times when local people are endowed with plenty of free time and also need cash income for domestic expenditure. Almost 50% of the families living inside the national park are engaged in collection and sale of NTFPs. Each tribal household derives an annual income of Rs.7,000 to Rs.10,000 from these forest products. About a third of the families of non-tribal communities are also engaged in collection and sale of different types of forest produce. Thus collectively about 400 families of tribals and 250 families of other communities draw upon the forest products as a source of cash income. Almost every tree of usufruct value is located and harvested by these people. 200 to 300 tons of different usufructs are collected and taken out of the forests in this manner. Traders are strategically located along the fringes of the national park and in the nearby townships. Unfortunately policy of ban on collection of NTFPs from protected areas but free access and even sale in other reserved forests has come in the way of curbing these greedy traders. So the NTFP collection goes on in the national park areas also although in a very subtle way in the name of collection from district forests. Certain products like reeds, woody climbers and canes are rarely found in forest areas outside the protected areas. These products are used by different sections of people and dealt by different class of traders. Areas which are tapped heavily for the non forest produce are as under :

1. Karkala Wildlife Range :

Kabbinala, Shirlalu, Narsibail, Kochigudde and Hukratte in Mala, Maphala, Kotyanthadka in Kuthloor.

2. Belthangadi Wildlife Range :

Panjala, Addayathodu, Seegematti, Kanilagundi, Pochha, Rabe, Yerumala.

3. Kudremukh Wildlife Range :

Nellibeedu, Karle, Kalkodu and Bangaru balige.

4. Kerekatte Wildlife Range :

Yedagaru, Seerlu, Hadikesagodu, Avantu-Devantu, Menisinhadya and Mundsar.

Schedule caste communities from outside the national park boundary in Kuthloor, Naravi, Hosmar, Muniyal, Kadthale, Padukudur and Kervase regularly collect climbers and reeds at the rate of one head load per day, make baskets with splits and sell in the villages. There are at least 50 people in Naravi section and 25 people in Andar section engaged in this vocation in summers. Illicit cutting of bamboo mainly for fencing around the farms is quite high in Didupe valley. Ballies of promising young saplings of different species are cut in large numbers and used for fencing in almost all the enclosures within the national park. A huge number of poles gets sacrificed for this purpose alone annually. Canes and reeds are also used liberally as fencing materials.

Harvesting of muruganahuli (*Garcinia gummigutta*) is quite high in Sringeri taluk where the tree population is also high. Market price of the rind has a direct impact on the harvest levels and therefore the competition to collect the produce. If the prices are high, harvest begun very early, even if the crop is unripe and the harvest is thorough. Otherwise it is generally confined to the vicinity of the households. Most of the produce ultimately reaches Kerala and from there it is exported after processing to western countries where it is used to treat obesity.

6.4.1 – Poaching :

There are a huge number of licensed crop protection guns inside the park. An equal number of unlicensed weapons exist in and around. These are some times used for poaching. Dogs, traps and snares are also occasionally used for hunting of small game. Kudremukh used to be a poachers' paradise. People from Mangalore, Udupi and even up to Bhatkal used to visit Kudremukh hill ranges regularly for hunting purposes for pot. In addition, people from Mudigere, Sringeri and planters from Koppa and Kalasa also used to hunt occasionally in Kudremukh hills. Team members work in relay till they succeed in getting enough meat. Grasslands with clear visibility offers an ideal hunting ground and the ungulates were almost decimated by 1990s. Big as well as small game like birds, flying squirrels and civets are hunted. The entire park becomes inaccessible as swollen rivers and streams circumscribe each watershed during monsoons. Now due to more awareness among local people, more intense patrolling by forest department, this is negligible or nil.

Range wise list of licensed guns is furnished hereunder :

Table – 9 : Rangewise list of licensed guns :

Sl. No.	Name of the Range	Number of licensed guns
1	2	3
1	Karkala Wildlife Range, Karkala	376
2	Belthangadi Wildlife Range, Belthangadi	068
3	Kerekatte Wildlife Range, Kerekatte	230
4	Kudremukh Wildlife Range, Kudremukh	180
	Total	854

Details of individual license holder are available in all the range forest offices and divisional office. Festivals are a great occasion and invariably attempts are made by the villagers to poach. Adjoining places like Ballalarayanadurga are ideal hunting grounds for the gaur because the habitat is partly outside the national park, easily accessible and the protection measures are less stringent. Meat of some species like Slender loris is believed to have great prenatal curative properties and therefore they were hunted at convenience, meat is dried, stored and used when required.

Wild pig, if well protected for a couple of years, breeds prolifically and proves to be of considerable nuisance to crops. Availing the relaxation offered from the strings of law, wild pigs are commonly shot during monsoons around the paddy fields either with weapons or explosives and meat is locally consumed and sometimes fed to the market. Fishing inside the national park is rather rare except for occasional dynamiting of pools of water at the end of summer. But no big fish are caught nor is the catch large. Fishing with rod is common in the backwaters of Lakya dam especially during evenings, an activity that is responsible for forest fires around this place.

6.5.1 – Grazing :

For long time in the early history, cattle were regarded as wealth. Though not to the same extent, the situation now also remains so in the park area. There are no sheep, goats, donkeys, horses or pigs within the park but the cattle including cows and buffalos are in good numbers. The cows and bulls belong to a non-descript breed known as “malnad giddas”. They are diminutive in size with stunted growth and have

no definite breed characteristics. In general, they are dark haired. The lactation period is 6 to 7 months and the dry period is 7 to 8 months. Average milk yield is hardly 500 ml. Though small in stature, they are sprightly animals with extraordinary power of endurance and resistant to diseases. These animals have for centuries been playing an important role in the rural economy of the region. Farmers spend practical nothing towards the feed.

Of late, these animals are used mainly for generating farmyard manure and partly to generate income during hard times by sale of calves. Farmyard manure is generated by providing a bed of dry leaves in the cattle sheds where these animals are made to stand day after day urinating and defecating in the same place for weeks. The manure so generated is taken out of the shed once in 2-3 months. It is impossible for any other breed of cattle to undergo this ordeal and still survive.

Nearly 10000 cattle heads graze inside the national park. Herbivores consume about 1/10 of their body weight green herbage daily. At this rate nearly 75000 tons of green forage is eaten away by them. Since the availability of forage grasses is limited with passing time or rise in cattle population range will be used intensively. Grazing grounds near habitations are mowed to naked soil. All nearby grazing grounds are exhausted and overgrown with a mat of dwarf sized *Nilagirianthus heyneanus* as an ecological reaction.

6.6.2 – Encroachments :

There are about 300 encroachments within the national park who have occupied 270 ha. of forest land. These figures are provisional. Detailed survey may change in figures altogether. With the final notification of the national park, encroachments have come to a grinding halt but retrieving the lost forestland is still incomplete. Some of these encroached sites are deep inside the jungles and constitutes small pockets of land. The encroachers tend to interfere with the flora and fauna around these encroachments and as a result, the zone of influence around such pockets is disproportionately large. Fortunately there are not many coffee and tea estates in the national park. There are some on the eastern boundary and each one of them has encroached a bit of forestland. Eviction proceedings are underway as per law.

6.6.3 – Other interferences :

There are several other biotic interferences, which are smaller in magnitude but are of long-term consequence. Of these, the high traffic flows along the national and state highways is the most serious, given the fact that the noise level, pollution load as well as the blinding headlights do not permit free movement of animals. Given the small population size of each species, impediments to *pan mixis* could be genetically disastrous. Secondly huge quantity of litter – all kinds of plastics and bottles is strewn along the roads. Now government has banned the usage of plastic articles in Kudremukh National Park as per Government Order No.FEE 244 ENV 2003 (II), Bangalore, dated : 20-10-2003. Wild animals have been found licking urinated spots, eating discarded ice cream cups and hanging around places where waste food is thrown especially near S.K. Border, Lakya dam, Gangamoola, etc.

The other kind of interference includes swimming in the natural pools along the water courses, collection of medicinal plants by the nati vaidyas (who are in a sizeable number both within and outside the national park and collect a wide range of plants and plant products), etc. People flock to the temples built illegally along the highways inside the park seasonally. Truckers use them as halting place for the night.

6.6.4 – No. of detected offence cases :

The number of detected offence cases epitomizes the extent of law breaking and its future potential. Presented hereunder is the list of offence cases recorded from the national park in the last five years :

Table – 10 : Offence cases in Kudremukh National Park :

Sl. No.	Year	Illicit felling cases	Illegal NTFP cases	Poaching cases	Total
1	1998-99	11	14	02	27
2	1999-00	18	06	01	25
3	2000-01	22	04	-	26
4	2001-02	21	05	02	28
5	2002-03	19	06	-	25

Table – 11 : List of encroachments in Kudremukh National Park :

Name of the district	Name of the Range	No. of encroachment cases		Total encroached area (in Ha.)	
		Before 1978	After 1978	Before 1978	After 1978
Chikmagalur	Kudremukh Wildlife Range	-	70	-	71.24
Chikmagalur	Kerekatte Wildlife Range	-	51	-	28.08
Dakshina Kannada	Belthangadi Wildlife Range	-	37	-	42.29
Udupi	Karkala Wildlife Range	-	-	-	-
	Total	-	158	-	141.61

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CHAPTER - VII

PLAN OBJECTIVES

7.1.1 - Objectives :

Since the Rio Conference, the world is awakening to the complex biodiversity of this planet and the necessity to maintain it for human survival and well-being. The National Wildlife Action Plan, 2002-2016, reinforces it. In this background, the following objectives are set for the management of this park.

- Kudremukh wildlife division is a unique and intact piece of nature close to virgin forests harboring diverse and rich flora and fauna with distinct ecological features. Hence prime objectives is to protect this treasure to the fullest extent possible, so that many endangered and endemic flora and fauna inhabiting the area are adequately protected and propagated.
- Arrest and reverse the trend of forest degradation due to the unsustainable removal of forest products by communities living in and near the forest areas. Restore the degraded portions of the division to its original glory, through habitat improvements and watershed management.
- Reverse the trend of forest degradation due to monoculture exotic species plantation by gradually thinning the exotic species and introducing the local species and fruit yielding species.
- Develop water resources through plantations and water harvesting program. Treatment of micro watershed in the project area by soil conservation, ground water recharge to rejuvenate the degraded habitats and improve site quality. Improving the ground water recharge by desilting the existing water holes; construction of check dams.
- To create awareness and spread the message among the people about the need to protect the nature in general and the wildlife in particular. To educate the people, especially those, who are living in the villages and towns surrounding the division, there by enlisting their co-operation in conservation. To inculcate in the minds of

children, love for all forms of wildlife and the need for conservation of Natural Resources.

- To maintain and develop, to the extent considered necessary, tourism for recreation, education and scientific exploration. To provide wilderness experience to genuine enthusiasts in particular and to the interested public in general. To enable the public to see and appreciate the rich heritage of our Country.
- Involve tribal and other people in protection, wildlife conservation, identify and promote eco-friendly practices and life style pattern by way of meeting ecological awareness among people. Employment generation for the most needy sections of society, particularly those belonging to women, scheduled castes/scheduled tribes and land less rural labourers inhabiting the forestland adjoining area.
- Create durable community assets for such populations, which would contribute to overall Eco-development in the target areas. To reduce the negative impacts of people on the protected area and resolve man-animal conflict and vise-versa through eco-development activities and conservation education.
- To maximize the carbon sequestration and enhance the watershed efficiency.
- To provide for capacity building for efficient management of the park through better training of staff, infrastructure and close monitoring.
- To promote and encourage wildlife research and ecological studies consistent with the long-term management objectives.

7.2.1 - Conservation values in Kudremukh National Park :

Kudremukh National Park is the home to many endemic rare and endangered species of flora and fauna. It is the largest remaining habitat of Lion tailed macaque as well as the largest remaining block of evergreen forests in Karnataka state. Studies into the biodiversity have recently begun. Summarized account is as under :

Flora :

- Kudremukh National Park is the home of an estimated 2500 species of flowering plants a third of which are endemic to Western Ghats. Its wealth includes the most primitive to the most advanced of the plant kingdom and a few “living fossils”. Nearly two hundred are considered threatened. There are 400 species of known medicinal plants, about 180 species of edible plants and about 70 species of orchids. There are at least about 400 tree species (nearly 200 have been labeled especially along the highways).
- Kudremukh National Park is one of the largest expanses of grassland shola ecosystem in the mid-Western Ghats of Karnataka.
- A wealth of 700 to 750 species of mushroom flora is estimated to exist within the national park. But there are very few studies on this group.

Fauna :

- Invertebrates : A large variety of insects including some of the spectacular butterflies and moths occur in the dense evergreen highland and lowland forests. It is estimated that India has over 1400 species of butterfly species of which Western Ghats harbour nearly 320 species including 37 endemics and 23 others shared with Sri Lanka (Gaonkar *et al* 1996). 100 species of butterflies and 50 species of moths have already been recorded from the national park. It has a variety of 73 species of mollusks belonging to 14 families, some of which are highly endemic (Madhyastha – 2003). Research revealed 16 species of ants in this region.
- Fish : 23 endemics and 8 species of common fishes are reported from Kudremukh National Park (Arunachalam *et al* 2001). Mahasheer listed as endangered by Zoological Survey of India, breeds in Tunga river upstream of Sringeri township.
- Amphibians : Over 117 species belonging to 21 genera of amphibians are recorded in the Western Ghat forests and coastal areas of which 76% are endemic to the region. About 35 species of amphibians including 5 species of apodons were recorded in the national park in Sringeri taluk. According to

IUCN red list category, Kudremukh National Park has three endemic and seven vulnerable species of amphibians.

- Reptiles : National park is the home of King Cobra, Rock python, 20 species of other snakes,. 10 species of other reptiles including the monitor lizard and Pangolin.
- Birds : 400 species of birds occur in the Western Ghats. Evergreen forests of the national park are estimated to contain about 150 species of birds including the Great hornbill, Ceylon frogmoth etc. Among these about 16 species are endemic (27-30 if sub-species are included) and many having a patchy distribution.
- Mammals : Kudremukh National Park hosts 38 species of mammals belonging to 28 genera. It also contains some of the rare primates such as Slender loris, Lion tailed macaque, four species of civets, Malabar giant squirrel, common giant flying squirrel and small travancore flying squirrel.

Ecological values :

- National park is the catchment for Tunga, Bhadra and Netravathi rivers, which play a vital role in the regional economy. It receives one of the highest rainfall in South India (average of 7000 mm per year). Huge quantity of water is held as underground reserve and the same is fed into rivers following the monsoon.
- It has one of the highest standing biomass estimated at an average of 250-300 tons per ha. and therefore acts as one of the great carbon sinks.
- The national park moderates regional climate because of its ability to condense the atmospheric moisture into precipitation and also works in the reverse direction transpiring huge quantities of water that go towards cloud formation. It has a vast and enduring effect on the regional climate.

Economic :

National park has one of the highest quantities of proved iron ore reserves.

7.3.1 – Impediments in achieving the objectives :

- a) Presence of large number of settlements in the PA
- b) Excessive fire and grazing pressure
- c) Mining and associated disturbances
- d) Exotic plantations

7.4.1 – Plan period :

Organization and administration of the park is well laid out and will not warrant frequent reviews. Important processes such as conversion of monoculture plantations into polycultures, voluntary rehabilitation of people and the reclamation of mine site suggested in this plan are likely to be somewhat long drawn. So this plan is prepared for a period of 10 years commencing from 2003 to 2013. Review will be due around 2010 by which time the above processes would have been achieved and the park management is required to be reoriented towards still higher objectives. This is a reasonable period to eliminate all the pressures on the park and consolidate the management practices. By this time, about 30 years of rest would be available to the natural forests to recover and reach a secondary climax.

Under this plan, there are two cycles of five years each. During the first cycle, it is programmed to establish required infrastructure such as staff quarters, patrolling track network, bridges, nature camps, etc., remove all the encroachments, reclaim the mined area, liquidate all the exotic plantations and remove and rehabilitate the inhabitants from core areas. During the second cycle, the focus should be on habitat development, rehabilitation of the remaining enclosures, replacement of the worn-out infrastructure such as vehicles, wireless, etc., and eco-development on a modest scale. However, reclamation of mine and rehabilitation of inhabitants have not been included as a part of this plan.

CHAPTER – VIII

THE STRATEGIES

8.1.1 – General :

Through a series of measures, most of the objectives set out for the first phase of the previous plan are achieved. National park is now totally free from timber extraction operations. Protection level is enhanced. Hunting pressure on the mega fauna has come down drastically. The forests have been regenerating very satisfactorily. So faunal density is also growing appreciably. Constitution of the park and the restrictions thereon are also adequately publicized. The park is now at a crucial stage of take off. For achieving the plan objectives, the following strategies are necessary :

- a) Provide for an efficient administration and effective protection,
- b) Reverse the habitat fragmentation and consolidation thereof,
- c) Zonation of the national park and zone wise prescriptions
- d) Tourism and
- e) Mitigate the external pressure.

8.2.1 - Strategy 1 : protection :

The forests have been organised into compartments. Beats and sections have been reconstituted accordingly. Strength of beats and sections has been enhanced. Required executive staff details are furnished in **ANNEXURE - XII**.

Effective protection is the subject matter of next chapter as a theme plan.

8.3.1 - Strategy 2 : Habitat consolidation :

Park boundaries on the eastern side are irregular, highly convoluted and irrational. It passes halfway through the hill slopes along the contour segregating the tree line from the grasslands, both of which are ecologically integrated. Unfortunately, the legal status of the tree-clad land just below the reserved forest boundary frequented by wild animals is not firmly determined. It is better to add such areas to national park

and rationalize the boundary from Mullodi uptill Balige and further up till Thanikodu and issue a fresh notification so that the park boundary represents the ecological boundary intotality. Ideally the boundary should pass along the western boundary of Balige, Honnekadu and Kalkodu settlements and Jarkuni coffee estate.

There are also good pockets of thick vegetation extending out from the national park at Buktibail and Kigga. This can also be easily added for effective protection and control. Their addition will enable the formation of outer game paths along the contours for permanent boundary demarcation and effective protection. Otherwise the national park will left with irregular and illogical outer line along its eastern boundary which would be difficult to maintain.

Someshwara Reserved Forest serving as a corridor between Someshwara Wildlife Sanctuary and the Kudremukh National Park is proposed to be added to the sanctuary and if it is done, it will be in fitness of things.

There are some large parcels of land both within and outside the national park, which contain similar flora and fauna but are not a part of the national park. Tholali, Heggan and Matholi represent such parcels of land belonging to private individuals inside the national park. 300 ha. of forest belonging to Varanga jain mutt on the north-west represents the private land parcel abutting the national park. There are certain wooded land parcels belonging to government all along the northern and eastern boundary of the national park, which are extension of the park itself. Such parcels exist at Kigga, Himige, Mavinakadu, Sallolli, Elemane, Balige, Honnekadu, Karle, Sunti kumri, Mullodi and Basrikal. It is necessary to consolidate the habitat by acquiring the private land parcels and adding the government lands to the national park so as to make it a complete ecological entity. All these parcels of land contain similar flora and fauna as that of the national park.

8.3.2 - Rehabilitation of inhabitants :

Containing the influence of the inhabitants and their cattle on the national park will be humanly impossible because of their wide distribution and numbers. Conversely, the national park will put the local people to lot of difficulties because of restrictions on rural development and wild animal depredations. In the interest of

people's future development, a relocation and rehabilitation package needs to be offered to those who are willing to accept it. It may not be possible to rehabilitate all the inhabitants at one time. Therefore it may be taken up in stages. During the first phase of the plan, inhabitants of the core areas along with isolated very small hamlets in the adjoining areas should be considered for rehabilitation. A separate project for this purpose is already conceived and it is receiving the attention of the government. This project should be brought into effect as soon as possible and implemented humanely. The lands so retrieved should be added to the national park through a separate notification. No treatment is proposed to lands so acquired except demolition of structures along with other plantation crops etc., which may otherwise act as a temptation for the people to revert to these sites on occasions. These areas will act largely as grazing grounds and wetlands for the wild animals. These may become the favorite grazing grounds in due course of time. A few salt licks, ponds and check dams will be an added advantage. It is necessary to keep these sites free from the invasion of trees especially in Karkala and Belthangadi Wildlife Ranges where grazing grounds are few and far between. Game paths/patrol tracks should not directly lead to such sites. Such land should be allowed to remain fallow for all times.

8.3.3 – Mine reclamation and management of the Kudremukh township :

The Hon'ble Supreme Court of India in its judgment in I.A.670/2001 in W.P.202/1995 passed an order to close down the mining operations in Kudremukh by December 2005. Following this judgment, Government of India had given concurrence for renewing the mine lease up to December, 2005.

In this background, steps have to be taken to re-notify the deleted portion of national park and also work out a package for winding up the mining operations. This has to be dealt as an independent project. Ideally, all the structures should be demolished and the lease area should be restored to its original condition as quickly as possible. Mine site should redone to natural slope and planted with local grasses and ferns. Works should begin sufficiently in advance so that the reclamation task is totally and properly accomplished with the resources that are to be acquired for this purpose from the lessee company as per the terms laid down in the original lease as well as the latest orders of the Government of India and Government of Karnataka.

8.4.1 - Strategy 3 : Park zonation :

The national park is to be zoned theoretically for the purpose of planning, programme implementation and administrative convenience. Zone map is furnished in **Plate – 13**. Four zone are recognized as under :

Table - 12 : List of zones :

- a) Core Zone – Consists of the following compartments :

Range	Compartments
Karkala	12, 14 - 2 nos.
Belthangadi	2, 9, 13 & 14 - 4 nos.
Kerekatte	6 to 17, 19 & 22 - 14 nos.
Kudremukh	3, 4, 8, 9, 16, 17 & 18 - 7 nos.
Total	27 nos.

- b) Habitat Improvement Zone – Consists of the following compartments :

Range	Compartments
Karkala	1 to 7, 9 to 11, 13, 16, 18 & 19 - 14 Nos
Belthangadi	1, 4, 8, 10 to 12, 15 to 20 - 12 Nos
Kerekatte	1 to 5, 23 & 25 - 7 Nos
Kudremukh	1, 2, 5 to 7, 12, 15, 19 to 21 - 10 Nos
Total	43 nos.

- c) Tourism Zone – This is not an exclusive zone but a overlapping one covering the following compartments :

Range	Compartments
Karkala	8, 15, 17 & 20 - 4 nos.
Belthangadi	3, 5 to 7 - 4 nos.
Kerekatte	18, 20, 21 & 24 - 4 nos.
Kudremukh	13 & 14 - 2 nos.
Total	14 nos.

- d) Buffer Zone – This is a zone of 5 kms outside the boundaries of the national park. This is not constituted into any compartments but the areas have to be dealt village wise. This zone is constituted mainly for eco-development work but to foster and strengthen the relationship between nature and people.

As of now, there is no distinction of each zone on the ground. This is not possible immediately due to a number of interferences. It can remain as the ultimate objective to be accomplished after the rehabilitation programme is completed. The core zone deserves to be given the best possible protection, as the animal density is very high in this region. Habitat improvement zone is a sort of first buffer to the core zone. Habitat improvement works are required all over the national park considering its infancy and the need to carry out basic components of habitat development works in metamorphosing a commercial forest into a national park. The buffer zone outside the national park is to be declared as an eco-sensitive zone to prevent the entry of environmentally unfriendly industries and to take up eco-developmental work. 5 km. Buffer + vegetation map is furnished in **Plate – 14**.

8.5.1 - Strategy 4 : Eco-tourism :

By definition eco-tourism is a responsible travel to natural areas that helps conserve the environment and sustains the well being of local people. It has five basic elements, namely,

- Responsibility, concern and commitment to conservation
- Community participation and benefit sharing
- Respect for local culture, traditions and laws of the land
- Visitor satisfaction
- For education and
- Generation of local employment

Planning and creation of infrastructure facilities should take into account these factors. Kudremukh National Park should be promoted as a wilderness area.

8.6.1 - Strategy 5 : Eco-development :

The national park essentially covers hill region. A large number of habitations exists at the foothills all around and draw upon the resources of the national park. This is a permanent zone of interference, which cannot be eliminated because it is outside the national park. The nature and extent of pressure have been discussed in para 4.7.1.

These areas are to be declared as eco-sensitive zone under Section 5 read with rules 5 and 13 of Environmental (Protection) Act, 1986 and rules there under so as to eliminate new land based projects coming up within the zone and creating further pressure on the PA.

It is necessary to take the help and support of local people in promoting the conservation objectives. Harmful and unsustainable uses of resources have to be gradually remolded into sustainable alternatives, which may demand substitutes or warrant an altogether different life style around the national park. Both these components should be integrated and promoted in a harmonious way so that conservation becomes a way of life rather than a programme. In the run up, local people, their resource requirements and problems should be addressed first to reduce the pressures on the park and eventually engage the general public in promoting conservation education.

A separate eco-development project is required to develop buffer areas and to secure constructive public support. It is an important strategy and it will not be possible to undertake the same with the present level of resources. Separate funds are available from Government of India for the eco-development, which should be availed. Buffer villages should be prioritized and site-specific programmes should be designed and implemented. Some of the suggested programmes are;

- a) To involve the fringe villagers in developing alternate source of biomass, fuelwood, etc., including NTFPs and diffuse the pressure on protected area.
- b) Reduce man-animal conflict by providing stonewall, solar power fencing, etc., so that wild animals do not stray out and damage crops and property.
- c) Provide for replacing the local cattle with better breeds, construct gobar gas plants, provide solar lighting, supply subsidised ferro-cement wood substitutes and also initiate certain welfare measures like drinking water supply, organizing medical camps etc.
- d) Provide immediate and substantive relief in case of damage to life and property by wild animals and take measures to reduce the future risk.
- e) Provide gainful employment for the local landless people and marginal landholders through forestry works.

- f) Support alternate livelihood strategies like guides, transporters, hospitality organisations, etc.
- g) Involve the local people to share the management responsibilities of the protected areas.
- h) Promote land use practices compatible with bio-diversity conservation.
- i) Improve the economic conditions of the nearby villagers by making them to grow medicinal plants, vegetables and fruit yielding plants.

The whole task will be rendered easy if the local people are enlightened about the significance of wildlife and bio-diversity conservation. So regular conservation education programme should be taken up for the people in and around the national park. Public opinion makers, youth and school children should be the main target. Traditional rights of villagers in the buffer zone may be honored to the extent they do not jeopardise the conservation objectives.

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CHAPTER - IX

PROTECTION OF HABITAT

9.1.1 - General :

The national park enjoyed a fair degree of protection on account of its terrain and thin population density. Staff provided originally for the management of the national park is grossly inadequate and some posts need to be shifted. A large number of posts remain unfilled. The principles underlining the protection is

- a) Providing protection to the natural flora and fauna against predation by human beings (smuggling, poaching, and encroachment).
- b) Management of fire
- c) Protection of wildlife from live stock (communicable disease)
- d) Maintenance of boundary demarcation
- e) Providing good communication to achieve all of above.
- f) Fencing to exclude domestic livestock from the area for the benefit of the wildlife.
- g) Creation and maintenance of firebreaks and fire lanes.
- h) Conversion of monoculture exotic species plantation into diversified woodlands.

9.1.2 – Significance of Wildlife Habitat :

Wildlife and wildlife habitat play a vital role in the ecological and biological processes that are essential to life itself. The functioning of the biosphere, and hence the maintenance and enhancement of human life, depends on countless interactions among plants, animals, and microorganisms.

These ecological processes are essential for agriculture, forestry, fisheries, and other endeavors necessary to human life. They also help maintain environmental quality by degrading and otherwise removing some pollutants and by preventing waste accumulation. Some of the biological processes in which wild species play a key role

are pollination, germination, seed dispersal, soil generation, nutrient cycling, predation, habitat maintenance, waste breakdown and pest control. Birds, for example, can be important in controlling insect pests.

Biological diversity, or biodiversity, means the variety of life on earth and includes the entire web of living organisms from soil microbes, plankton, frogs, and trees to grizzly bears and blue whales. From the perspective of sustainable use, wildlife is a renewable resource that provides many benefits and socioeconomic advantages. Sustainable use is defined as "the use of components of biodiversity in a way and at a rate that does not lead to long term decline" but maintains the "potential to meet the needs and aspirations of present and future generations." Sustainable use will ensure that the numerous tangible and intangible benefits of wildlife that we enjoy today can be enjoyed by future generations as well.

Wildlife habitat regardless of whether it is upland or wetland habitat, is significant because of a number of functions it performs to support wildlife. Wildlife needs adequate space and habitat for the following basic life requirements:

- Safe, undisturbed areas for breeding, both on land and in the water;
- Shelter, which can be underground, in the soil, on the land surface, in water, or in trees and shrubs;
- Food supply, which may require suitable habitat for the plants and animals that provide the food supply;
- Migratory routes; and
- Over wintering areas for those species that require seasonal migration for shelter or breeding.

9.1.3 – What's green landscaping about ?

Using a greater variety of plants, primarily natives

Native plants :

Native plants (also called indigenous plants) are plants that have evolved over thousands of years in a particular region. Native plants occur in communities, that is, they have evolved together with other plants. As a result, a community of native plants

provides habitat for a variety of native wildlife species such as songbirds and butterflies.

Numerous organizations produce lists of native plants, often with information on the conditions they require. There are also state and federal agencies and programs, native plant nurseries and societies you may wish to contact, or software you can use. In addition, many state programs provide technical resources as well as financial assistance.

9.1.4 - Importance of native plants :

Native plants have been growing and evolving for thousands of years and, as a result, have adapted to its soil type, rainfall, and temperature. As a result they are more likely to thrive with minimal care than exotic plants. That can mean less need for water, fertilizer and pesticides. Also, native plants are less likely to create environmental havoc when they're planted, unlike aggressive exotics such as kudzu.

Native plants have evolved so that they have an integral place in the ecosystem (local community of plants and animals). Other plants, animals and/or insects may require them for habitat or nutrients during all or parts of their life cycles. When natural areas are lost or cut into pieces or harmed in other ways from our activities, what's left becomes all the more critical for the survival of many species. By using native plants we can help offset these losses. Of course, not every native plant will thrive in every location. It's important to know your site conditions and the requirements of the native plants when making a selection.

9.1.5 - Some important facts :

- Native plants do not require fertilizers
- Native plants require fewer pesticides than lawns.
- Native plants require less water than lawns.
- Native plants provide shelter and food for wildlife.
- Native plants promote biodiversity.
- Native plants save money.

9.1.6 - Establishing forest protection camps and intensive patrolling :

In view of better protection and control the original beats and sections have been reconstituted. Even so, in a terrain of this nature, it is physically impossible for the executive staff to be in total command of the area. Good protection is possible by intensive foot patrolling in groups or teams. It will be rendered easy if the field staff stay close to the forest. While on patrol, there should be enough number of staff to apprehend the wrong doers because it is easy for them to escape or challenge. Therefore a strategically located forest protection camp should support every section forest officer. Each camp should consist of a posse of three people and should be housed within the park in appropriately built camp sheds. Permanent staff should join the camp team on shift duties and patrol the beats and sections very intensively and regularly. Permanent staff should lead the protection camp staff. They should not patrol independent of each other. Ideal patrol team size should be four people equipped with a weapon and wireless set. Staff will be greatly benefited by periodic trainings in this regard. Establishing sufficient number of these camps and ensuring that all parts of the park are patrolled regularly is the most important aspect of protection. As far as possible, tribals and local youth familiar with the forests should be employed on these camps. At the rate of one camp per section, 17 antipoaching camps are necessary for the entire national park. These camps should not be positioned in one place forever nor should the same people continued in the same camp. Problems vary temporally and spatially and therefore the protection camps should relocate themselves accordingly to address the problems. List of the places suggested for construction of semi-permanent sheds is as under :

Table – 13 : List of places suggested for semi-permanent sheds :

Sl. No.	Range	Section	Locations
1	Karkala	Nuralbettu	Gundi
2		Mala	Bijjale
3		Kervase	Narsebail
4		Andar	Kabbinala
5	Belthangadi	Kuthloor	Alambra
6		Savanalu	Manchadakallu
7		Navoor	Gundalpade
8		Mittabagilu	Podi ketharu
9		Mithabagilu	Shanthigudde
10		Savanalu	Kungibanta
11		Navoor	Tholali

12	Kudremukh	Bhagavathi	Kuringal
13		Samse	Seethabhumi
14		Malleshwara	Tholali
15		Samse	Yelneer
16	Kerekatte	Shirlu	Padmagudde
17		Kerekatte	Heggan
18		Kerekatte	Manikyabetta
19		Nemmar	Thanikodu
20		Nemmar	Kadekal
21		Menasinahadya	Kyathanamakki

They should be so designed to command a good view of the forest, but remain camouflaged and should be accessible to the wireless network. Every camp should be provided with maps, minimum facilities for cooking, a weapon, a walkie, first aid kit and solar power. Free rations also have to be provided. Protection camps should attend to the problems relating to stealing of NTFPs/timber, cattle grazing, fire, trekkers, litter, petty maintenance works, etc. Each camp should maintain a daily movement cum observation register wherein all kinds of information pertaining to the flora, fauna and offences should be registered. The proforma for recording daily information and data is furnished at **ANNEXURE – XIII**. This register is of great value especially in estimating population densities of mega fauna, which is otherwise very difficult in evergreen forests besides giving a general idea of the floristics. Copies of these registers should be collected every month at the divisional office, compiled and maintain as permanent record.

9.2.1 - Fire management :

Fire is a not serious problem in Karkala Wildlife Range but in the other three ranges, it is one of the worst problems. While fire as a tool to manipulate the habitat is indeed essential, indiscriminate or misuse creates irreversible problems. Fire and humans have co-evolved. It is the most ancient tool by which man projected himself into the landscape. A fire regime is thus a cultural as well as a biological system. In the instant case, all fire regimes are human artifacts associated with his activities such as agriculture, gathering forest produce, hunting, fishing as well as grazing and therefore cannot be eliminated so long people inhabit the park. The extent of grasslands and the present frequency of fires is a direct indicator of the grazing pressure on the

forestland. So long cattle continue to visit the national park, the threat of fire cannot be eliminated.

Fire management as such is not a logical system rationally applied. We lack control over fire environment. Put in a different sense, fire misbehavior is an expression of human misbehavior. The occurrence of fire is therefore irregular, unpredictable and therefore not totally preventable. So the option available is to educate the public, take adequate precautionary measures for fire prevention and to suppress the fire if detected.

9.2.2 – Prescribed burning / advanced burning / control burning prohibited except in Karkala Wildlife Range :

For a few years control burning / advance burning of grasslands was practiced in the park but the results have not been impressive. It has put the ecology of grasslands at stake. The nearby woody vegetation was prevented from spreading out. Over the years the diversity and vigour of grasslands is affected. There was a great loss of life especially of the micro fauna and the food chain of insect dependent birds is seriously affected. Accidental fires are good enough to maintain the diversity of habitat. Yet as precautionary, control burning / advance burning of grassland will be continued.

However, in respect of Karkala Wildlife Range, grassland is a very critical factor. There are very little grasslands and whatever exists is planted with exotics. Grass has therefore become a serious limiting factor. Consequently herbivore density is negligible and even this population is forced to raid the private farmlands in the vicinity of the national park for fodder. They incur the wrath of farmers and quite often get liquidated silently. To avoid this situation, it is necessary to restore the natural grasslands quickly and also keep them continuously in the same state through annual prescribed burning during December. Existing natural grasslands are very inadequate north of the national highway in Karkala Wildlife Range. Therefore a sincere attempt must be made to create artificial grasslands over the abandoned or acquired farmlands in this part of the national park.

9.2.3 – Creation and maintenance of firebreaks :

Firebreaks should be created along the highway margins, game paths, hiking paths, hill ridges and around popular picnic spots. The firebreak should be of 4 meters width. Fallen trees on these lines should be cleared and disposed off. If it is possible to cart the timber from the firebreaks, they may be removed to the nearest depot and utilized for eco-development works. The network of game paths and the patrolling tracks act as permanent firebreaks and they should be so maintained by annually clearing the grasses and other weed growth in the month of December. Normally these belts are fire traced. If the work of clearing firebreaks is undertaken in late November or early December, it helps in generating a new flush of grass along the firebreaks. This was found to be more effective than late clearance and fire tracing.

Fire zones are generally well known and therefore the required firebreaks have been identified and prescribed for annual clearing in the programme of works. If necessary, new firebreaks may be created especially around the plantation felling coups or vulnerable sholas. The patrolling tracks play a significant role as firebreaks in addition to improving the access for fire protection. Therefore new paths may be carefully aligned and constructed in all the highly vulnerable fire zones especially in Kudremukh Wildlife Range. So far as Belthangadi and Kerekatte Wildlife Ranges are concerned, the forest protection camps should be relocated close to the grasslands in summers to be effective and watchful.

9.2.4 - Fire detection and control :

The terrain of the national park permits easy detection of fire from a few hilltops. The places ideal for this purpose are :

- | | | |
|-----------------------------|---|---|
| 1. Kerekatte Wildlife Range | - | <ul style="list-style-type: none"> a) Machangudda b) Manikyabetta c) Sooji gudda near Tanikodu |
| 2. Kudremukh Wildlife Range | – | <ul style="list-style-type: none"> a) Seethabhumi b) Bangaru balige c) Gangrikal d) K-1 Extension |

3. Belthangadi Wildlife Range – a) Didupe nature camp

Permanent look out towers should be constructed at these stations. Staff should be positioned on them. Kudremukh and Kerekatte Wildlife Ranges should equip themselves with at least two jeeps and 20 labourers each exclusively for fire protection job and station them at convenient locations. These teams should be dispatched to the scene of fire immediately on message to put out the fire. Road network should be developed in a manner to enable these teams to reach the fire spots in about half an hour's time. The forest protection camps may also be appropriately redeployed to keep a check on the fires and avail their services in the hour of need. Wild fire spreads rapidly and exponentially. The number of fires cannot be reduced substantially in the near future pending complete rehabilitation of all the inhabitants but the extent of fire damage can be brought under control. All preparations and arrangements must be so made that any fire reported will be acted upon and extinguished in less than an hour. Fire protection staff and arrangements should be in place by the middle of December and can be wound up by the end of April. During exigencies more parties can be engaged and hired vehicles can be used. But this will be required for a brief period from the middle of February to the middle of April.

9.2.5 – Fire monitoring and reporting system :

Incidents of fire should be reported to the head quarters on wireless immediately. The Range Forest Officer should submit a daily report of fire occurrence in the following format to the division office from January to end of April every year :

DAILY FIRE REPORT				
Range :			Date :	
Sl. No.	Compartment No.	Time of detection	Time of attendance	Summary of damage to forest
Signature of Range Forest Officer				

The Range Forest Officer should record the fire occurrences in the range map for future references. The Assistant Conservator of Forests and Deputy Conservator of Forests should also maintain a strict vigil on the fire.

9.3.1 - Protection against grazing and NTFP collection :

These two aspects are directly related to the human habitations inside the national park. So long the enclosures exist and people are allowed to continue in their traditional agrarian profession, rearing of cattle as well as collection of variety of forest products necessary to support their livelihoods is unavoidable. A sustained campaign of bringing awareness among the inhabitants may slightly reduce the intensity of these activities but total control will only be possible when all the people are rehabilitated. Till such time punitive action against organised offences of NTFP collection and cattle grazing should be initiated and taken to logical conclusion.

9.4.1 - Protection against encroachment :

The only issue that is specific to the national park is the numerous revenue encroachments in the enclosures of the park. This issue affects tribals. Due to historic reasons as well as ignorance, they never considered it necessary to possess titles for the lands they have occupied. They are caught in a difficult situation of neither being able to pursue their traditional life style because of the restrictions imposed by wildlife law nor avail compensation and seek a resettlement package. As a result, they have developed considerable resistance to the national park and its programmes.

9.5.1 - Protection from communicable diseases :

Although there was no recorded of epidemics to the wild animals, abundant precaution is necessary as any incident could wipeout the entire ungulate population. Immunization of cattle within the national park as well as those outside up to a radius of 3 kms. should be regularly done at government cost. This is very expensive considering the ephemeral nature of animal vaccination. It is not a permanent solution to the threat. So a sustained effort is necessary to upgrade the cattle breed especially in the fringes and the zone of interference. Promotion of stall-feeding, fodder plots,

artificial insemination and dairy will stave off the threat. It reduces the pressure on the park and also helps improve the economy of the region.

9.6.1 - Poaching :

Poaching of small game such as Flying squirrels, Indian hare, Mouse deer, Monitor lizard etc, is rather difficult to detect. Poaching of big game except wild pig is few and far between. However vigil has to be maintained since the old habits die-hard. This is to be accomplished through a series of forest protection camps mentioned in para 9.1.6.

9.7.1 - Communication facilities – wireless network :

For effective protection against theft, fire, grazing, etc., good communication facilities are necessary. An efficient wireless network is already functional. Due to the addition to existing staff strength, the number of wireless sets will fall short. So new wireless sets should be purchased and every permanent staff member should be given a good wireless handset. All the wireless equipments including the repeaters should be toned up and kept in good working condition round the year and specially so during the fire season through annual maintenance contracts.

9.7.2 - Development and maintenance of patrolling track network :

A good road network is necessary to provide access to the remote areas. The existing road network has been developed keeping this aspect in mind. However there are still certain shortcomings and all problem areas are not accessible. Forest areas east of Kudremukh township and the hill ranges around Lakya reservoir are inaccessible but highly fire hazardous. Koppa taluk portions as well as the northern part of Narasimhaparvatha State Forest is inaccessible but problem ridden in so far as NTFPs and poaching are concerned. Therefore new patrolling tracks should be planned, aligned very carefully and developed at the earliest. The patrolling track network map furnished at **Plate – 15** also indicates the alignment of proposed tracks. New tracks should avoid deep cutting. Filled edges should be planted with grass slips. Side and cross drains should be provided sufficiently. Wherever necessary bridges and culverts should be built. As far as possible, they should be networked without providing access

to outside areas. It should be possible to access one area from another without necessarily going to the head quarters or to the main public roads. Every patrolling track should be provided an entry barricade maintained under lock and key. These barricades should be always kept in locked condition and the custody of the keys should remain only with the officers.

9.8.1 – Boundary and D’line maintenance :

External boundaries have to be maintained very clearly and regularly. Demarcation pillars engraved with the national park title should be planted all along the outer boundaries. This should be a routine programme and should be accomplished along with other habitat development works as per the schedule of programme. Unless serious boundary disputes arise, there is no need to deal with the boundary demarcation programme as an independent work.

Maintenance of internal boundaries especially around the enclosures is also necessary so long the rehabilitation programme is not completed. Whenever encroachments are evicted, the boundary should be got immediately demarcated permanently.

Rationalization of park boundary by enclosing adjoining woodlets and small reserve forests will be taken up at a later date.

9.9.1 – Public education :

Within the Kudremukh National Park, cattle grazing and forest fires are the two sides of the same coin. So long huge cattle herds are maintained, fire is totally unavoidable and uncontrollable. Secondly people have never been educated about the long-term consequences of fire especially in terms of loss of soft palatable grasses and poor water retention. So a sustained campaign of public education through handbills, films, posters, display boards etc., should be taken up. Serious efforts are also necessary to try and convince them to reduce the cattle herd size. Effective steps should be taken to prevent cattle grazing inside the national park. It should form a part of the duties of the forest protection camps to drive away the cattle if and when found in

the national park. A scheme to improve the cattle breed should be worked out as a part of eco-development for the buffer zone all around the boundaries.

9.10.1 - Summary :

Protection is an important aspect until the rehabilitation of all inhabitants is completed and must be taken up with all seriousness. Sighting of animals is a direct indication of the degree of protection given. The present level of animal density is too low and unless the ungulates are well protected, the possibility of carnivores going up in numbers is remote. As such the carnivore density is abysmally low and if ecological balance is to be restored, protection should be treated as a fundamental strategy in the overall management of the park.

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CHAPTER - X

HABITAT MANAGEMENT

10.1.1 - General :

This practice is applied to land with existing tree cover or lands capable of growing trees or other woody vegetation to provide multiple resource benefits. The purpose of this is to establish or improve habitat for native species of wild life and plants. The national park, as a habitat is in good prospect but it is under tremendous pressure from different sources. The fundamental principles underlining habitat management are,

- a) Return the land to the natural flora and fauna (removal of exotics),
- b) Reduce human interference,
- c) Establishment of native trees or shrubs, seed producing perennial grasses, legumes and other specified small gains,
- d) Seeding and propagation of threatened and endangered plants,
- e) Vegetation management to control undesirable species and improve habitat quality
- f) Creation of habitat linkages (wildlife corridors)
- g) Water resource development including shallow water areas, waterholes and wetlands.
- h) Minor water control structures for develop establishment of desirable vegetation, control of noxious vegetation and promote natural water level fluctuation beneficial to wildlife.

10.2.1 - Return the lands to natural flora and fauna :

Extensive plantations of exotic species blot the national park. By suppressing the grasses they have displaced the local flora and consequently the fauna. Plantations have been done close to the villages and highways because of the labour availability and ease of access. Consequently cattle are forced to migrate further interior and accordingly there is a shift in the feeding and breeding grounds of the wild fauna. To

support the cattle, people also traverse deeper into the forest and kindle fires. Consequently exotic plantations have been a cause for shrinking the natural habitat drastically. Exotics have no ecological role. Therefore all the exotic plantations except those falling within the lease area of Kudremukh Iron Ore Company Limited have to be removed within the first five-year period of this plan. Company plantations should be dealt as a part of the reclamation project of the mine and township areas. Principles of silvicultural management or economic returns should not come in the way of liquidating the exotics. The following principles should be observed while extracting the plantations :

- When a compartment is taken up for working as per the programme of this plan, all the plantations including the dead and standing stock in the entire compartment should be marked and extracted in the same year. Not a single exotic tree shall be allowed to continue till the next cycle.
- Extraction work right from marking to fire protection of the site till the end of the summer season should be entrusted to a government agency or done departmentally.

10.2.2 - Teak and other plantations :

There are a few teak plantations aged more than 40 years on the northwest of the park. There is sufficient natural regeneration of local species within them. Congestion is not evident as the growth rates are negligible. However where congestion has taken place and teak trees are struggling to survive due to lack of light, some thinning of teak poles has to be carried out. Dibbling of fruit yielding species may enrich these sites. Similar operations may also be taken up inside the softwood plantations also. Further the exotics should be removed and seed dibbling, planting of cane, bamboos and other naturally aided plantation can be taken up.

10.3.1 - Natural vegetation management :

The objective is to maintain pristine conditions within the national park to capture the full spectrum of biodiversity and also unleash the full watershed potential.

Kudremukh National Park is a place of many specialties and the emphasis is to maintain and further sharpen these characteristics. Evergreen forests are summits of creation and no one can improve an undisturbed forest. In fact man was only successful in simplifying complex eco-systems and not otherwise. His interference will result regression towards non-specific life forms and therefore not desirable. In these sensitive forests, we don't know the safe limits for manipulation. Natural vegetation should be left to itself totally and there should be no interference of any kind. Because of this approach, there could be a slight fall in the over all bio-diversity. But this is to be expected because nature keeps a redundancy reserve in the form of biological nomads to meet contingencies and if external manipulations are eliminated, they get phased out. What is finally achieved is a state of balance – a second climax that would remain stable and therefore perpetuate itself thereafter. Gap dynamics are no doubt important in maintaining the biodiversity but the forests themselves are capable of generating appropriate gaps by shedding of limbs or through fall of trees. No separate efforts need to be made for this purpose.

However, a limited manipulation in the form of removal of weeds, shrub growth and tree growth up to the size of pole crop is permitted in the former cultivation sites to maintain them as permanent meadows. Such site already exists in Muduba of Kerekatte Wildlife Range. This site needs to be maintained annually free of any woody vegetation.

10.4.1 - Soil and water conservation :

Soil is a non-renewable resource and all the nutrients in the high rain fall zone is held in a state of equilibrium in the top 10 to 15 cm of the soil and in the vegetation. Any disturbance, of any magnitude is bound to affect the nutrient cycling. The nutrients get washed down and replenishments will be extremely difficult to regenerate.

It is necessary to take up construction of gully checks not only to retain the soil but also to improve the water storage capacity. This is more so in upper reaches and in plantation areas. It may not be possible to treat the entire compartment at one go. Therefore it is suggested that problem areas of each compartment should be identified and given priority for treatment in the first cycle. However in the second cycle, a general treatment of the entire compartment area for soil and water conservation

measures should be taken up. Gully checks should be constructed with available rubble stone especially in the higher reaches and the grasslands. Soil and water conservation measures are a part of routine habitat improvement programme.

10.4.2 - Water resource development :

Certain management interventions help the wildlife disperse uniformly and avail the full benefit of the habitat. These are to be used in a limited way after assessing the ground situation. They can also be carried out to aid and promote eco-tourism. Water is generally not a constraint but if small sources are developed at higher elevations especially in the grasslands, it will be very helpful for the wildlife. Ponds / check dams developed so far are clustered towards the periphery where water is readily available and also there is a danger of contracting communicable diseases from domestic cattle. All future works should focus on the grasslands where water is a constraint in summers. Springs should be identified and small ponds / check dams are to be constructed by at the time of working in the compartment. The number of available springs is very small. Where suitable and necessary, available water sources in the shola forests may also be developed. On an average if one pond were available over an area of 10 sq. kms, it would be adequate. These ponds should be disilted on a cycle of five years as a part of the works in the compartment.

10.4.3 - Provision of salt licks :

There are no natural salt licks within the park. By experience it has been found that artificial salt licks are very well utilized. So we can continue to renew the existing salt licks annually and also provide for more if necessary. On an average, three to four salt licks can be provided within the vicinity of each pond. Overall 100 to 200 salt licks per range fairly well distributed would be sufficient to meet the requirement of animals. Each salt lick should be replenished with 25 Kgs. of salt twice in a year after the monsoon.

10.5.1 - Summary :

Except removal of the exotic plantations, other items of habitat development have been given greater thrust in the later part of the plan period because the available

habitat is large enough to accommodate the present wildlife population. However works would be necessary to achieve the objectives of improving the watershed efficiency and sequestering the atmospheric carbon in greater quantities. Scope is big but quantum jumps will not be possible because of the complex environmental and ecological issues involved. Therefore habitat restoration programme should proceed steadily over a long time frame.

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CHAPTER - XI

ECO-TOURISM

11.1.1 – Introduction :

It is recognized that unless people from different walks of life see and experience for themselves the serenity and beauty of the natural environment, the sheer richness, complexity and delicate balance that exists within the biological world and the grand nature of many rare and endangered species such as Lion tailed macaque, king cobra, wonderful orchids, etc., they are unlikely to appreciate the true value of biodiversity conservation and in turn the required public support may be found wanting. In every visitor to park lie a potential friend, supporter and crusader for future conservation.

11.2.1 – Eco-tourism :

Eco-tourism is unique in several ways in Kudremukh National Park. There are many attractive landscapes, replete with thick glades of forests, clear and silent streams and religious places. The picture perfect landscapes and their wilderness attract a lot of visitors mainly as trekkers. The tourist spots are rather dispersed and therefore as of now the pressure is not felt. Eco-tourism is markedly different from other kinds of tourism and requires a sensitive and cautious approach including meticulous planning. So lot of planning is necessary to enhance the physical carrying capacity and also ensure that visitors experience the wilderness.

11.3.1 – Tourism zone :

There are three tourist zones around the three ranges viz., Belthangadi, Kudremukh and Kerekatte. Each zone is so located to be connected to a few visitors' spots as discussed in para no.5.4.1. Tourist zone of each area is limited to the spread of these spots. Accordingly the distribution of tourist zone is as under :

Tourism zone – 1 : This zone lies between Bandaje falls, Navoor rest house, Gundalpade camp shed, Bolle falls and Kudumagundi

falls (on Netravathi river) (Compartment Nos.10, 12, 13, 15 & 16 of Belthangadi Wildlife Range).

Tourism zone – 2 : This is spread around an area of 3 kms on either side of the S.H.No.66 from Kudremukh town to S.K.Border. A number of places like the Kudremukh deer park, lakya dam, mining site, Bhagavathi nature camp, Kadambi falls, Singsar-Ganapathikatte game path, Bhagavathi-Kadambi game path, Gangrikal-Sheerlu-S.K.Border game path, Gangamoola, Nagatheertha, Kadambi falls, Suthanabbi falls etc., fall in this zone. This is one of the key areas for tourism in the national park. As it is, this area receives lot of visitors and highway passengers. This is one of the best areas for the eco-tourists (Compartment Nos.1, 2, 5, 6, 7 & 21 of Kudremukh Wildlife Range & 14 of Kerekatte Wildlife Range).

Tourism zone – 3 : This zone is spread around Kigga temple, Narasimhaparvatha peak, Sirimane falls and Yelakkigudda peak. Being close to Sringeri township, it might attract quite a number of visitors. As of now, Sirimane falls attract 100 – 200 visitors on holidays but since it is outside the national park, they are not counted as visitors to the park (Compartment Nos.23, 24 & 25 Kerekatte Wildlife Range)..

Locally well-known hill peaks such as Kudremukh, Ballalarayanadurga, Valikunja and Kurinjal have been traditional trekking destinations and can be permitted to be visited under the supervision of departmental staff or a qualified and recognized guide. These peaks and the trekking paths connecting them have not been formally recognized as a tourism zones because of the narrow stretch of visitor use but are permitted for tourist use.

11.3.2 – Tourist facilities :

The existing Bhagavathi nature camp needs to be improved by providing a dormitory, tented accommodations, dining block, interpretation facilities and a good library. Each center should be equipped with accommodation for about 30 people, a

kitchen and dining hall, an interpretation center, facilities for water recreation, etc. Signages and literature are very poor and they have to be improved substantially.

11.4.1 – Game paths :

Game paths will be open to tourists as per their requirements. The target groups are students, youth and teachers. Private vehicles may be franchised to take tourists on these routes on fixed charges. A trained guide/departmental staff should accompany such hired vehicles.

11.4.2 – Trekking paths :

There is also a need for developing certain hiking paths from the fringe to the nearest hill peak or to a specific landscape element.

Table - 14 : List of trekking paths proposed for development :

1	Kudremukh	<ol style="list-style-type: none"> 1. Nellibeedu to Kudremukh and back 2. Bhagavathi nature camp to Kuringal, Gangamoola, Varaha theertha and to main road (S.H.no.66)
2	Belthangadi	<ol style="list-style-type: none"> 1. Netravathi nature camp to Bandaje abbi - Ballalarayanadurga and back via Nandikadu 2. Navoor to Tholali and back 3. Manjotti to Jamalabad and back
3	Karkala	<ol style="list-style-type: none"> 1. Mullur picnic corner to Kurangal peak and back 2. Mullur picnic corner to Valikunja peak and back
4	Kerekatte	<ol style="list-style-type: none"> 1. Kigga to Narasimha parvatha peak and back 2. Sirimane nature camp to Avantu and back

These hiking paths should be well laid out, provided with good signages and manned by trained local youth who will also act as guides. Separate skill development training should be held for the local youth for this purpose. Further considering the requirements of various trekking groups, routes may be chalked out in future.

11.4.3 – Do's & Don'ts :

Do's :

- The use of polythene and plastics is unhealthy for the environment. Use of plastics is banned.
- Carry away all non-degradable litter-empty bottles, tins, polythene bags etc. And throw them in municipal dustbins only, so that they can be disposed off properly.
- Observe the sanctity of holy sites. In case of any offerings, contact the staff of the temple committee only.
- Do not listen to radios, tape recorders or any other electronic entertainment equipment at high volume to avoid noise pollution.
- In case temporary toilets are set up near campsites, after defecation, cover with mud or sand. Ensure that the spot is at least 30 meters from a water source.

Don'ts :

- Allow the flora and fauna to flourish in its natural environment. Taking away of cuttings, seeds and roots is illegal.
- Avoid using pollutants, such as detergent, in streams or springs.
- Do not use wood as fuel to cook food at the camp site and do not destroy the forest wealth which are our heritage.
- Do not leave smoldering cigarettes or make open fires in the forests. Do not consume alcohol, drugs or any other intoxicant.
- Do not tempt the local children by offering them foodstuff or sweets. Respect local traditions.

- When taking photographs, respect privacy; ask for prior permission and use restraint.

11.5.1 – Eco-tourism guidelines :

- Activities permitted are trekking, bird watching, photography, swimming in the notified places, and wildlife viewing without disturbing them.
- Group activities should be encouraged.
- Guides should be selected, trained and made available to the visitors on cost.
- The tourists should be given a thorough briefing of dos and don'ts and it should be included in the guidebook.

The evergreen forests of Kudremukh have very low visibility of wildlife due to the thick undergrowth and low carrying capacity of large animals. Wildlife cannot be sighted easily from vehicles. So visitors should be taken on foot to observe and study the rich biodiversity of smaller organisms and enjoy the beauty of natural landscapes and wilderness. Kudremukh has been famous for trekking and visitors come to enjoy the walk on the difficult terrain of the steep hill slopes. Arrangement shall be made to issue tickets at the nature camps and a few important visitors' spots. Reservation of accommodation should be computerized at the divisional office. E-mail access should be created for the visitors. A website should also be launched and managed. Free film shows and slide talks should be arranged to the visitors at the interpretation center. Special camps on trekking, bird watching, botanical visits, etc., may be arranged seasonally.

11.6.1 – Monitoring eco-tourism :

Impact of the tourism should be monitored closely by observing the sighting chances of wild animals, visible impacts of litter, wear out of the trekking paths, degradation of the vegetation, frequent encounter of each other by tourists etc., to determine the carrying capacity and accordingly the tourist number should be controlled.

A feedback should be obtained from every visitor and follow-up action should be taken consistent with the management objectives.

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CHAPTER - XII

ECO-DEVELOPMENT

12.1.1 - General :

There cannot be any development and protection of the national park without the active cooperation and support of the local population. Many people do not have basic facilities like safe potable water, health services, education, electricity, etc. There are about 40 village with a bout 90 hamlets inside the outer periphery of the national park. There are 1299 families within and many more families reside on the periphery. This does not include the KIOCL Township. As most of theses villagers are agrarians the dependence on forests is multifold. They depend on the forests for their daily need of fuel, small timber, fodder and green manure.

It is these people within and around the national park who either put fire or helps in extinguishing the fire. The nearest and maximum encountered government machinery is a forest official.

In order to mitigate the pressure on forests directly and to take the people along the following socio eco developmental works are proposed.

- Distribution of smokeless chullahs, which reduce the consumption of firewood by almost 60%.
- One time subsidy in the form of LPG stove
- Construction of gobar gas plants
- Training camps on vermiculture, mushroom cultivation, sericulture as appropriate.
- Training in bee keeping and distribution of beehive boxes. Distribution of grafts of fruit trees to aid and enhance their earning.
- Nature camp for the local population for exposure about forests and Kudremukh National Park.
- Encouragement to go for better breeds and stall-feeding.
- Medical facilities in the form of artificial insemination and vaccination to the cattle.

CHAPTER - XIII

PUBLICITY

13.1.1 - General :

Publicity is the basic ingredient for building any opinion or brand image. The need to develop an opinion for the national park is very essential for its survival in long term. It will also aid in removal of any misgivings if any about the national park. The following activities are listed.

- Nature education camps for students and teachers of schools and colleges.
- Workshops for local community leaders like members of gram panchayat, taluk panchayat and Zilla panchayat and other elected representatives.
- Publishing of posters, handbills, pamphlets, brochures etc.

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CHAPTER - XIV

GENERAL REGULATIONS

14.1.1 - Census :

Till now, not a single scientific population estimation has been made for any species and this is a big lacuna on the part of the management. Census of wild fauna is a difficult task given the habitat conditions, low density and liberal availability of water around the year. Mega fauna such as gaur, sambars, deer etc., which live in herds can be easily located and recognized by the local forest protection camps. They should keep a watch on the population size of these herds and the trends. The data reported by them should be screened to arrive at an estimate of their population. Alternatively transect estimates can also be taken up. Lion-tailed macaque is a flagship species of the national park and their population have to be monitored continuously. A separate programme to mark the territorial jurisdiction of different troops will be a worthwhile exercise following which it will be easier to monitor them. Other important species such as bears, king cobra, hornbill, etc., are very difficult to sight and therefore population estimates can only be on the basis of random sampling. The wide range of micro-fauna also needs monitoring through a set of permanent monitoring plots.

A single time operation for population estimation is unlikely to yield correct data. Therefore qualified staff may be separately engaged for this task. It also requires close supervision by senior officers.

14.2.1 - Wildlife outside the PA :

The PA management is often faced with issues connected to escaped wild fauna or fauna external to the PA. Panthers and big snakes like king cobra and python are found widely distributed outside the PA and often become problematic. The PA management should keep a watch on such animals, recover as many as possible and take them to the national park unless otherwise they are injured or incapacitated. Occasionally gaur and spotted deer may also stray out. These are difficult to recover and should be allowed to exist outside PA. Loss of a few individuals of these species is not of any consequence, as sufficient numbers exists inside the PA.

The Wildlife (Protection) Act is undergoing a series of amendments. A number of marine animals are also getting notified in various schedules. However, these go unnoticed. The PA management should take up the responsibility of organizing periodic trainings to the local non-PA forest staff and also give adequate publicity through the public media to educate the public about new additions.

14.3.1 – Rescue center :

An animal rescue center should be established at Pilikula Nisarga Dama to treat injured animals, abandoned infants or to house incapacitated animals. Required minimum infrastructure facilities may be provided and a competent NGO may be associated with this programme.

14.4.1 – Staff amenities :

Although major part of the infrastructure is in place, some more are necessary to meet all the requirements. Staff quarters are required at the following places :

Table – 15 : List of required quarters :

Sl. No.	Name of the Range	Required quarters	Place
1	Belthangadi	Forester Forest Guard	1. Kuthloor 2. Navoor 3. Mittabagilu 1. Malige 2. Jamalabad 3. Nandikadu
2	Kudremukh	Forester Forest Guard	1. Singsar 2. Biligal 1. Kuranjal 2. Bhagavathi 3. Guthyadka 4. Jamble 5. Kalgodu
3	Karkala	Forester Forest Guard	1. Kervase 2. Mala 1. Kabbinala 2. Berkala 3. Bijjale 4. Mapala
4	Kerekatte Wildlife Range	Forester	1. Menasinahadya 2. Shirлу 3. Kadekal

		Forest Guard	4. Kigga 1. Yadagunda 2. Yemmegundi 3. Mundagar 4. Chatnamane 5. Narasimhparvath a 6. Menasinahadya
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Every forester and forest guard should be equipped with weapons, wireless and a haversack along with standard equipment, maps, beat/section book etc.

14.5.1 - Research & Monitoring :

There is no separate research section in the wildlife wing. Academic and research institutions conduct most of the research work with their own funding. Usually the research work is isolated and unconcerned with the management issues of the PA. Findings of the research work are not made available. Considering the high bio-diversity and a conglomeration of agencies working on different subjects, there is a need to monitor research work very closely at the PA level itself. Every research agency must sign a Memorandum of Understanding (MOU) with the Deputy Conservator of Forests and should take specific permission every time to visit the PA. A summary of work done on each visit shall be presented to him during the next visit and a final copy of the research findings should be deposited with him. There are large number of areas to be researched by the social scientists, ecologists and field biologists. From the management perspective, a detailed inventory of the floral and faunal species is urgently required. For an exhaustive and scientific survey, a set of permanent monitoring plots have to be laid out covering different altitudes, terrains, forest types etc

Research should be taken in these plots on a long-term basis and the results should be documented plot wise. The executive staff are not conversant with research aspects.

Some of the topics for research as follows :

- a) Grass land and Fire ecology especially the invasion of ferns

- b) Biology of flagship species
 - c) Survey of endangered species and conservation methods
 - d) Social and economic aspects of the communities living inside the national park
 - e) Hydrology and water regime of the national park
- and
- f) Eco-restoration of iron ore mine site etc.

Regular surveillance should be kept on communicable diseases within the national park and a record of their occurrence should be maintained. They are generally confined to pockets and need immediate attention.

14.6.1 – Budget :

Development of the national park received an impetus after it started getting corporate funding from the Kudremukh Iron Ore Company Ltd. The park was receiving a budget support of Rs.200.00 lakh per year since 1997. Continued funding support was indicated for a period of 10 years from the year 2000-01. A project to utilize the funds for planned development was approved by the Government of Karnataka in G.O.No.APG.130.FWL.2000 Bangalore, dated : 23-04-2003. With the Supreme Court judgment directing the closure of mining operations by 2005, this funding source dried up and new arrangements are being worked out. It is anticipated that adequate budgetary resources will be made available under the five year plan schemes in addition to the normal state and central budget resources.

14.7.1 – Programme of works :

A detailed programme of work indicating the year, location, quantity of work and their financial implications is furnished at **ANNEXURE – XIV**. The programme is broadly divided into five categories as under :

- a) Regular maintenance works
- b) Protection works
- c) Habitat protection and management

- d) Eco development
- e) Eco tourism
- f) Infrastructure

This classification aims at prioritizing different items of work in the order of their importance to the management of the national park. Whenever there is budget constraint, the annual maintenance works should be accorded priority. Programs like eco-development of the buffer areas and rehabilitation of inhabitants require huge commitment of funds and therefore may not be possible under the routine annual programmes. They should be packaged separately as independent projects and sourced appropriately.

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