GENERAL INTRODUCTION TO THE KANHA TIGER RESERVE

Among the first nine Tiger Reserves launched during 1973-74, Kanha forms part of an eco-region once renowned internationally for its rich floral and faunal attributes. Nestled essentially on the northern slopes of the Maikal hills of the Satpuras in Central Indian highlands, and falling administratively in the Mandla and Balaghat districts of Madhya Pradesh, the present Tiger Reserve and its surrounds were proud witnesses to an amazing era of conservation history. The Kanha landscape chronicles a glorious history of wildlife conservation, and is potentially rich in natural heritage. Besides a viable population of tigers and the only world population of the hard ground barasingha, a wide spectrum of plant and animal species considerably add to the significance of this landscape.

The State Govt. has been mandated to prepare Tiger Conservation Plans for Tiger Reserves, vide Section 38 V (3) and (4) of the Wildlife (Protection) Act, 1972 (as amended upto 2006), to ensure the proper management of the Tiger Reserve area.

As per the Wildlife (Protection) Act, 1972 (as amended upto 2006), Section-38 V (1) & (2), the provisions of Sub-Section (2) of Section-18, Sub-Section (2), (3), & (4) of Section-27, Sections-30, 32 & Clauses (b) & (c) of Section-33 of this Act shall, as far as may be, apply in relation to the Tiger Reserve as they apply in relation to a Sanctuary. Notifications pertaining to the Tiger Reserve are appended **(Appendix-1)**.

The Tiger Reserve is under the administrative control of a Field Director with his headquarters located at Mandla. The Tiger Reserve consists of the following conservation entities:

The Core Zone (Critical Tiger Habitat): The total area of the Core Zone is 917.43 sq. km. The Core Zone is actually part of the erstwhile Kanha National Park and notified as such by the MP State Govt. The entire Core Zone is a Reserved Forest with three sub-divisions and six forest ranges.

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The Buffer Zone (Multiple Use Area): The area of the Buffer Zone Division is 1134.31 sq. km., and it consists of forest land, revenue land and private holdings. Except for some of the eastern part, the Buffer almost completely surrounds the Core Zone. Administratively, there are two sub-divisions and five forest ranges in this zone.

The adjoining forested landscape of the Tiger Reserve falls within the territorial divisions of East & West Mandla, North Balaghat, Kawardha (Chattisgarh), and Mohgaon Project of Forest Development Corporation (Madhya Pradesh).

Administrative Control:

The Field Director of the Kanha Tiger Reserve is administratively overall in-charge of the Tiger Reserve. The zonation or division-wise set up of the Tiger Reserve is as under:

Zonation			
Zone	**Area (In sq. km.)**	**Status**	**Control**
Core Zone (Critical Tiger Habitat)	917.43	Core Zone	Kanha Tiger Reserve
National Park	22.57	National Park	Kanha Tiger Reserve
Buffer Zone	1134.31	Multiple use area	Kanha Tiger Reserve
Total Area of Tiger Reserve	**2074.31**		

Core Zone

Sl. No.	**Range**	**Area Description**				**Total Area (Ha.)**
		RF	**Orange Area (Suitable)**	**Orange Area (Unsuitable)**	**Revenue**	
Mandla District						
1	Kisli	13895.582	0.000	0.000	0.000	13895.582
2	Kanha	12166.834	0.000	0.000	0.000	12166.834
3	Sarhi	13988.180	0.000	0.000	0.000	13988.180
	Total:	**40050.596**	**0.000**	**0.000**	**0.000**	**40050.596**
Balaghat District						
4	Mukki	13022.507	0.000	0.000	0.000	13022.507
5	Bhaisanghat	16923.806	0.000	0.000	0.000	16923.806
6	Supkhar	21746.087	0.000	0.000	0.000	21746.087
	Total:	**51692.400**	**0.000**	**0.000**	**0.000**	**51692.400**
	G. Total:	**91742.996**	**0.000**	**0.000**	**0.000**	**91742.996**

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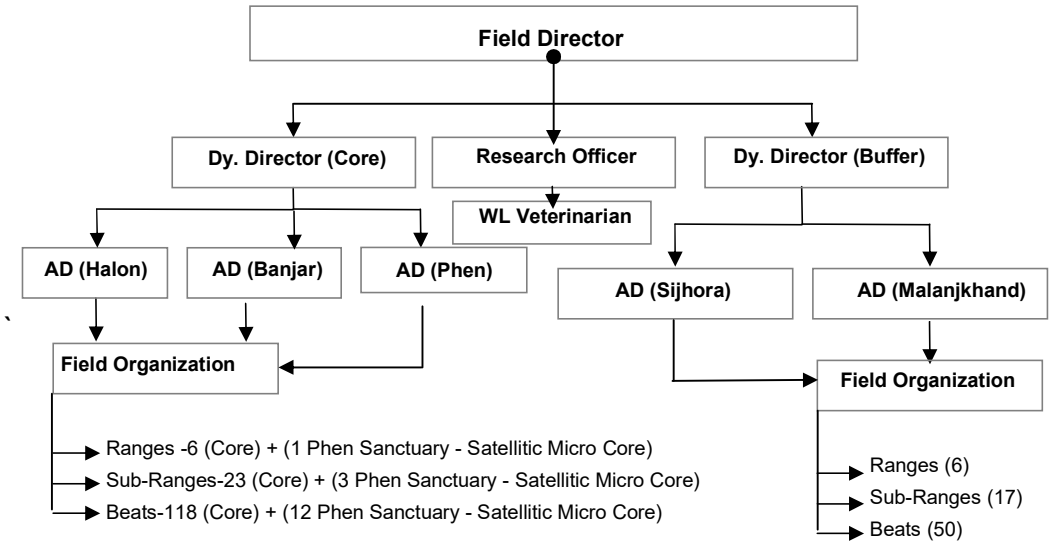
Buffer Zone

Sl. No.	Range	Area Description				Total Area (Ha.)
		RF	Orange Area (Suitable)	Orange Area (Unsuitable)	Revenue	
Mandla District						
1	Khatia	9485.060	272.600	257.920	3927.250	13942.830
2	Sijhora	6534.060	321.540	116.130	11601.020	18572.750
3	Motinala	14807.450	107.790	181.450	5220.320	20317.010
	Total:	**30826.570**	**701.930**	**555.500**	**20748.590**	**52832.590**
Balaghat District						
4	Khapa	6937.965	0.000	0.000	9973.030	16910.995
5	Garhi	15307.799	0.000	0.000	17528.180	32835.979
6	Samnapur	5484.126	0.000	0.000	5368.270	10852.396
	Total:	**27729.890**	**0.000**	**0.000**	**32869.480**	**60599.370**
	G. Total:	**58556.460**	**701.930**	**555.500**	**53618.070**	**113431.960**

Organizational Chart of Kanha Tiger Reserve



The Field Director is not a Drawing and Disbursing Officer (DDO), but has been entrusted with an overall supervisory role, vested with the administrative/ financial powers of a Chief Conservator/ Conservator of Forests. Both the Deputy Directors are DDOs for their respective divisions, with the usual financial and administrative powers as envisaged in the Forest Financial Rules/ Financial Code. The Research Officer is responsible for conducting wildlife research and monitoring activities and undertaking conservation planning in the Tiger Reserve, and coordinating and collaborating with outside agencies for the same. The

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Assistant Directors (AD) function as Sub Divisional Officers in their respective jurisdictions, with all the relevant administrative powers delegated by the forest department.

The Annual Plan of Operations (APO) of the Tiger Reserve is prepared by the Field Director in consultation with the officers and field staff of the Core and Buffer divisions and the same is submitted to the Principal Chief Conservator of Forests & Member Secretary, National Tiger Conservation Authority, New Delhi through the Principal Chief Conservator of Forests (Wildlife), Bhopal. Budgetary allocations are also provided to both the divisions by the Field Director, once sanction is received from the competent authority. The Deputy Director (Core) does not have a separate office, but functions as a DDO in the office of the Field Director. The office of the Deputy Director (Buffer), however, is a separate entity under the management of Kanha Tiger Reserve.

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THE PROTECTED AREA

PART-I

(CURRENT STATUS)

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CHAPTER – 1

INTRODUCTION TO THE CORE ZONE

1.1 Name, Location, Constitution & Extent:

1.1.1 **Name, Location & Constitution:** This sub-plan of the Tiger Conservation Plan for the Kanha Tiger Reserve has been proposed for the Core Zone. The Conservation Plan will attempt to address this conservation entity as per the final notification of the Govt. of Madhya Pradesh.

The Core Zone is situated administratively in the Mandla and Balaghat districts of Madhya Pradesh, and geographically forms part of central Indian highlands.

The geographical coordinates of the Core Zone are as under:

Conservation Unit	Geographical Coordinates	
Core Zone	Latitude	22° 02' 52.6" to 22° 25' 48.8"
	Longitude	80° 30' 09.3" to 81° 02' 48.4"

Extent (Legal Status & Area Statement): The Core Zone falls into the southern part of the Mandla district and the north-eastern part of the Balaghat district at altitudes between around 500 and 800 mtr. The total area of the Kanha National Park was 940 sq. km. Now this area incorporates 917.43 sq. km. of the Critical Core or Critical Tiger Habitat. This has also been notified by the MP State Govt. No. F 15-31-2007-X-2 dated 24-12-2007. The entire Core Zone and National Park are Reserved Forests and derive their legal sanctity/ inviolability from Section-35 and 38 V (2) and (4) (i) of the Wildlife (Protection) Act, 1972 (as amended upto 2006).

The International Union for the Conversation of Nature (IUCN) is a lead organization of wildlife conservationists and scientists in the selection, establishment and management of protected areas. As per the IUCN a protected area is defined as ***an area of land and/or sea especially dedicated to the protection and maintenance of***

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biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means. In order to accomplish its advisory management function, IUCN maintains a worldwide list of protected areas.

It is implied that all categories should fall within this definition. Though all protected areas meet the general purposes contained in this definition, in practice the precise purposes for which protected areas are managed differ greatly. The following are the main purposes of management:

- Scientific research.
- Wilderness protection.
- Preservation of species and genetic diversity.
- Maintenance of environmental services.
- Protection of specific natural and cultural features.
- Tourism and recreation.
- Education.
- Sustainable use of resources from natural ecosystems.
- Maintenance of cultural and traditional attributes.

As per the priorities accorded to these main management objectives, the following distinct categories of protected areas emerge:

- I- Strict protection (Strict Nature Reserve/ Wilderness Area).
- II- Ecosystem conservation and recreation (National Park).
- III- Conservation of natural features (Natural Monument).
- IV- Conservation through active management (Habitat/ Species Management Area).
- V- Landscape/seascape conservation and recreation (Protected Landscape/ Seascape).
- VI- Sustainable use of natural ecosystems (Managed Resource Protected Area).

The Kanha National Park falls into the II category of the IUCN protected area management classification system.

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While the detailed compartment-wise area statement is appended **(Appendix-2)**, the sub-division and range-wise area statement of the Core Zone is as under. The Phen WLS has also been attached administratively to a sub-division:

Sub-Division (HQ)	Range (HQ)	Area (sq. km.)
Banjar (Kisli)	Kanha (Kanha)	121.668
	Sarhi (Bichiya)	139.881
	Kisli (Kisli)	138.955
Halon (Mukki)	Mukki (Mukki)	130.225
	Bhaisanghat (Garhi)	169.238
Phen (Garhi)	Supkhar (Supkhar)	217.460
	Phen WLS (Motinala)	110.704

The detailed existing status of forest area in the Core Zone is as under:

Legal Status	Name of Division	Forest Area During the Last Management Plan		Decreased Forest Area During the Last Management Plan		Increased Forest Area During the Last Management Plan		Current Forest Area	
		No. of Forest Blocks	Area (ha.)	No. of Blocks	Area (ha.)	No. of Blocks	Area (ha.)	No. of Blocks	Area (ha.)
Reserved Forest	Core Zone	7	91742.996	-	-	-	-	7	91742.996
Demarcated Protected Forest		-	-	-	-	-	-	-	-
Undemarcated Protected Forest		-	-	-	-	-	-	-	-
Total:		**7**	**91742.996**					**7**	**91742.996**

1.1.2 Notification: Additions to and alterations in the area of the National Park/ Core Zone over the years and its present constitution have been notified by the Govt. of Madhya Pradesh vide the following orders:

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Sl. No.	MP Gazette Notification	Area (sq. km.)	Relevant Act	District	Total Area (sq. km.)
1	FD No. 2813-98-42/XI-55 dt. 22.05.1955 w.e.f. 01-06-1955	253.04	MP. NP Act, 1955 (VII of 1955 Section 3 (2) & (3))	Mandla	253.04
2	FD No. 5725-4184-X dt. 13.05.1964	65.40	MP. NP Act 1955 (VII of 1955 Section 3 (2) & (3)	Mandla	318.44
3	FD No. 8893-X-2-70 dt. 15.12.1970	128.257	MP. NP Act, 1955 (VII of 1955 Section 3 (2) & (3)	Balaghat	446.686
4	FD No. 4021-1643-X-II-74 dt. 03.09.1974	487.720 5.621	Section 18 of WL (P) Act (1972)	Mandla & Balaghat Mandla	487.72 493.341
5	FD No. 15-13-76-2-10 dt. 29.09.1976	939.94 National Park	Section 35 of WL (P) Act, 1972	Mandla & Balaghat	939.94
6	F No. 15-31-2007-X-2 dt. 24.12.2007	917.43 Critical Tiger Habitat within the NP	Section 38V of WL (P) Act, 1972 (as amended upto 2006)	Mandla & Balaghat	917.43

1.2 Approach & Access:

The access and approaches to the Core Zone are as under:

By Surface

- Jabalpur-Mandla-Bamhni-Jaharmau-Khatia-Kisli: 155 km.
- Jabalpur-Mandla-Bamhni-Jaharmau-Tatri-Baihar-Mukki: 189 km.
- Jabalpur-Mandla-Bichhia-Sarhi: 154 km.
- Nagpur-Seoni-Nainpur-Chiraidongri-Khatia-Kisli: 255 km.
- Nagpur-Seoni-Nainpur-Chiraidongri-Tatri-Baihar-Mukki: 280 km.
- Nagpur-Seoni-Mandla-Bichhia-Sarhi: 305 km.
- Nagpur-Seoni-Balaghat-Baihar-Mukki: 287 km.
- Raipur-Simga-Kawardha-Chilpi-Supkhar-Mukki: 178 km.
- Raipur-Simga-Kawardha-Chilpi-Supkhar-Mukki-Baihar-Tatri-Khatia-Kisli: 248 km.
- Raipur-Simga-Kawardha-Chilpi-Motinala-Sijhora-Sarhi: 190 km.
- Bilaspur-Pandaria-Chilpi-Supkhar-Mukki: 188 km.
- Bilaspur-Pandaria-Chilpi-Motinala-Sijhora-Sarhi: 183 km.
- Gondia-Balaghat-Baihar-Mukki: 125 km.
- Gondia-Balaghat-Baihar-Mukki-Garhi-Sarhi: 200 km.

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- Rajnandgaon-Khairagarh-Malajkhand-Mukki: 181 km.
- Rajnandgaon-Khairagarh-Malajkhand-Mukki-Garhi-Sarhi: 246 km.

By Rail

- Convenient railheads are Jabalpur (Central Railway), Mandla (Mandla-Nainpur narrow gauge section of South Eastern Railway), and Nagpur (Central Railway Junction).

By Air

- Jabalpur (Madhya Pradesh), Raipur (Chhattisgarh) & Nagpur (Maharashtra) are operative civil airports.
- A permanent helipad exists at Khatia.

1.3 Statement of Significance:

The Kanha Core Zone, is one of the finest wildlife protected areas not only in south-east Asia, but also in the world. It is a typical geo-physiographical representative of the central Indian Highlands, a significant geographical region of our country, as far as the occurrence and distribution of flora and fauna are concerned. The protected area represents a unique nature reserve of central Indian Highlands sal and miscellaneous woodland and grasslands. The Core Zone and its immediate surroundings are nestled slightly east of the centre of the highlands and it occupies, for the most part, the northern slopes of the main Maikal ridge in the Satpuras, and the valley is encompassed by the spurs of varying elevations extending from the main hill ranges. The eastern and the western half of the Core Zone form part of the Halon and the Banjar valley respectively.

The protected area forms part of an eco-region once renowned internationally for its immense natural wealth, and these forest-tracts were regarded as some of the finest and hitherto untouched wilderness areas in the country. Long history of stringent protection against all kinds of biotic pressure and a range of diverse habitat types along with conservation oriented villages inside and outside the Core Zone, ensure the status of Kanha as a world class nature reserve and a promising centre of biodiversity. The Core Zone also supports an endemic population of the hard ground barasingha (*Cervus duvauceli branderi*), whose commendable resurrection over the years has become a very inspiring success story in wildlife conservation.

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Besides, a viable population of the highly endangered tiger, the flagship species, now-a-days debated passionately the world over for its protection, is also being conserved most successfully in the Core Zone. The protected area also harbours a wide range of faunal species, some of which figure prominently in the IUCN Red List of Threatened Species. Some of these species are *Cuon alpinus*, *Melursus ursinus*, *Lutra perspicillata*, *Panthera pardus*, *Panthera tigris tigris*, *Bos gaurus* and *Python molurus.* There are 43 species of mammals and 26 of reptiles. The floral diversity is comprised of around 850 species of 10 varieties of angiosperms belonging to 506 genera and 134 families, and 22 species of Pteridophyte belonging to 14 genera and 14 families (Pandey & Namdeo, 2009). The above floral diversity also includes 2 species of Gymnosperm belonging to 2 genera and 2 families. The above flora of the protected area also includes around 50 species of aquatic plants and 18 species of rare plants. The dominant family in the Core Zone is Poaceae with 109 species, representing 66 genera.

The Core Zone is also rich in avifauna, and over 300 species of birds have been reported by various workers (Kailash Chandra et al., 2005). The protected area also supports a variety of lesser fauna, which include numerous varieties of insects, including butterflies, moths and beetles; reptiles, fishes and other lesser life forms, and all these contribute significantly to the functioning of this wildlife ecosystem. The unprecedented rate of extinction of the lesser fauna outside makes their conservation extremely important.

The intangible significance of such a wonderful and assiduously preserved protected area also consists in the improvement of local environment, including stabilization of hydrological cycle, conservation of soil and moisture; impartation of conservation education, providing recreational facilities, and protection of our rich and impressive heritage for the posterity.

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CHAPTER – 2

BACKGROUND INFORMATION & ATTRIBUTES

2.1 Boundary:

The entire National Park and the Core Zone are duly notified as such, and comprises legally constituted Reserved Forest from which all rights have been extinguished. There is no boundary dispute, and as per the final notification, the National Park and the Core Zone are clearly demarcated on the ground with the help of cement concrete pillars, masonry pillars and cut and cleared boundary lines of Reserved Forest blocks.

2.2 Geology, Landform & Soils:

Parent rock geology and soil types have a strong bearing on the types of vegetation of a particular area. The main formation period in the Core Zone is Archaean, a unit of geological time. The Deccan trap, one of the largest volcanic features on the earth, is the principal geological formation. The Deccan trap occurs along with gneiss, and crystalline schists in the western part, and basaltic volcanic overflows in the eastern part of the Core Zone. Gneiss rocks are metamorphic. These rocks may have been granite, which is an igneous rock, but heat and pressure changed it. Schist rocks can be formed from basalt, an igneous rock; shale, a sedimentary rock; or slate, a metamorphic rock. Through tremendous heat and pressure, these rocks were transformed into this new kind of rock. Basalt is the most common type of rock and is very dark in colour. It also contains several types of minerals.

The flat-topped hills, or *dadars*, are capped by vesicular and clayey laterized rock often rich in bauxite. The contents of ferric compounds lend a characteristic red colour to the rocks. The soil here is shallow and more or less completely dries up after the rains, supporting only grassy expanses with almost no tree growth. The gentle folds on these flat-topped hills hold heavy clayey soil which retains good moisture and supports excellent palatable grasses. The plains and valleys of the protected area contain the rocks that are granitic gneisses and micacious schists, and support sal forests. The rock on the *dadars* is weathered basalt that harbours miscellaneous forests.

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Along side of the northern edge of the Kanha valley, beginning from Silpuradadar through Ganeridadar to Mundidadar – a length of over 15 km., is an excellent example of the intermediate chain of plateaux. These have rich soil and excellent grasses and, very often, dense bamboo too. The rock structure in this part is different due to the zone of transition from black basalt to porous schists and granites. While the distribution of water is rather restricted in this part, stray pools in streambeds retain water most of the year. The terminal slopes falling to the intermediate plateaux and to the valleys are gentle, and contain a richer alluvial soil with plenty of humus and decayed vegetation. These soils are responsible for good multi-tired forest growth.

The flat-topped hills fold into narrow valleys and sometimes gorge with perennial streams. This perenniality is due mainly to the impervious layer of black basaltic rocks beneath the water-holding bauxite on these plateaus. At other places, the plateau edge ends in a sheer drop, with the many escarpments providing vantage points and a breath-taking view of the slopes and valleys.

There is a good distribution of water in the zone of transition from bauxite to basalt. Most of the water which does not permeate the basalt, rises in sporadically distributed seepage springs on the slopes and rivulets in the upper gorges and valleys well into the dry season.

In the valleys and other low lying areas, the soil is fine-textured alluvium enriched by humus. In the western part of the Banjar valley in the Kanha, Sarhi, Kisli and Mukki ranges, the soil derived from schist and granite is sandy. In the lower pockets, the soil is finely textured and has humus. In flat valley bottoms it tends to be somewhat clayey and is locally called *Kanhar*. Perhaps the name of the village after which the National Park is named Kanha comes from this soil there.

In the past, a pilot study was taken up in the National Park to bring out the salient geological and geomorphological setup of the habitats using analyses of pictorial data, viz. Landsat MSS and Landsat TM FCC enlargements on 1: 1,00,000 approximately. These were supported by panchromatic aerial photographs on 1: 25,000 scale. The study led to various interpretive photogeological, photogeomorphological and slope maps of the National Park.

Soil survey for a part of the National Park was undertaken as part of ecosystem evaluation. The survey was conducted by the use of maps, aerial photographs (1: 10,000), and satellite imagery (1: 2,50,000) colour composites. Interpretation equipment such as mirror stereoscope, Kargyl reflecting projector, hand held lenses and a standard soil survey kit for ground truthing were also used for the analysis of pedogenetic factors. The soils of the park were found to be governed to a large extent by variation in slope angles leading to the following 3 orders given as under:

- **Inceptisols:** Includes 4 families of this order
  - Fine loamy Udic Ustochrepts
  - Coarse loamy Udic Ustochrepts
  - Loamy skeletal Udic Ustochrepts
  - Coarse loamy Aquic Ustochrepts

- **Alfisols:** Includes 4 families of this order
  - Fine loamy Udic Haplustalfs
  - Fine loamy Udic Rhodustalfs
  - Loamy skeletal Udic Rhodustalfs
  - Fine loamy Aquic Haplustalfs

- **Mollisols:** Includes 3 families of this order
  - Coarse loamy Pachic Haplustolls
  - Coarse loamy Udic Haplustolls
  - Loamy skeletal Udic Haplustolls

Besides the above, the study also identified the distribution of soil families according to the physiographic units of the National Park.

Soil types mainly depend on parent rock material, climate or weathering, organisms, topography and time. The following principal types of soil occur in the National Park.

2.2.1 **Black Cotton Soil:** This soil type occurs due to the weathering of trap rocks and gets deposited in the low lying areas below the hill formed by the Deccan trap. Though highly clayey in nature and not conducive to tree growth, they, however, support

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excellent grasslands. This soil type is common in the low - lying areas of the Bhaisanghat and Supkhar ranges and also in pockets of the Mukki and Kanha ranges.

2.2.2 **Alluvium:** This soil type occurs on the banks of all the major watercourses and streams, and consists chiefly of fine-silt. This is extremely favourable to sal forest, helping them attain an excellent growth in the Supkhar, Garhi, Mukki and Kanha ranges. The extensive Kanha valley, harbouring a number of watercourses, also falls under this soil type. These areas are the favoured sites for settlement of villages due to fertile soil and availability of perennial water sources. The abandoned cultivated areas in this tract have developed into excellent pasture for wild herbivores, such as the Kanha, Uranakhero and Parsatola meadows, apart from the Sonf meadow in the Sarhi range. Many old forest villages, now relocated outside, were earlier situated in these areas.

2.2.3 **Sahara:** Though alluvial in nature, this soil type contains a greater part of sand including coarse sand and gravel. These types occur in the upper peripheries of the valleys and lower slopes, supporting good tree growth in favourable moisture regime. These are found in most of the areas occupied by gneisses and crystalline schists in Maliadadar, the Banjar valley and south Phen blocks. This soil supports mixed forests where soil depth is good and results in the improvement of forests and bamboo quality. Such soil type is not supportive of good waterholes, the fodder value on account of bamboo and regeneration of other tree species is very high.

2.2.4 **Barra:** Large expanses of this type of soils are found on the flat and extensive *dadars* in the Tiger Reserve. This soil type is good and supports grass, though the tree cover in these areas is thin or scanty. Such habitats are excellent for wildlife provided the availability of nearby water sources is good.

2.3 Physiography & Drainage:

Geographically, the Maikal range is the most important terrain feature, running along the eastern boundary of the Core Zone, forming the watershed between rivers the Narmada and the Mahanadi. This hill-range continues to the west within the Core Zone as the Bhaisanghat ridge, bifurcating the Narmada catchment between the Banjar, to the south-west and west,

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and the Halon, to east and the north-east. Many spurs branch out to the north from the main Maikal and the Bhaisanghat ridges, and divide the headwaters of the Halon into a number of tributaries, viz. the Phen, Gourdhuni, Kashmiri and the Gondla. The Bhaisanghat ridge bifurcates near Bamhnidadar, with the main spur running to the north, while its branch running west sub-divides the Banjar catchment between the Banjar itself and its tributary, the Sulkum (also called the Surpan in the lower reaches). The elevation on the main ridge varies from 800 meters to 900 meters or more above MSL.

The Halon originates in the Chhatisgarh area just outside the Supkhar range, and flowing through this range in the eastern part for about 25 kms., enters the Buffer Zone. The river remains perennial within the park. The Banjar, forming the Core Zone's south-western boundary, though not perennial, retains small and large pools of water. Due to the erraticity of rains over the past several years, only some of the major tributaries of these rivers have perennial stretches in the upper reaches where they flow in the transition zone from Laterite-bauxite to black basalt. Beyond the black basalt zone and into the schists, the water disappears, remaining only in pools in the nullahs at curbs blocked by granite rock outcrops. Generally, the water flow in most of the nullahs and tributaries starts receding by February – March. The major streams in the lower valleys such as Kanha, Kisli and Mukki retain their flow up to March. In March too, as sal trees renew their foliage, there is high water loss due to transpiration.

2.3.1 **Flat-Topped Hills**: The physiographical features of the Core Zone also include hilltops on the main ridge where the branching spurs tend to flatten out as extensive plateaus, which are locally known as **"*dadars*"**. Some of these dadar are quite large, having an area of 10-12 sq. km. The chief among these dadar are: Katangidadar, Kuseradadar, Garhidadar, Katoldih, Sukdi, Ajanpur, Dudhania, Adwar, Jholar, Deoridadar and in Supkhar and Bhaisanghat Ranges, and Bamhnidadar, Bijadadar, Chhindipathar, Algidadar and Kodaidadar in the Kanha and Mukki Ranges. These plateaux are characterized by thin tree growth, shallower soils and scanty grass. Some of the watercourses originating in these flat-topped hills retain water in pools in the upper slopes throughout the year. These plateaux experience strong winds in the summer and winter. Some of these plateaux lie at an altitude of above 960 metres and, except in summer, harbour large herds of gaur.

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2.4 Climate:

The climate of the Core Zone is typically tropical monsoonal type. Due to variations in temperature, humidity, wind velocity and precipitation throughout the year, local climatic factors serve as regulators of vegetation and habits and activities of wild animals in the Core Zone.

2.4.1 **Summer:** The summer sets in around the late February and lasts till around mid-June when the Core Zone receives pre-monsoon showers. The last fortnight of May is the hottest, and the temperature may rise up to around 45°C. The summer is usually dry but rains, hailstorm and thunder do sometimes occur in the months of March and April. The relative humidity in the early afternoon is as low as 10-20%. The miscellaneous forests, which have been shedding their leaves, now wear a bleak look, and the lush green meadows turn yellowish-brown. There is a general drop in the water level throughout the Core Zone, barring a few perennial water-courses, streams and waterholes in the lower valleys. The production of green shoots/ flushes in the early-burnt meadows of the Core Zone also comes down. In some vulnerable areas of the Core Zone man-made ground fires are very common, and the staff is faced with problems in fire fighting operations due to high temperature. Due to precautions and a very effective fire protection strategy, only less than 1% of the area gets burnt every year. This, however, depletes the habitat of forage and browse during the pinch period to some extent. Such man-made fires usually originate from the outer peripheral areas close to the park boundary, as the indigenous people clear the ground by fires to collect mahua fruits, or set fire to induce new flush of tendu leaves from root suckers. At times, wanton fires occur to divert the attention of the staff, and the miscreants sneak in to collect fallen antlers or honey. Fire incidents in the Core Zone during the past several years are as under:

Year (Feb.-June.)	No. of Incidents	Area Burnt (Ha.)	% of area affected
1999	167	925.160	0.88%
2000	75	276.950	0.26%
2001	32	147.300	0.14%
2002	51	274.300	0.26%

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2003	101	665.800	0.63%
2004	42	198.000	0.19%
2005	100	564.800	0.54%
2006	21	99.514	0.09%
2007	105	567.400	0.54%
2008	24	372.700	0.35%
2009	85	467.750	0.45%
2010	6	8.500	0.009%

2.4.2 **Rains:** The rainy season arrives with pre-monsoon showers usually received in the second or third week of June. Regular rainfall, however, may take place by even the second or third week of July. Generally, the wettest months are July and August, when around 53% of the total annual rainfall is received in the season, which is around 1300 mm. The rains transform the entire protected area very quickly, and the meadows as well as the forests get restored to their former lush-green conditions. This phenomenon results in the congregations of large herds of wild ungulates, specially chital, in the meadows of the Core Zone.

Lack of winter rains in a particular year reduces food availability in the meadows. During such times the barasingha utilizes depressions along watercourses where there is still enough green grass due to moist condition. This lack of winter rains also hampers the rutting activities of the barasingha to some extent, as most of the wallows become dry. Such a long spell of dryness also gives impetus to summer fires. These seasonal fluctuations pose a great deal of managerial problems. The management of waterholes in dry years, if preceded by reasonably good winter rains, is not as serious a problem as it is in the year preceded by a good rain-year but without winter rains. Continuous torrential rains in a particular year cause considerable damage to the forest road network, bridges, anicuts and tanks inflicting financial losses to the Core Zone. And, if such a year is followed by a long absence of rains from September onward till mid-June, it results in a very heavy grass growth posing great problems in fire protection.

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The climatological data relating to the Kanha centre for the period 2006 to 2010 has been presented. The analysis of total rainfall in a season, and its distribution offers very interesting managerial considerations, which are as under:

- Substantially low rainfall in a particular year, succeeded by a long dry spell (no winter rains) causes reduction in fodder production. The following summer witnesses extensive and severe fires despite effective fire protection measures. This phenomenon also leads to water scarcity.
- Substantially low rainfall, followed by two or three good winter showers, causes water levels to go down in dug-wells. There may be dearth of drinking water, but tanks, anicuts and pools in riverbeds do retain water for wildlife.
- An average rain year succeeded by a long dry spell results in a reduction of palatable grasses in the meadows, forcing the ungulates to take to water-courses and waterholes where green forage is available.

The average meteorological data of five years (2006 to 2010) recorded in the Core Zone is as under:

Month	**Temperature (o^o)**				**Rainfall (mm.)**
	Min.	**Max.**	**Mean Min.**	**Mean Max.**	
Jan.	0.0	34.0	4.5	25.5	16.60
Feb.	3.0	35.0	7.1	32.7	18.00
Mar.	9.0	36.0	12.5	34.5	24.76
Apr.	11.0	41.1	15.0	38.1	25.26
May	17.0	45.0	21.3	42.0	16.79
Jun.	17.0	30.0	21.7	39.5	206.74
Jul.	19.0	40.0	22.3	30.4	359.52
Aug.	18.0	41.0	21.5	32.0	321.61
Sep.	11.0	38.0	20.2	30.8	214.87
Oct.	10.5	37.4	16.7	33.8	52.48
Nov.	4.8	33.8	10. 6	30.5	33.40
Dec.	0.0	32.0	6.5	28.1	3.78

2.4.3 **Winter:** The winter sets in November and lasts till February. December and January are the coldest months in winters. In severe winter, the night temperature comes down very low, and severe ground frost occurs in the meadows and valleys, with the mercury dropping to 0^oC or sometimes even to the sub-zero temperatures. These frosts may kill sal seedlings on the periphery of grooves and in the openings, and also

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hasten the post-seeding drying up of the grass in the meadows. A thin blanket of fog covers the clearings, particularly along the nullah beds during the early hours of morning. This has, however, little influence on the animals. The relative humidity reaches 100 percent during the night, and the incidence of dew is heavy. Leaf fall sets in towards the end of winter, and the deciduous trees remain leafless until shortly before the break of monsoon, while the sal renews its foliage almost simultaneously with the fall. Rains are scanty, though the area may receive a few showers in winter. Winds are not common in the winter and only the upper plateaus sometimes experience it.

In the winter of 2011, the minimum temperature dropped to as low as -5°C at Mukki & Supkhar and -4°C at Kanha and Kisli in the month of January. The Core Zone experienced severe frosty mornings, with a white sheet of ice spread over grasslands, and frost-damaged plants under open sky. At many places, particularly in the Supkhar range, the canopies of large areas of sal turned brown. Even the senior most employees of the Core Zone are unable to recall any such climatic phenomenon in the past.

There are three distinct seasons, viz:

- **Winter:** November to February (with the night temperature dropping to -2°C sometimes during December and January).
- **Summer:** Late February to mid-June (the hottest period extends from May up to the first or even second week of June, with the day temperature sometimes soaring to 45°C).
- **Rains:** July to late September (August is the wettest month, and the average annual rainfall is around 1300 mm.).

2.5 Hydrology & Water Sources:

The protected area lies in a deciduous zone, and the availability of water throughout the year, specially in the summer, is a very important factor requiring serious attention of the Park Management. Though the hydrology of the wildlife ecosystem has gifted it with a number of

perennial and seasonal streams, streamlets and some rivers, but their spatial and temporal distribution is not satisfactory. This sometimes causes serious problems in the summer. Besides the above, the Core Zone also harbours some areas with high water tables that can easily be dug up as small waterholes, locally known as *jhirias*. Some of the main rivers and streams flowing through the Core Zone are as under:

Sl. No.	Name of Rivers/Streams	Name of Range
1.	Banjar	Kanha
2.	Semrahi	Kanha
3.	Kharadi	Kanha
4.	Minkur	Kanha
5.	Ghanghar	Mukki
6.	Baghmar	Kisli
7.	Bhapsa	Kisli
8.	Ghanghar	Kisli
9.	Salghat	Kisli
10.	Magar nala	Kisli
11.	Chuhri	Kanha
12.	Desi nala	Kanha
13.	Neela nala	Sarhi
14.	Surwahi nala	Sarhi
15.	Sulkum (Surpan)	Sarhi
16.	Dudhanaia	Bhaisanghat
17.	Taraiya	Bhaisanghat
18.	Kashmiri nala	Bhaisanghat
19.	Rohni nala	Bhaisanghat
20.	Halon	Supkhar

As stated earlier, the distribution of natural water is not adequate in the protected area, and this requires the Park Management to make special efforts for water development to ensure that water remains more or less uniformly distributed for wildlife throughout the Core Zone.

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2.6 Quasi Wetlands:

These are not true wetlands in the real sense of the term, and do not conform to the definition in having water tables at, or near, the surface of the soil for most of the year, often containing unique communities. They are highly productive, providing food for a large range of organisms.

There are, however, some water bodies in the Core Zone which may well pass off as wetlands. Some of these are as under:

Sl. No.	Name of Water bodies	Name of Range
1.	Menhar nullah dam	Kanha
2.	Desi nullah anicut	Kanha
3.	Kanhari tank	Kanha
4.	Ronda tank (upper & lower)	Kanha
5.	Sondar triple tanks	Mukki
6.	Sondar (upper & lower tanks)	Mukki
7.	Bisanpura twin tanks	Mukki

These wetlands attract a variety of birds, and are also favorite haunts of the barasingha and the chital in the pinch period. The barasingha also wallows at these sites during the rutting season, when they turn muddy/ swampy in the late winter.

2.7 Vegetation, Cover Types & Biogeographic Classification:

2.7.1 **Vegetation:** The protected area is rich in the typical floral attributes of the central Indian highlands. This can be attributed to a number of beneficial factors including the combination of landforms, soil types and moisture regime. The various topographic features of the protected area command special vegetative characteristics. The plateaux, or flat-topped hills, are basically grassy expanses with sporadic growth of fruit-bearing trees such as achar (*Buchanania lanzan*), aonla (*Embilica officinalis*) and tendu (*Diospyros melanoxylon*). The depressions, gorges and streams, just below these plateaux, support bamboo (*Dendrocalamus strictus*), mango (*Mangifera indica*), jamun (*Syzigium cumuni*) and arjun (*Terminalia arjuna*). The upper slopes of the Core

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Zone support mixed forests with a large number of mahul (*Bauhinia vahlii*) climbers. Besides, many other species of tree also grow here. The middle reaches of the slopes has excellent growth of bamboo under the trees. In the lower reaches, sal in almost pure stands replaces the mixed woodlands. Sal may also be noticed encroaching upon the meadows, and at many places substantial chunks have been occupied. In the larger clearings, susceptible to frost and fire, hardy species such as palas (*Butea monosperma*), lendia (*Lagerstroemia parviflora*) and tendu (*Diospyros melanoxylon*) have appeared sporadically and are gradually increasing in number and spread of crown cover, threatening the grassy expanses. The valleys are covered with dense stands of sal alternating with grassy meadows. Along the Mukki-Supkhar road in the Bhaisanghat area, there is also a patch of planted teak. A sprinkling of teak, however, occurs naturally in a small area of mixed forest in Bhilmakona along the Ganeridadar-Mundidadar road, near the Deoridadar (Bhaisanghat range) and Otesarra (Supkhar range) patrolling camps. Technically, however, after Champion and Seth (1968), the following forest types have been identified in the Core Zone:

1) Moist Peninsular Sal Forests **(3 C/C2)**
   a) High level sal **(3 C/C2 ci)**
   b) Low level sal **(3 C/C2 cii)**
   c) Valley sal **(3 C/C2 ciii)**

2) a) Southern Tropical Moist Mixed Deciduous Forest **(3 A/C 2 a)**
   b) Southern Tropical Dry Mixed Deciduous Forest **(5 A/C-3)**

A working classification in the field, however, suggests that the forests are mainly of two types:

- Sal
- Mixed deciduous

2.7.2 Vegetal Cover Types:

2.7.2.1 **Past Studies:** Kanha Tiger Reserve, being rich in floral and faunal attributes, has invited many studies in the past relating to habitat/ cover mapping using remote

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sensing techniques. It is relevant here to mention briefly some of the major studies as under:

- A study of wildlife habitat using high-resolution space photographs under the joint Indo-Soviet Remote Sensing Experiment TERRA onboard Salyut-7 was conducted. The multiband photographs taken on April 6th and 9th, 1984 during the 1st Indo-Soviet joint manned space flight were used to map the cover types of the area. The photographs pertaining to bands 2, 4 and 6 were used to prepare colour composite image using multi-spectral projector. The colour slides prepared from these colour composites were projected on a base map of 1: 50,000 for the purpose of interpretation. The key for interpretation was established using the near synchronous ground truth data collected in the area. This study led to the classification of cover types, habitat suitability, and the mapping of waterholes and terrain types.
- Panchromatic black and white aerial photographs covering the entire 940 sq. km. Core Zone of Kanha Tiger Reserve in 1: 10,000 scale was interpreted by standard photo interpretation technique. This was preceded by undertaking a survey for the interpretation and delineation of the stereopairs into 7 forest cover types. After the interpretation of aerial photographs the details were transferred onto a base map of 1: 25,000 scale using aero-sketch-master and zoom transferoscope. The core area was also visually interpreted by using False Colour Composite (FCC) date of Landsat MSS of the year 1980.
- Black and white panchromatic aerial photographs of 1: 10,000 scale (August, 1979) was used for mapping the vegetation types of western part of Kanha Core Zone. The Landsat multi-spectral scanner (path-row, 154 – 045, date 27-02-1973) and (Landsat thematic mapper (path-row, 143 – 045, date 19-11-1985) was analyzed through digital techniques. Maximum likelihood classifier was used for classifying multi-spectral satellite data on Multispectral Data Analysis System (M-DAS). The above techniques complemented by field methodologies led to the formulation of 15 vegetation classes, 1 class of bamboo brakes and 4 classes of grassland vegetation.
- Aerial remote sensing techniques were also used in the National Park for habitat mapping, monitoring changes in habitats and planning roads and tracks. The

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above study involved comprehensive method of standard aerial photo-interpretation techniques, supplemented by adequate ground truthing. Black and white aerial photographs on 1: 10,000 scale flown in April 1979 covering the Core Zone area was used for the classification of the forest cover into important crop composition and structural classes.

- Forest Survey of India, Dehradun conducted a study between 1983 and 1989 to monitor the changes in the vegetation cover of Kanha National Park. This was based on the visual interpretation of the Landsat Imagery. Diapositive imagery in FCC made from the Landsat on 1: 1 million scale for the period 1983 formed the input for vegetation mapping of the year 1983. The scene on 1: 1 million scale was enlarged to 1: 250,000 scale with the help of Large Format Optical Enlarger. The assessment of the forest cover for the period 1989 was based on the interpretation of Landsat imagery on 1: 250,000 prepared from Survey of India toposheet. The result of the above study broadly indicates as under:

  - The open forest cover has increased by 1.31 sq. km.
  - The non-forest has decreased by 1.31 sq. km.

- In the study for the preceding Management Plan, the following vegetal cover types were classified from the Geo-coded Multi-Spectral Satellite False Colour Composite (FCC) of IRS – 1B/ 1C/ 1D taken by the NRSA, Hyderabad in the year 1998. The table below presents the classification of the National Park into various broad cover types along with the percent areas occupied by each cover type:

Sl. No.	Broad Classes	National Park	
		Area (sq. km.)	% of Zone Total
1.	Sal Forest	226.55	24.10%
2.	Miscellaneous Forest	170.24	18.11%
3.	Sal with Bamboo	139.25	14.81%
4.	Miscellaneous with Bamboo	56.92	6.06%
5.	Grasslands	252.95	26.91%
6.	Grassland with Shrubs	71.10	7.56%
7.	Non Forest	19.50	2.07%
8.	Water	3.49	0.37%

The above broad classes have further been sub-classified into the following vegetation cover types:

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Vegetation Cover types	National Park	
	Area (sq. km.)	%
Dense Sal	124.191	13.21
Low Density Sal	54.619	5.81
Sal Without Undergrowth	49.668	5.28
Sal Mixed With Misc. Species	171.342	18.23
Dense Moist Deciduous Forest	109.593	11.66
Medium Dense Moist Deciduous Forest	82.931	8.82
Open Moist Deciduous Forest	97.239	10.34
Dry Deciduous Forest	53.772	5.72
Dense Bamboo Mixed With Misc. Species	44.194	4.70
Grasses	47.582	5.06
Grasses With Shrubs	25.383	2.70
Agriculture	5.470	0.58
Open Bamboo Mixed With Misc. Species	63.547	6.76
Fallow	6.440	0.69
Water	4.028	0.43
TOTAL	**940.000**	**100.00**

2.7.2.2 **Grasslands:** The Kanha ecosystem is characterized by undulating landscape, dotted with dense groves of vegetation, hillocks and rolling meadows. Though each cover type has its own ecological importance, the grasslands/ meadows of the Kanha Core Zone constitute the most important habitat type as they sustain ungulate populations of chital, barasingha, sambar, and gaur and, indirectly, populations of predators and co-predators. These grassy expanses, except for the frost-hollows, are actually the sites of relocated villages, their agricultural fields and old shifting cultivation sites and are, therefore, anthropogenic. The existing meadows, which used to serve as pasturelands for the village livestock, were already under grazing pressure. After the relocation of the villages, the old abandoned village sites morphed into excellent heterogeneous grasslands. The population of wild herbivores gradually increased and these heterogeneous meadows became a very important part of the habitat mosaic in the Kanha wildlife ecosystem. Several plant communities have been identified in these meadows, and as per results of stock mapping exercise, the current area of grasslands accounts for about 8.04% of the total area of the Core Zone.

2.7.2.3 **Aquatic Plant:** The management has over the years created a large number of water bodies to ensure an equitable distribution of water for wild animals. These water bodies and many other water courses such as rivers, nullahs, and temporarily flooded

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low lying areas and meadows also harbour a number of aquatic plant species along edges, on the surface, or at the bottom of shallow water courses. These plants command immense ecological importance in the Kanha ecosystem, and are an important link in the water body food chain. They support the fish and animal life, specially the barasingha, in and around the water bodies. They also provide important habitat and cover for the young fish. The growth of aquatic plants and algae is dependent upon sunlight and nutrients in the water. The amount of nutrients or fertility of the water bodies tend to increase as they get older, resulting in an increase in plant and algae growth. There are generally several types of aquatic plants that inhabit water bodies. The types are characterized according to how they are attached to the sediments. These are: emergent, freely-floating, rooted, floating-leaved and submersed forms. In large water bodies, these types may occupy different regions such as margins, deep or shallow water etc. The list of aquatic plants is appended **(Appendix-3)**.

2.7.2.4 **Rare Plants:** The Kanha ecosystem also supports at least 18 species of rare plants belonging to 15 families. The presence of these species also adds to the stature of Kanha from the standpoint of plant protection and biodiversity conservation. Rarity can be looked at and defined in several different ways, depending upon the context of the question and conformity to the guidelines issued by an authorized institute of the state or central govt. Special publications such as the Red Data Book etc. are bought out to describe these species in detail. In general, however, a plant species has to qualify one or several of the following criteria to be declared as rare:

- It enjoys legal protection.
- Considered sufficiently exceptional, unusual or uncommon.
- Considered sensitive due to its uniqueness or restricted distribution.
- Declining locally or regionally.

The list of rare plants is appended **(Appendix-4)**.

2.7.3 **Biogeographic Classification:** Floristically, the Kanha Tiger Reserve is part of the Indo-Malayan Realm, and, zoo-geographically, a member of the Oriental Region. As per the biogeographic classification of India (Rodgers & Panwar, 1988), the area lies

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in zone-6E – Deccan Peninsula – Central Highlands. The eastern and the western part of the Core Zone is divided by a narrow ridge known as the "chicken's neck".

2.8 Habitats & Trophic Niches and Wild Fauna & Status:

2.8.1 **Habitat & Trophic Niches:** Types of vegetation and habitats of wildlife in a wildlife ecosystem depend upon the physiography, geology, climate, and precipitation in the area. The physiography of the Core Zone is characterized mainly by forested shallow undulations, hills with varying degrees of slopes, plateaus, and valleys. These physiographical features along with sal and miscellaneous crops offer unique settings and ecotones, giving rise to diverse types of wildlife habitat and form ideal niches for various species of plants and animals. The above factors are responsible for a wide range of floral and faunal diversity and habitat types in the Core Zone. Habitat uses by the some major species of wildlife are as under:

Animal Species	Shelter/ Escape Route	Loafing Cover	Breeding Cover
Tiger	Dense sal and miscellaneous forests, close to grasslands	Forest/ forest edges, along forest roads and nullahs	Rocky outcrops in dense forests
Leopard	Dense sal and miscellaneous forests, close to grasslands	Forest/ forest edges, periphery of habitations	Dense forests
Wild dog	Open sal and miscellaneous forests, close to grasslands and water bodies	Open spaces, including grasslands, along forest roads	Dens in dense forests
Jackal	Open forests and forest edges	Open spaces, including grasslands, along forest roads	Dens/ ground rock crevices in forests
Sloth bear	Rocky outcrops in Dense forests	Dense forests and along forest edges	Dense forests
Gaur	Dense forests/ grasslands, close to water bodies	Forest and open spaces	Dense forests
Blue bull	Scrub forests	Flat areas of open forests	Scrub forests
Barasingha	Grasslands, small groves, close to water bodies	Open grasslands	Tall grass
Sambar	Dense forests and undulating landscape	Dense forests and along the edges	Dense forests
Chital	Open forests and forest edges	Forest edges and grasslands	Open forests
Barking deer	Dense forests	Open forests and forest edges	Dense forests

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Chousingha	Open forests	Open spaces and forest edges	Dense forests
Wild pig	Open forests	Open forests	Dense grassy cover
Langur	Dense and miscellaneous forests	Forest and riverine areas	Dense groves of trees
Hare	Open forests	Open grassy expanses	Dense shrubby undergrowth
Jungle cat	Forest areas	Open forest areas	Forest areas
Civet cat	Forest and dense grassy areas	Along forest roads and trails	Burrows/ under the rocks
Porcupine	Forest areas	Along forest roads and trails	Burrows in dense grassy under growth

2.8.2 **Intra & Inter-Specific Relations:** Various intra and inter-specific relationships among different species of carnivore and herbivore also exist in the Core Zone. Ecologically, these interactions result in the adjustment of equilibrium. Some of these relations are as under:

Interaction Type	Species	Nature/ Effect
Predation	Tiger – Ungulates Tiger – Cattle Leopard – Ungulates Leopard – Cattle Leopard – Porcupine Leopard – Peafowl Wild dog – Ungulates Jackal – Ungulate fawns, small prey Man – Wildlife species	Prey smaller in size
Direct competition	Tiger – Leopard Leopard – Wild dog Barasingha – Chital	Inhibition of species in some areas
Indirect competition	Ungulates – Livestock	Inhibition in peripheral areas of forest villages
Antagonism	Ungulate – Villagers	Inhibition of wild species inside or close to forest villages
Mutualism	Chital – Langur	Favourable interactions between the two
Neutralism	Chital – Sambar Gaur – Chital Gaur – Sambar	No species is affected

2.8.3 **Wild Fauna & Status:** The above typical fauna of the central Indian highland, part of the Oriental-Zoological Realm, is a fusion of the Indo-Chinese, Ethiopean and

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Palaearctic elements (Prater, 1948; Roberts, 1977). As stated above, these settings and transitions have resulted in excellent mosaics of wildlife habitats and structural variations for major faunal species. The habitats themselves provide a range of micro-habitat niches that are valuable for lesser fauna. The heterogeneity of habitats also has a strong bearing on the local distribution of mammals. The presence of the mosaics of meadows, being large expanses of herbage availability, within the woodland, also has a significant bearing on the aggregations of herbivores. The rich habitat diversity of the protected area supports abundant animal communities, including mammals, birds, reptiles and the lesser life forms.

The famous central meadows of Kanha (Kanha range) are very rich in ungulates and other faunal species. This is a high prey density area and is encompassed on three sides by the ridges of the Deccan trap, leaving the only opening for the movements of the animals in the north direction towards Sonf. This topographical peculiarity creates a physical barrier to animal movement from the central meadows. Consequently, these meadows and contiguous forests also have a high density of tigers and their excellent natal areas. Similarly, the ridges extending along the eastern boundary of the Core Zone also impede animal movement between the eastern and western parts of the protected area. Such topographical attributes foster pockets of high and low prey density areas within the protected area, resulting in unequal concentrations of tigers and co-predators in different portions of the habitat.

The Kanha Core Zone is renowned internationally for the successful conservation of two endangered wildlife species viz: the tiger and the central Indian barasingha. The tiger is now regarded as a highly endangered species in the world and is precariously restricted to only a few tiger range-countries, India being one of them. Deeply embedded in the human psyche as a living symbol of power, grandeur, ferocity, and magnificence, and central to innumerable myths of the divine and nature, no species of wildlife has captured the imagination and sentiments of international community in the history of conservation as spontaneously as the tiger, evoking successfully a tremendous response from the concerned quarters. As far as the Indian sub-species is concerned, barring only a few representative wildlife ecosystems, tiger conservation is still fraught with immense uncertainties and upsets. Against the above backdrop, the

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Kanha Core Zone has effectively conserved a viable population of the tiger ever since the ambitious "Project Tiger" was launched around 37 years back.

The resurrection of the majestic hard ground barasingha in Kanha is by far one of the most inspiring successes in the history of wildlife conservation in the country. Recognized as a sub-species of the nominate species of the swamp deer (*Cervus duvauceli duvauceli*) of the sub-Himalayan *terai* of north India, the Kanha barasingha is a food specialist with a narrow niche, and an exclusively graminivorous deer species, dependent totally on grasslands. Concerted managerial efforts to conserve this species have also proved to be a great learning process in the protected area and have resurrected the branderi barasingha from the brink of extinction.

Apart from the above two endangered species, some other wildlife species of different status as per the IUCN Red List of Threatened Species Version 2010.2 and the Schedules of the Wildlife (Protection) Act, 1972, are as under:

Sl. No.	Name of Species	Scientific Name	IUCN Status	WPA Schedule
1.	Tiger	*Panthera tigris tigris*	Endangered	I
2.	Leopard	*Panthera pardus*	Near Threatened	I
3.	Dhole	*Cuon alpinus*	Endangered	II
4.	Sloth Bear	*Melursus ursinus*	Vulnerable	I
5.	Hyena	*Hyaena hyaena*	Near Threatened	III
6.	Bengal Fox	*Vulpes bengalensis*	Least Concern	II
7.	Wolf	*Canis lupus*	Least Concern	I
8.	Jackal	*Canis aureus*	Least Concern	II
9.	Swamp Deer	*Cervus duvauceli branderi*	Vulnerable	I
10.	Chital	*Axis axis*	Least Concern	III
11.	Sambar	*Cervus unicolor*	Vulnerable	III
12.	Barking deer	*Muntiacus muntjak*	Least Concern	III
13.	Nilgai	*Boselaphus tragocamelus*	Least Concern	III
14.	Gaur	*Bos gaurus*	Vulnerable	I
15	Four-horned Antelope	*Tetracerus quadricornis*	Vulnerable	I

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16.	Wild Pig	*Sus scrofa*	Least Concern	III
17.	Langur	*Presbytis entellus*	-	II
18.	Rhesus Macaque	*Macaca mulatta*	Least Concern	II
19.	Hare	*Lepus nigricollis*	Least Concern	IV
20.	Jungle Cat	*Felis chaus*	Least Concern	II
21.	Smooth Coated Otter	*Lutra perspicillata*	Vulnerable	II
22.	Mouse Deer	*Moschiola indica*	Least Concern	I
23.	Civet cat	*Viverricula indica*	Least Concern	II
24.	Mongoose	*Herpestes edwardsii*	Least Concern	II
25.	Porcupine	*Hystrix indica*	Least Concern	IV
26.	Indian Python	*Python molurus*	Near Threatened	I
27.	Monitor Lizard	*Varanus bengalensis*	-	I
28.	Pea Fowl	*Pavo cristatus*	Least Concern	I
29.	Red Jungle Fowl	*Gallus gallus*	Least Concern	IV
30.	Green Munia	*Estrilda Formosa*	Vulnerable	IV

Note: *As the Lesser Florican has not been sighted recently, its name is not given in the list.*

The following species of termite were found in the Kanha Core Zone in a faunal survey conducted by the Zoological Survey of India in 1995. The National Park has been quoted as the only source of the following species in Madhya Pradesh.

Termite spp. – *Euhamitermes kanhaensis*
Termite spp. – *Eurytermes boveni*
Termite spp. – *Pericapritermes tetraphilus*
Termite spp. – *Odontotermes bhagwatti*

2.9 Major Conspicuous Changes in the Habitat Since Inception:

The following changes have been recorded in the wildlife habitats of the Core Zone since its inception:

- Relocation of 28 forest villages (the latest being Jami in 2010) from the erstwhile National Park has resulted in tremendous amelioration of wildlife habitats, and creation of larger tranquil zones for wildlife. The relocated village sites have

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morphed into excellent heterogeneous grasslands, the mainstay of thousands of ungulates.

- The hard ground barasingha once restricted to several habitats of the Kanha, Mukki and Supkhar ranges only, are also sighted frequently in the Kisli and Bhaisanghat ranges.
- Stringent overall protection throughout the year has helped gregarious woody tree species like *Shorea robusta*, *Lagerstroemia parviflora*, *Butea monosperma*, *Diospyros melanoxylon, Cassia fistula* and *Bombax malabaricum* encroach into the grasslands and old clearings.
- Sal has become very dense in pure crop areas, and has good regeneration in many places. In high prey density areas, however, the regeneration of the species is poor, and regeneration of miscellaneous species is conspicuous under sal.
- Since 2004-05, the sporadic and gregarious flowerings of bamboos have occurred in several places. Consequently, in gregariously flowered areas, old bamboos have dried and died back, and have resulted in dense regeneration. Sporadic flowering of bamboo still continues in several areas of the Core Zone.
- Water development measures have ensured availability and almost equitable distribution of water for wildlife throughout the Core Zone. The pinch period, however, has turned more problematic in the recent past, and in some areas water has to be supplemented through water tankers.
- Some invasive species such as *Phoenix acaulis*, *Desmostachya bipinnata* and *Parthenium hysterophorus* etc. are invading prominent grasslands.
- *Pogostemon benghalense and Colebrookea oppositifolia* are also invading the forest edges of the Kanha, Kisli and Mukki ranges.
- Grazing pressure of ungulates has resulted in general degradation of grasslands, with poor soil cover and moisture regime, giving rise to infestation of weed/ unpalatable species like *Lantana camara, Aristida adscensionis, Ageratum conyzoides, Sida spinosa* and *Cassia tora*.

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CHAPTER – 3

HISTORY OF PAST MANAGEMENT & PRESENT PRACTICES

3.1 Geographic Region:

The Kanha eco-region is part of the central Indian highlands, one of the seven geographic regions of India. As far as forest and wildlife wealth is concerned, the central Indian highlands are of utmost significance. Situated on the 22nd parallel of north latitude and between the 76th and 82nd of east longitude, the central Indian highlands, part of the extensive tableland that forms the main peninsula of our country, are extensive undulating plains, with many peaks, hill ranges and flat-topped hills, with the Vindhyas in the north and the Satpuras in the south, sprawling around 500 km. across the state of Madhya Pradesh and Chhattisgarh. In the east, these mountain chains join the Chota Nagpur Plateau of Bihar and other hill chains in Orissa and Andhra Pradesh, and extend well into the States of Gujarat and Maharastra in the west. This geographical sub-region once held extensive, though fragmented, forest belt and accounted for a significant part of the total forests and wildlife habitats in India. Though the sub-region is now under characteristic biotic pressure, it still supports typical floral and faunal species of the region. The highlands also hold the sources of several of the important Indian rivers of the country.

3.1.1 **The Maikal Range & the Satpuras:** The Maikal, a mountain range in Madhya Pradesh, Central India, running in a north-south direction, forms the eastern base of the triangular Satpura range. This mountain range harbors Laterite-capped, flat-topped plateaus with elevations ranging from 2,000 feet (600 m) to 3,000 feet (900 m). The Satpura-Maikal watershed is considered the second largest in India. The Narmada, Sone, Mahanadi, Tapti, Pandu, Kanhar, Rihand, Bijul, Gopad, and Banas rivers run almost parallel from south to north, and have carved extensive basins in the relatively soft rock formations of the Maikal range. The vegetation varies greatly from grass and thorny trees to deciduous trees such as the teak and sal. Agriculture, the principal economic activity, is practiced mostly in the alluvial basins. The crops include rice, wheat, gram (chickpea), jowar (sorghum), barley, corn (maize), pulse (legumes), sesame seeds, and mustard seeds. Mineral deposits include coal, limestone, bauxite, corundum, dolomite, marble, slate, and sandstone. Ethnographically

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important, the Maikal also holds many groups such as the Gonds, Halbas, Bharais, Baigas, and Korkus.

3.2 **Geological Significance:**

The region commands a very interesting geological significance that was first revealed by an Austrian geologist, Aduard Suess (1831-1914) in his classic "The Face of the Earth". He proposed the hypothesis that an extremely large landmass, a super-continent, which he named "Gondwanaland", after the region in Central India that displays the typical geological features of the Permian and Carboniferous periods, shared by all four continents corresponding to the above periods, was in existence in the Paleozoic era. The most common leaf form found throughout Permian period had a distinctive leaf type that was first described from India, in 1822, by the great French palaeobotanist Adolphe Brongniart. He named them Glossopteris ('tongue leaf'). The occurrence of *Glossopteris* Brongniart leaves and certain vertebrates throughout the Gondwana countries were significant early evidence for the theory of continental drift at the beginning of the last century, long before it was a generally accepted concept and the mechanism of plate tectonics was known. The rock strata that contain this evidence are called the Karoo (Karroo) System in South Africa, the Gondwana System in India, and the Santa Catharina System in South America. Around 165 million years ago, this super-continent included Australia, Antarctica, Southern New Guinea, Africa, South America, and India. The Plate Tectonics theory suggests that this landmass was carried on Plates that began to move, and the landmass got fragmented over time into the present formation of continents.

3.2.1 **Ethnographical Attributes:** The region is also rich ethnographically, being the land of Octhonous people. Heavily dependent upon the forest resources, with a touch of aboriginality, they command a strong bearing on natural ecosystems. The following principal tribal groups are found in the region:

3.2.1.1 **The Gonds:** The Gondwana, or the "land of the Gonds", a part of the geologically significant region in Central India covering Kanha Tiger Reserve, comprises parts of old Madhya Pradesh, Andhra Pradesh, and Maharastra states. The present Gondwana tract is basically named after the inhabitants of the principal ethnic tribe Gond.

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Anthropologically, these Gonds are Proto-Australoid, having a supposed racial affinity with the aborigines of Australia, and belonging to the Dravidian stock of Asian origin.

The Gond was the most significant group of original Indian tribes. In the 1500's, several Gond dynasties were firmly incorporated by the Gond rajas, or kings. They ruled like Hindu princes until Muslim armies conquered them in 1592. In the 1700's, the Gond lost all power to the Maratha kings who forced their culture to make them retreat to the hills.

The majority speaks various and, in part, mutually unintelligible dialects of the Gondi, an unwritten language of the Dravidian family. Some Gonds have lost their own language and speak Hindi, Marathi, or Telugu, depending on the linguistic dominance in their respective areas. Previously, a considerably large part of settlements were temporary, and the Gonds practiced shifting cultivation. A significant percentage of the Gonds are Hindus, worshipping hundreds of gods and goddesses. The remaining are animists. The Animist Gond believe that the wood is the dwelling place of the gods, village deities and hereditary spirits. They habitually pray to the ancestral spirits for guardianship and blessings. The staple foods of the Gonds are the two millets known as *Kodo* or *Kutk*i. Rice is their ceremonial feast, which they prefer eating during the time of festivals. Most of the Gonds are meat consumers.

The Gond villages are intended to be communal, territorial units. A chief heads the tribe, and a committee of elders guides each village. The chief is regarded as the judge of all tribal disputes, while the elders have legal authority over their villages. The Gond kinship is patriarchal and line of descent is traced patrilineally. The tribe is divided into clans, each of which stands for the offspring of a common male ancestor. The Gond does not marry within its own clan and cross-cousin marriages are preferred. Multiple spouses are also common. A strong lineal connection exists between all members of the tribe. Equality and brotherhood are the main principles of the tribe. They live by farming, hunting, and eating the fruits of the grove, but they also trade and sell cattle. Others are daily wagers.

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3.2.1.2 **The Baigas:** Another ethnic group of the same stock, living around the Tiger Reserve is the Baigas who have been transfused with the material culture of Hindu settlers over the last few centuries but they still remain a very primitive tribe with animistic religion, magic and traditions, and prolific jungle lore. As the Baigas are amongst the oldest inhabitants of India, their origin and affinities are very obscure, but it is believed that they have similarities with the peoples of Northeast India/ Burma and Southeast Asia. They are forest dwellers and skilled woodsmen. The Baigas are the most primitive and interesting forest tribal of the region, but they have completely lost their language, if they ever had one.

Generally, the Baigas take to the *bewar* form of cultivation that consists of 2 to 3 acres of dense forests chosen usually on a very steep slope. The owner Baiga cuts down the entire standing forest crop and burns it in the high summer. Later, in the rains, this ash scattered field is sown with the seeds of marginal crops such as *kodon, Kutki, Baiganitur* or sweet potatoes. In case, the rains are good in subsequently years, the field will provide excellent crops until the fourth or fifth year. After this the owner will abandon the field for a new one. Though the Baigas believe that the forest grows denser after the abandonment of a *bewar*, much damage is inflicted on the existing forests.

3.2.2 **Brief History:** The Kanha eco-region, which includes the present Core Zone and its contiguous large forest tracts of the various territorial divisions, prides on a conservation history of almost one hundred years. There is an enormous body of writings - diaries, memoirs, and books etc. - authored by Indian and British wildlife conservationists, and forest and army officers and, of course, huntsmen, on the wide spectrum of wildlife species and their abundance in these wilds. These forest tracts were regarded as some of the finest and hitherto untouched wilderness areas in the country. Many widely travelled Indian and British conservationists, including AA Dunbar Brander, Capt. James Forsyth, and EP Gee, who had also enjoyed the finest wilderness areas of Africa and Europe, were also in awe of this region and expressed themselves generously in their accounts. Till the first two or three decades of the last century, human population in and around the present Kanha Tiger Reserve, was not a serious threat to the natural heritage. Increasing biotic pressure, however, quietly indicated the shape of things to come in the future.

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Physical features, climatic factors and soils have imparted rich floral and faunal diversity to these wildlands, and the habitat supports a typical central Indian range of plant and animal species, including some endangered species. The Core Zone has now been one of the most prominent wildlife protected areas of national and international fame for almost over five decades. The protected area has been tremendously successful in providing a sound ecological status to these wilds through stringent protection measures and scientific management of the wildlife ecosystem under Project Tiger. The protected area also commands the unique distinction of supporting the last world population of the hard ground Barasingha. This rare and endangered species has been saved from the brink of extinction, and now enjoys a relatively secure status due to excellent managerial efforts. Above all, the protected area is also a fine example of restorative ecology.

3.3 Conservation History:

3.3.1 **Legal Status of Forests:** As stated above, the forest tract was inhabited mainly and traditionally by the Gond and the Baiga tribes, the latter confining themselves largely to the upper valleys and plateaus close to the main Maikal range. Though the information on the early history of these forests prior to 1860 is extremely scanty, the old records indicate that the villagers enjoyed free access to cut and burn forests at will. The system of shifting cultivation, locally called the “bewar”, flourished almost unchecked on hill slopes until as late as 1870.

The introduction of the Wasteland Rules in 1862, however, formed the outlines of forest management, restricting the cutting of a few tree species such as the sal, saja, shisham and bija. Around 1865, the sal forests were brought under the purview of the First Forest Act, and the Banjar Valley and a few other blocks were declared Reserved Forests. In 1873-74, most of these forests were duly demarcated in the field. The area also chronicles the visit of the legendary Dr. D Brandis, the then Inspector General of Forests, in 1876. Later, in 1879, after the passage of the Indian Forest Act, 1878, the entire forestland constituting the present Tiger Reserve was declared Reserved Forest. Ever since, the forests have retained a firm legal status, and are credited with accurate and reliable topographic maps.

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3.3.2 **Dependence of Local People on Forests:** As far as the past dependence of local people on these forests is concerned, the extraction of forest produce for domestic and agricultural use under the commutation system was introduced in 1879 to regulate the unrestricted cutting by villagers. This system also proved ineffective and was gradually curtailed, and finally stopped in 1933. Villagers were drawing most of their domestic requirements from the landlords' proprietary forests, which were not included in the Tiger Reserve. After the abolition of the ex-proprietary rights, some supplies of the cut material to meet the petty demands of villagers were permitted from annual coupes under working. Later, even this was terminated, and petty cut material was made available from special depots opened in the villages.

Grazing was permitted unrestricted upto 1915, when grazing rules came into force. These rules regulated grazing through grazing units and closure of regeneration areas. With the rise in cattle population and poor governance in the post-independence period, control over grazing became weak and grazing pressure rose tremendously in the areas close to villages.

3.3.3 **Forest Management:** The tract, comprised of valuable sal forests, recorded the beginning of commercial exploitation in 1862 when the crop was extracted for railway sleepers. The first systematic plans of these forests were prepared by Mr. AP Percival and AA Dunbar Brander in 1900 and 1904 for forest areas in the Balaghat and Mandla districts respectively, prescribing the Selection-cum-Improvement felling. Commercial exploitation, however, prevailed over the improvement part of the prescription. The next plan, prepared by Mr. Gurdial Singh, which come into force from 1932, prescribed the Shelterwood system for better sal forests, with floating Periodic Blocks, and the Selection-cum-Improvement system for the inferior crop. This plan, however, more or less remained suspended due to the indiscriminate heavy felling for World War II and drought mortality of the crop. Later, from 1949-50 to 1963-64 the forests of the Mandla and Balaghat districts were managed under the working plans prepared by Mr. JC Mehta and Mr. SS Buit respectively. These plans prescribed the Conversion-to-Uniform system in the better quality sal forests, whereas the Selection-cum-Improvement system in the inferior quality. Besides, miscellaneous forests were worked under the Coppice-with-Reserve system. Bamboo also came under the regular exploitation in these plans. The standards of grazing

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control and fire protection were fairly good from 1910 onwards until the Forties. All forests exploitation in the area of Core Zone was stopped from 01-06-1959.

Salient Points of Past Forest Management

No commercial exploitation until 1860	
1862	Wasteland Rules formed
1865	Sal Forests - First Forest Act
1879	Reserved Forest Rules formed
1862 to 1870	Best sal trees exploited for railway sleepers
1900	Mr. AP Percival's First Working Plan for the Balaghat Area
1904	Mr. AA Dunbar Brander's First Working Plan the for the Mandla Area
1932	Mr. Gurdial Singh's Second Working Plan for both Mandla & Balaghat Areas
1949-50 to 1964-65	Mr. JC Mehta's Working Plan for the Mandla Area
1949-50 to 1964-65	Mr. SS Buit's Working Plan for the Balaghat Area
No commercial exploitation since 01-06-1959	

3.3.4 **Legal Status of Wildlife:** These forests were renowned for a wide range of game animals and birds. Even as in other parts of the country wildlife was faced with rapid decimation, these remotely situated wilderness areas still had a tremendous potential of wildlife. With the Independence, grater emphasis on food production was given and crop protection licenses were freely issued. Besides, large chunks of *malgujari* (proprietary) forest and wasteland were reclaimed for cultivation, making convenient inroads into the forests and further squeezing prime wildlife habitats. These forests constituting the present Tiger Reserve had begun enjoying statutory protection for wildlife under the Indian Forest Act, 1927; the Wild Birds & Animal Protection Act, 1912; and the Indian Game Act, 1935, and the MP National Park Act, 1955. Though only regulated *shikar* was permitted under the shooting block system, with provision of periodically closing the blocks and imposing game limits in open blocks, the actual control in the field slackened in the post-Independence era. Prime wildlife habitat suffered further on account of tremendous grazing pressure and frequent fires.

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Nevertheless, these forests still possessed a remarkable potential for Indian wildlife, and were later to constitute one of the finest wildlife protected areas in the country.

3.3.5 **The Valleys:** The history of Kanha is, actually, that of the Banjar and Halon valleys, named after the respective rivers, and forming the western and eastern part of the tiger reserve. Acclaimed countrywide as excellent *shikar* blocks in the 1930s, parts of these valleys later moved up in conservation status and became Wildlife Sanctuaries and later jointly formed the present National Park in 1955. The potential of tiger conservation was so great that the National Park was also among the first nine to be included in the ambitious Project Tiger scheme (now known as National Tiger Conservation Authority) in 1973.

3.3.5.1 **Banjar Valley:** It was declared a Sanctuary on the 16th May 1933, prohibiting the shooting of all game except wild boars and birds. In 1941, the status of the Sanctuary was reduced to that of a Game Sanctuary in view of the virtual impossibility of the regeneration of sal. In 1943, an area of 134 sq. km. (Kanha Valley) was upgraded to a Sanctuary and the rest of the area was declared as district officers' shooting block. In 1945, permission was issued to kill 250 chital in the Sharwantal *maidan* within the Sanctuary. The Maharaja Kumar of Vijaynagaram shot 30 tigers in and around the Sanctuary between 1947 and 1951. Again, in 1952, the Sanctuary area was enlarged to 252 sq. km. Subsequently, the whole area of 252.97 sq. km. of the Banjar Valley was declared as Kanha National Park. In the subsequent extensions in 1964 and 1970 the Park assumed the size of 446 sq. km.

- 1860 - Capt. James Forsyth's reference in "The Highlands of Central India"
- 1879 - Reserved Forest with no special attention to wildlife management
- Upto 1933- Remains a shooting blocks
- 1933 - Sanctuary notified (233 sq. km.)
- 1943 - The Sanctuary reduced to 134 sq. km.
- 1945 - 250 Axis deer shot
- 1947 to 1951 - The Maharaj Kumar of Vijayanagarm shot 30 tigers
- 1952 - Sanctuary enlarged to 252 sq. km.
- 1955 - National Park constituted (252.97 sq. km.)

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- 1964 - 65.39 sq. km. added to the National Park
- 1970 - 128.24 sq. km. added to National Park, now total area 446.6 sq. km.
- 1973 - Kanha declared a Tiger Reserve
- 2007 - Part of the National Park notified as the Core Zone

3.3.5.2 **Halon Valley:** The old Supkhar shooting block falls into the Halon Valley. In 1935, this shooting block was declared a Sanctuary. Subsequently, there was phenomenal rise in game populations, including carnivores. This, however, came in severe conflict with the huge number of the cattle of *dahiyana* (cattle camps) that used these grazing grounds, as also with the numerous forest villages situated in the tract. A large number of cattle kills also occurred. Subsequently, probably in 1937, the area of the Sanctuary was reduced from 500 to only about 60 sq. km. Again, due to hue and cry from nearby villagers the area was put back in district officers' shooting block in 1942. In 1949, Mr. SS Buit, Working Plan Officer, recommended to extend Kanha Sanctuary upto Supkhar area. Hence, an area of 487.72 sq. km. of this Supkhar tract was declared a Sanctuary in 1974, and, subsequently, declared a National Park in 1976, and merged with Kanha National Park.

- 1931 - District Officers' shooting block
- 1935 - Sanctuary Declared (about 500 sq. km.)
- 1937 - The Sanctuary reduced to about 60 sq. km.
- 1942 - The Sanctuary denotified.
- 1974 - Supkhar declared a Sanctuary (487.72 sq. km.)
- 1976 - The Supkhar Sanctuary declared a National Park, enlarging the area to 940 sq. km.
- 2007 - Part of the National Park notified as the Core Zone

3.3.5.3 **Erstwhile Supkhar Sanctuary:** Presently Supkhar is one of the six forest ranges of the Core Zone. Supkhar forms the eastern most forest range bordering the newly constituted Chhattisgarh state. Spread over 235 square km., the Supkhar range lies in the upper part of the famous Halon valley, named after the river that originates from just outside the boundary of the range, now in Chhattisgarh, and zigzags through this

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beautifully forested range before entering the buffer zone and finally draining into the Budhner river well outside the Tiger Reserve.

Captain James Forsyth, a soldier of the Bengal Lancers, also a forester and naturalist, and known worldwide for his wildlife classic "The Highlands of Central India", traveled through this valley in January 1863. He pitched his tents at the village Topla, which now lies in the buffer zone, outside the western boundary of the Supkhar range. He recalls the wintry nights in the tent amid the roars of two resident tigers moving very closely. Forsyth made memorable forays into the wilds, roaming about this wilderness with his rifle, retinue and trained hounds, and also bagged several animals. Forsyth has written lucidly about the forests and wildlife of the Halon valley in his classic. He saw large herds of barasingha and likened them to the red deer of Scotland. The captain also recounts the continual characteristic bugling of these animals heralding the peak of the breeding season. His interactions with the local tribesmen also confirmed abundance of barasingha on the plateaus in the region. Forsyth records how the Baigas, a local tribe, used axes as projectiles, and also dogs to kill these animals. Little did he realize that around 150 years later this valley would become totally bereft of this handsome deer species, and would require special initiatives for its reintroduction.

This range was actually part of the renowned old Supkhar shooting block of the 1930s, covering the erstwhile Supkhar range, later declared a Wildlife Sanctuary and added to the present Kanha Core Zone and the National Park. The present Bhaisanghat range is also part of the old Supkhar range. In 1935, this shooting block was declared a Sanctuary. This change of status later conflicted seriously with the interests of a large number of cattle camp owners who were using this area as grazing grounds for their cattle. Besides, this area also harboured a lot of villages with typical agricultural and husbandry practices. The consequent increase in the population of carnivores resulted in frequent cattle kills and other inconveniences. The cattle camp owners and villagers opposed this conservation initiative vehemently, and started setting indiscriminate fires to wildlife habitats and forests. Besides, new conservation status of this area also witnessed a considerable increased in chital population that adversely affected sal regeneration. In this backdrop, the area of the Supkhar Sanctuary was reduced to 60 sq. km., covering the Khonga and Kushera meadows

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near the erstwhile Supkhar village. Shortly, in a span of only a few years, the number of ungulate species increased manifold in these meadows resulting in depredation of agricultural crops. The increase in the number of tigers and bears in this area again created a serious interface with villagers who voiced their antagonism and anger against wildlife and the Sanctuary. Ultimately, the officers had to denotify this Sanctuary, and again made it a district officers' shooting block in 1942. Consequently, in later years, forest officers and conservationists observed a rapid decrease in the status of wildlife in this area. This potential area was, however, declared a wildlife Sanctuary in 1974.

3.4 Habitat Management:

This is now established knowledge that a habitat is a home to a wildlife population, and includes space food, cover and shelter. The Kanha wildlife ecosystem consists of several mosaics of habitats that support populations of various wildlife species. Needless to add, these habitats always require periodic monitoring and managerial interventions to remain sufficiently healthy to sustain wildlife populations depending upon them.

While there are broadly two habitat types, namely forest and grassland, in the Kanha Core Zone, finer classification of habitats may suggest the following types:

- Sal Forest.
- Miscellaneous Forest.
- Miscellaneous Forest with Bamboo.
- Grassland.
- Grassland with Groves.
- Large Clearings.
- Forest – Grassland Edges.
- Riparian.

The list of main tree, shrub, herb, weed and grass/ grass-like species occurring in the Core Zone are appended **(Appendix-5)**.

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There are, however, also some special sites having geomorphological origins with a significant bearing on the fauna of the Core Zone. These sites may also be regarded as special habitat types. Some of them are as under:

- Caves.
- Dens.
- Overhangs.
- Bouldery Aggregates.
- Saltlicks.

3.5 Grassland Habitat:

These grasslands constitute the most important part of the habitat mosaic sustaining the prey populations and, in turn, the predators and co-predators. Besides the obvious significance of this habitat type, it is also vary crucial for the survival of the hard ground barasingha in this Core Zone. The grasslands, except for the frost holes, are the sites of relocated villages, their agricultural fields and old shifting cultivation sites, and are therefore regarded as anthropogenic. The meadows, which used to serve as pasturelands for the village cattle, were already under biotic pressure. After the relocation of these villages, the population of the herbivore species gradually recorded an upward trend, and the heterogeneous grasslands became a very important part of the habitat mosaic in the Kanha wildlife ecosystem. High degree of protection afforded to the Core Zone, and scientific wildlife management resulted in large population of the prey base, subjecting most of these grasslands to tremendous grazing pressure, further aggravated at places by natural topographic barriers.

3.6 State of the Grasslands & Forest Edges:

Grasslands in the Core Zone form around 8% of the total area, and are very important for the survival of the huge population of ungulates. These grasslands themselves are comprised of around 16 plant communities. Till around the 1940s of the last century, the protected area used to receive an average annual rainfall of around 1800 mm. Consequently, the meadows had a good moisture regime and they supported tall grasses. These meadows were the mainstay of the main species of ungulates, including the hard ground barasingha for whose

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survival the tall grass played a very important role. The practice of cool/ early burning of these grasslands in December-January was already an accepted norm prescribed by the forest department. In winters, the grass, already dried up due to frost, burnt well, and at the same time the soil had enough moisture to help the rhizomes produce green shoots soon after cool burning. Besides, frequent wanton fires were also very common in the grasslands, and they also gave rise to this phenomenon. Departmental burning practice was undertaken primarily to prevent fire-hazards during the summer. Consequently, the meadows started attracting a large number of ungulates, and the grazing pressure on these burnt grasslands continued until the next rains. This prolonged grazing resulted in the rhizome vigour being sapped due to the nonstop production of green shoots without allowing them to grow fully and rebuild the rhizome through photosynthesis. This fire protection practice gradually caused the more palatable perennials to disappear from the central meadows under the heaviest grazing pressure. Further, tender annuals also suffered from the destruction of seed by fire. The barasingha had to suffer the most from this burning practice as its sustaining grasses were wiped out over large areas.

The Kanha meadows had been receiving some protection since 1933, when the area was declared a Wildlife Sanctuary, through 1955 when it was upgraded to a National Park. The Kanha National Park was included in Project Tiger in 1973-74 and ever since the management of grasslands, specially those in the Kanha range, have been guided by the most important objectives of stabilizing a sharp decline in barasingha population and building a good prey base for an increasing population of tigers and co-predators in the protected area. Gradual strengthening of protection measures also ensured an increase in ungulate population, which in turn increased grazing pressure in these meadows. The above factors along with the cool burning practices gradually added to the degradation of the grasslands. The amount of rainfall received by the National Park also decreased gradually, and around the 1980s it came down to about 1600 mm. The situation persisted, with ever increasing grazing pressure of the ungulates and the meadows getting degraded due to the above, coupled with low moisture regime. By this time the barasingha, who preferred tall grass for its parturition, and to avoid sympatric competition with the chital, had abandoned these grasslands for more conducive ones. For the past several years the average annual rainfall has come down to around 1300 mm.

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The roots of a grass plant underground are almost the same size as its top over-ground. The roots may be regarded as the mirror image of the over-ground part. This relationship provides a very practical guide to the general health of a grassland. Generally, the removal of leaf area over-ground through grazing is akin to root pruning, and resting from grazing strengthens the roots. In this way, continuous root pruning or uncontrolled grazing leads to reduction in root biomass, slow nutrient cycle, ultimately causing plant death. Grasses, however, may also degenerate if over-rested. Therefore, grazing has to be carefully managed with intermittent grazing and resting. Besides, grass is a strong plant and can grow more vigorously than most of the annual weeds as its growth often starts from the food material stored in the rhizome, and not from the limited food stored in a seed as in the case of an annual weed. Due to chronic grazing pressure, the grasses are not allowed to grow, as stated above, and the weed plant thrives unhampered. While the pressure on the grass is maintained all through the growing season, the weed plant is allowed to grow flower, fruit and seed. In the subsequent years, there is a progressive increase in the weed density due to profuse seeding. Consequently, the growing space is gradually usurped by the weeds to the exclusion of the grasses, specially the more tender and palatable grass species.

Though all weeds are undesirable plants, all undesirable plants may not be weeds. However, for the grasslands being managed with a specific objective, the weed is defined simply as an undesirable and unwanted plant. Besides *Lantana camara*, *Cassia tora*, *Parthenium hysterophorus* and *Ageratum conyzoides* many weed species also occur in these grasslands. While some grasslands of the Supkhar range are infested by *Desmodium heterocarpon*, *Vernonia divergens*, *Bidense bidermata* etc., the grasslands of the Mukki and Bhaisanghat ranges harbours *Petalidum barleriodies*, *Plactranthus incanus*, *Ageratum conyzoides*, *Achyranthes aspera*, *Acanthospermum hispidum* and *Sida spinosa* etc.

It is widely accepted that grassland degradation occurs due to overgrazing. In the initial stages of pressure, the more palatable plant species, annuals and perennials, are reduced or eliminated, and are replaced by less palatable species. Invasive species from other ecosystem also encroach into grasslands. Dry areas, however, bear most of the grazing pressures in low rainfall years, palatable perennials tend to be replaced by annual grasses. Initially, in good rainfall years, these annual grasses may produce more forage than the original ecosystems, but in poor rainfall years, they produce very little or nothing. Originally, where forage production altered with good or bad years changes to a little or plenty situation. In low

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rainfall years (and in the initial period of the following normal or high rainfall year), the soil surface, once protected with perennial grasses, is exposed to erosion. In this way, the process of degradation continues with less plant growth, increasing grazing pressure (unless animal populations are substantially decreased) and increasing signs of erosion.

Anthropogenic history, successional intricacies, old burning practices and chronic grazing pressure have initiated these meadows into the process of degradation. Many prime grasslands have turned regressive over the years. Naturally, it has become a cause for concern for the Park Management. Large chunks of once fine grasslands have been invaded by *Desmostachya bipinnata*, locally known as *Kush* grass, with serrated leaves and low palatability. This species is regarded as very hardy and is a great survivor whose roots many go as deep as 5 feet to meet the sub-soil water. Some areas have been dominated by *Imperata cylindrica*, another hardy species. The dwarf palm, *Phoenix acaulis*, has also encroached into many parts of important grasslands and forest edges. This is said to be an indicator of degraded soil and fire prone areas. Many forest edges have also been colonized by *Colebrookia oppositifolia* and *Pogostemon benghalensis*. Needless to add, such colonization reduces forest edges and replaces more favourable species for wildlife. Currently, the Sonf and Ronda meadows, the mainstay of the barasingha population in the Core Zone, are also threatened with signs of degradation. These grasslands have also been undergoing gradual change in species composition. Tall grass areas have reduced over the years, and unpalatable species have become a common sight in these grasslands.

The chital is the most numerous of all ungulate species in the Core Zone, and its large herds are very common sightings during the rains. Such aggregations, however, are not seen after October/ November. Visiting forest officers and scientists also regard this phenomenon as an indicator of overgrazed grasslands in the Core Zone, whereby large herds have to disperse far and wide for grazing.

Further, the Kanha meadows are also under the arrested stage of ecological succession due to past anthropogenic interventions such as felling, fire and grazing etc., and are being encroached upon by gregarious hardy woody species such as *Butea monosperma*, *Lagerstroemia parviflora, Bombax ceiba, Cassia fistula, Cordia myxa,* and *Diospyros melanoxylon* etc. The seedlings of these woodland species appear in the grasslands as small patches, and grow in size and area to create favourable conditions for other species to invade

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the grasslands. In short, the vegetation tends to reach its climatic climax to be governed later by the climate of the region. Though a natural and progressive phenomenon, such reduction of the grassland habitat, so important to the barasingha for its daily foraging and annual fawning, is also a serious threat to the survival of the species.

It is worthwhile to briefly mention here the prescriptions given in the previous Management Plans for the management of these grasslands in the protected area. Over all these years, the Park Management has been acting upon the prescribed guidelines, depending upon the availability of funds.

- **Mr. HS Panwar (1973-74 to 1978-79)**
  - Stoppage of annual early burning in regressive grasslands.
  - Burning regimes of 3-4 years in other grasslands.
  - Improvement of meadows – ploughing and sowing/ planting of grass seeds/ cuttings.
  - Planting of indigenous fruit and fodder trees on the fringes of meadows.
  - Habitat manipulation.

- **Mr. AS Parihar & Dr. PC Kotwal (1989-90 to 1998-99)**
  - Pasture development.
    - Relief enclosure.
    - Eradication of weeds.
    - Eradication of brushwood.
  - Burning regime for grasslands.
    - Avoidance of fire in heavily grazed grasslands.
    - Valley grasslands – once in two years.
    - Plateau grasslands – once in three years.
  - Reproductive cover for barasingha.

- **Dr. Rajesh Gopal & Dr. Rakesh Shukla (2001-02 to 2010-11)**
  - Weed eradication.
  - Brushwood eradication.
  - Maintenance of tall grass cover.
  - Rotational grazing.
  - Restocking of grasslands.
  - Expansion of grassland areas.
  - Cool burning.

The Park Management, however, cannot think of any cause, other than chronic grazing pressure, for this regression. There might, however, be a number of factors operating below ground which affect the above ground vegetation, and the Park Management thought it worthwhile to have some aspects of the soils of selected grasslands analyzed. The Department of Biotechnology & Bioinformatics Centre, Barkatullah University, Bhopal, was contacted for this problem, and as per their guidance soil samples from the main grasslands of Kanha and Mukki were sent for appropriate soil tests. The soil report concludes that plants are not able to flourish in the Kanha soil samples largely because of heavy infestation of fungal pathogens rather than deficiency of nutrients in the soils. The detailed report is appended **(Appendix-6).**

3.7 Structural Changes in Grasslands:

An ecological study on the grasslands of Kanha Core Zone was conducted (Pandey, 1982) with special reference to wildlife management. On the basis of phytosociological studies, dominance and co-dominance of different grass species 16 plant communities were identified. The same study was repeated in several prominent grasslands of the Core Zone (Pandey & Hardaha, 2007) to evaluate changes in the plant communities of these grasslands. The comparative status of both the studies is as under, and the details of main associates, including herb and tree species are appended **(Appendix-7)**:

Sl. No.	Old Associations	New Associations
1	*Dichanthium annulatum- Heteropogon contortus*	*Themeda triandra- Bothriochloa odorata*
2	*Dichanthium annulatum-Themeda triandra*	*Heteropogon contortuss-Dimeria ornithopoda*
3	*Dichanthium annulatum-Dimeria ornithopoda*	*Dimeria ornithopodaoda- Panicum montanum*
4	*Heteropogon contortus- Dichanthium annulatum*	*Themeda triandra-Heteropogon contortus*
5	*Heteropogon contortus-Iseilema laxum*	*Chionachne koenigii-Imperata cylindrica*
6	*Heteropogon contortus-Themeda triandra*	*Themeda triandra-Heteropogon contortus* *Saccharum spontaneum-Dimeria ornithopoda*
7	*Heteropogon contortus-Saccharum spontaneum*	*Dimeria ornithopoda-Saccharum spontaneum* *Ischaemum indicum-Eragrostis unioloides*
8	*Themeda triandra-Heteropogon contortus*	*Heteropogon contortus-Themeda triandra*
9	*Themeda triandra-Themeda quadrivalvis*	*Themeda triandra-Ischaemum indicum*
10	*Themeda triandra-Dimeria ornithopoda*	*Ischaemum indicum-Heteropogon contortus*
11	*Themeda triandra-Eragrostis tenella*	*Imperata cylindrica- Ischaemum indicum*
12	*Themeda triandra-Imperata cylendrica*	*Dimeria ornithopoda -Themeda triandra*
13	*Themeda quadrivalvis-Heteropogon contortus*	*Arthraxon lancifolius-Heteropogon contortus*

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14	*Iseilema lexum-Imperata cylindrica*	*Imperata cylindrica-Themeda triandra*
15	*Imperata cylindrica- Heteropogon contortus*	*Imperata cylindrica-Bothriochloa pertusa*
16	*Saccharum spontaneum - Eragrostis unioloides*	*Dimeria ornithopoda-Desmostachya bipinnata* *Dimeria ornithopoda-Ischaemum indicum*

The above study suggests that burning and grazing in the grassland habitat were found to be the most prominent biotic factors that considerably affected the structure and function of grasslands. These structures have led to secondary succession in the form of changed community types in these grasslands. Regressive trends in these grasslands have been attributed to overgrazing and repeated annual fire. Conclusively, the successional stages of grasslands are being governed by the various intensities of fire and grazing in different grasslands of the protected area, which in turn are regulating the ungulate population and utilization pattern of grasslands in prevailing conditions.

3.8 General Observations on Grasslands:

While prescriptions for the management of the grasslands have been described above, given below are some general observations/ suggestions as emerged from discussions with visiting wildlifers and scientists.

Though most grasslands of Kanha Tiger Reserve are anthropogenic, the role of flood and frost in some patches (more so in the historic past) cannot be ruled out. It would also be relevant to classify these grasslands from the management standpoint into the following categories:

- Hygrophilous grasslands (including low lying wet grasslands, semi-aquatic areas with sedge meadows).
- Mesophilous grasslands of the valleys and slopes (wooded grasslands with moderate humidity) away from the streams.
- Plateau grasslands (not necessarily xerophilous). Since these categories are quite different in their composition, geo-hydrological requirements, and successional trends, they would need totally different management strategies.

It has been noticed that a few patches of less palatable native grass, *Desmostachya bipinnata*, have come up on the harder grounds around Kanha and Kisli grasslands. Both *Desmostachya*

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bipinnata and *Imperata cylindrica* do not allow weeds and other species to invade. Some of the *Desmostachya* patches should be monitored, and others could be managed by limited harrowing and restocking with *Vetiveria zizanioides* just before monsoon. *Imperata* could be allowed to spread along the forest edges by frequent burning albeit in mesophilous conditions.

Quite a few meadows within Kanha and Kisli are closely cropped to the ground level. These meadows do not have much standing biomass but represent species rich grazophil communities characterized by the presence of several prostrate forbs and grasses (e.g., *Desmodium triflorum, Oxalis corniculata, Fibristylis dichotoma, Indigofera linifolia, Alternanthera sessilis,* and *Digitaria stricta*). It is known that such areas serve as important micro-sites and provide supplementary 'quality' diet to the herbivores during dry season. Use of such areas by herbivores need to be assessed before any management intervention.

One of the unique features of Kanha grasslands is occurrence of *Saccharum spontaneum* even on higher (less flooded) grounds. Perhaps, prevention of fire in mesic and hygrophilous grasslands has helped this species. No management intervention is required in *Saccharum* patches except occasional removal of brushwood and weeds.

Narrow strips of hygrophilous grasslands and seasonal puddles are dominated by members of Cyperaceae (several species of *Cyperus*, *Fimbristylis*, *Juncus prismatocarpus* and a few grass species). It has also been observed that there is very low abundance of typical hygrophilous grasses viz., *Phragmites karka, Coix lachryma-jobi*, and *Hygrorhiza aristata*. Two species of wild rice (*Oryza rufipogon* and *Oryza minuta*) have also been recorded around the puddles. It is advisable to mark and monitor such species from wild gene-pool conservation point of view. Other wild relatives of cultivars within Kanha Tiger Reserve include *Zingiber capitatum, Curcuma* species, *Echinochloa colonum, Sorghum halepense*, *Vigna umbellata* and *Panicum* species.

Mesic grasslands in the valleys (especially relocated village sites) are infested by exotic weeds such as *Ageratum conyzoides, Sida cordifolia*, and *Cassia tora*. Currently *Cassia* and *Sida* are uprooted manually towards the end of monsoon. Two strategies could be thought for the treatment of weed infested sites: (a) *Sida* and *Cassia*, wherever in low abundance, may be uprooted early in the growing season (when young, i.e. less than 30 cm. in height) or just

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before the monsoon season rather than waiting till the end of monsoon. This would provide space for the growth of grasses and palatable herbs during growing season. Availability of labourers could be a limiting factor during June but at least on experimental basis it should be tried, (b) Areas of heavy weed infestation by these species, and also by *Ageratum* could be excluded temporarily and treated mechanically by systematic removal of weedy vegetation and establishing rhizomatous grasses such as *Pennisetum hohenackeri, Vetiveria zizanioides* and *Saccharum spontaneum*. Heavily weed infested sites at Sonf may need such a treatment.

Current practices of occasional burning in plateau grasslands, firelines and removal of *Lantana* as well as *Hyptis suaveolens* (Van Tulsi) has proven to be very useful. A few fire hardy and unpalatable grasses such as *Cymbopogon martini* will have to be monitored on the plateaus. Regular control of fast growing *Lagerstroemia* and *Shorea robusta* from the mesophilous grassland edges may be necessary. However, scattered and stunted bushes of *Butea monosperma* and *Diospyros melanoxylon* should be retained in the meadows. Their retention and occasional cool season burning may help certain grasses (e.g., *Dichanthium annulatum, Cynodon dactylon, Bothriochloa pertusa*, and *Bothriochloa odorata*) which would be available to the ungulates during dry season.

3.9 Workshop on Grassland Management:

The above chronic biotic pressure, frequent occurrences of fire and the cool burning practice in the meadows till the late Seventies contributed to the present regressive trends of the grasslands. While some of the visiting scientists, foresters, and conservationists have attributed this deterioration to increased ungulate population and the consequent overgrazing, others suggested that climatic factors and/ or lack of new initiatives may be responsible for this. Whatever the reason, this phenomenon had now become a serious concern for the Park Management, and Dr. HS Pabla, Principal Chief Conservator of Forests (Wildlife), during his visit to the Kanha Core Zone instructed the Park Management to avail of this opportunity to organize a workshop on this issue at Kanha, and invite all the former field directors/ scientists of Kanha Tiger Reserve, and other experienced scientists of related fields to this event.

Accordingly, a workshop on grassland management was organized at Khatia Eco-centre, Kanha Tiger Reserve on the 25 & 26 October, 2010. The workshop, chaired by the Principal Chief Conservator of Forests (Wildlife), Bhopal, consisted of indoor technical sessions and

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field visits inside the Core Zone. The proceeding of this workshop is appended **(Appendix-8)**.

The greatest impact on wildlife species generally result from habitat modifications, which result in changes in wildlife species. In this way, the Park Management has to "manage" these wildlife habitats to achieve the stated goals/ objectives. Each wildlife species has its own specific requirements of food/ forage, cover and shelter and its mode of using the same in relation to other species in the wildlife ecosystem. The presence of a desirable wildlife species in habitat is actually a result and a measure of ecologically sound uses of land and water. As the conservation of larger faunal species in the Core Zone is the top most priority, the Park Management manages major habitat types under a habitat improvement programme as prescribed in the previous Management Plan (Gopal & Shukla, 2001). The habitat improvement programme basically includes: grassland management (rotational grazing, restocking of grasslands, and grazing relief exclosures), weed eradication, brushwood eradication, water development, and soil conservation etc.

3.10 Wildlife Protection:

3.10.1 **Legal Sanctity:** As stated above, the Core Zone of Kanha Tiger Reserve is entirely a Reserved Forest meant for protecting, ameliorating and propagating flora and fauna of the protected area. The essence of habitat and wildlife protection is to ensure all necessary safeguards against all forms of hunting, including killing, snaring, poisoning and trapping etc. of wild animals. It also covers protection against illicit felling and removal of vegetal biomass, illicit grazing and removal of minor forest produces, and illegal entry into the Core Zone etc. The Core Zone is duly notified, and has been given further legal impetus by the Wildlife (Protection) Act, 1972 (as amended upto 2006) for effective protection of wildlife and its habitats.

As stated earlier, protection has been accorded the top most priority among the many wildlife conservation practices carried out in the Core Zone. As per the previous Management Plan (Gopal & Shukla, 2001), the Park Management ensures protection of forest and wildlife throughout the year under various protection strategies.

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3.10.2 **Wildlife Offences:** Wildlife protection in the Core Zone is the most important conservation practice. The chief objective of protection has dictated various strategies and measures for the past many years, as far as effective safeguards are concerned. The protected area is known to have adopted a strong protectionist attitude for a long time, with its reliable communication system, strategically located patrolling camps and intensive patrols under various strategies throughout the year by the ever-vigilant staff. This has resulted in an appreciable increase in wildlife populations, with intrusions/ encroachments well under control. However, the cases of poaching of herbivores for sustenance by the peripheral villagers, fuel-wood collection for *nistar*, and removal of MPF do sometimes occur **(Appendices-9 to 10)**. A few cases of the poisoning and electrocution of tigers have also come to light in the past years. While these killings were proven cases of revengeful attitudes of the villagers whose cattle had been killed by tigers, these were grave wildlife offences all the same. The Park Management deals with wildlife offences very severely under provisions envisaged in various relevant Acts and Rules.

3.10.3 **Livestock Grazing:** While there is very effective control over illicit grazing by livestock in the Core Zone, some peripheral areas of the protected area do face this problem to some extent. Outside forest areas, including the Buffer Zone, contiguous to the Core Zone, are more or less depleted of grass cover due to chronic grazing pressure over so many years. The Core Zone contrasts starkly in having excellent biomass on the forest floor. Though the villagers understand well that illicit grazing is a forest and wildlife offence, they have no option but to drive sometimes their cattle into the Core Zone for grazing. Such cases are dealt with by the staff under the provisions of the Wildlife (Protection) Act, 1972. If such cattle are killed by carnivores inside the park boundaries no compensations are paid to the cattle owners **(Appendix-11)**. There are still 17 forest villages in the National Park. The Park Management has already earmarked some *nistar* areas for the inhabitants of these villages on humanitarian grounds. The information on the earmarked area for grazing in these villages is as under:

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Sl. No.	Name of Forest Village	Grazing Area (In ha.)
1	Kariwah	333.000
2	Jhapul	555.633
3	Bhilwani	1911.791
4	Mukki	80.000
5	Sukdi	191.294
6	Dhaniajhor	26.245
7	Ajanpur	315.270
8	Kadla	18.886
9	Jholar	179.856
10	Role	39.613
11	Benda	120.620
12	Bithli	68.521
13	Linga	127.541
14	Ranwahi	42.990
15	Patuwa	55.360
16	Chatarpur	21.370
17	Janglikheda	5.240
	TOTAL:	**4094.190**

3.10.4 **Wild Fires:** As stated above, there are still 17 forest villages in the National Park, and a large number of forest and revenue villages are located just outside it. This scenario automatically gives rise to the occurrences of man-made fires in the Core Zone. Natural fires do not occur here, and the protected area also does not experience fires by lightning. Man-made fires in the summer are actually the results of petty collection of MFP and gratuitous antagonism of local people against the Park Management. The fire season sets in around mid-February and lasts until the area recieves the first showers of the monsoon. The Park Management implements a very effective fire scheme, incorporating various preventive and control measures, to keep the fire incidences at a minimum. Fires in the Core Zone are monitored by the Fire Alert Managing System (FAMS) developed by the Madhya Pradesh Forest Department. The system uses this information and identifies the concerned active fire

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locations which are within administrative units of forest department. Then it automatically sends SMS to the concerned field staff and monitoring officers.

3.10.5 **Ecological Restoration:** Over the years these stringent protection and habitat management practices have restored the Kanha ecosystem significantly. This eco-restoration has resulted in overall betterment of vegetation cover and wildlife in the protected area. The Core Zone supports a mosaic of several habitat types catering to the needs of different animal species. Technical management has considerably added to the favourable climate, geology, physiography and vegetation of the Core Zone and has created and maintained excellent habitats. Besides, there are many geomorphic habitats, point habitats and coverts assiduously maintained by the Park Management. These habitats all over the Core Zone also support short migrations of animals throughout the year. Broad reconnaissance of the Core Zone suggests that there is an excellent juxtaposition and interspersion of these habitats in most of the unit areas. All these managerial initiatives have ensured very effective protection and propagation of the umbrella species of the wildlife protected area. The most remarkable example of this restoration has been the resurrection of the hard ground barasingha in the Core Zone.

Gradual restoration of the Kanha ecosystem has also improved grasslands and general vegetation biomass in many areas, which in turn has increased herbivore populations, with the consequent viability of tiger population in the Core Zone. A large prey base, an almost equitable distribution of water bodies and poaching and other illegal activities well under control, the Core Zone has over all these years developed into an excellent haven for a source population of tigers for dispersal into the contiguous forest areas.

3.11 Insect Attacks & Pathological Problems:

3.11.1 **Sal Heart-Wood Borer:** The infestation of the sal heart-wood borer (*Hoplocerambyx spinicornis,* Order: Coleoptera, family: Cerambycidae, subfamily: Cerambycinae) in the Core Zone raised a serious concern among forest officers, wildlifers and a host of national and international wildlife enthusiasts and well-wishers of the protected area during 1996-99. While the insect is part of the ecology of sal forests and had infested

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a number of forest divisions in the past, its emergence in the Core Zone made big news in the media for a very long time. A workshop of forest officers and scientists was also organized at Khatia eco-centre to discuss the intensity of the sal borer infestation in Kanha and its remedial measures. The issue was also seriously discussed at various meetings, including that of the Madhya Pradesh Wildlife Advisory Board. During this time, the Kanha Management also collected relevant data on this infestation in the Core Zone to assess the trend/ progress of this insect attack.

3.11.1.1 **Sal Borer Infestation:** Madhya Pradesh falls into the western life history zone of the sal borer which is endemic to the sal forests of Mandla and Balaghat. The earliest mention of this beetle is found in some of the old working plans (Datta, 1963): (i) The Banjar Valley Reserve, 1904 (ii) The Motinala and the Phen Reserves, 1907, and (iii) The Khannat Forests of the Karanjia Range, 1914). The epidemic of 1924-28 in the South Mandla Division was the most severe and virulent one. No previous attack of similar magnitude is on record. Slight damage by borer attack has been recorded from 1915-16 to 1921-22 in the South Mandla Division. During 1914-15, standing trees were also affected, and control measures were adopted by felling and barking of infested trees (Banjar: 423, Motinala: 63). Heavy damage was reported from the Karanjia Range during 1922-23 and 1923-24. Subsequent major epidemic outbreaks occurred in this area during 1963 and 1996-97. The Balaghat division also suffered from a major sal borer epidemic during 1925-28. The number of beetles caught in South Mandla Division (1928-29 to 1954-55) is presented as under:

Year	No. of Beetles Caught	
	Banjar	South Mandla
1928-29	192645	181026
1929-30	-	-
1930-31	6035	459
1931-32	2303	350
1932-33	2969	1694
1933-34	4158	1626
1934-35	-	818
1935-36	1551	6320
1936-37	27188	30340
1937-38	17978	11150
1938-39	-	-
1939-40	-	7557

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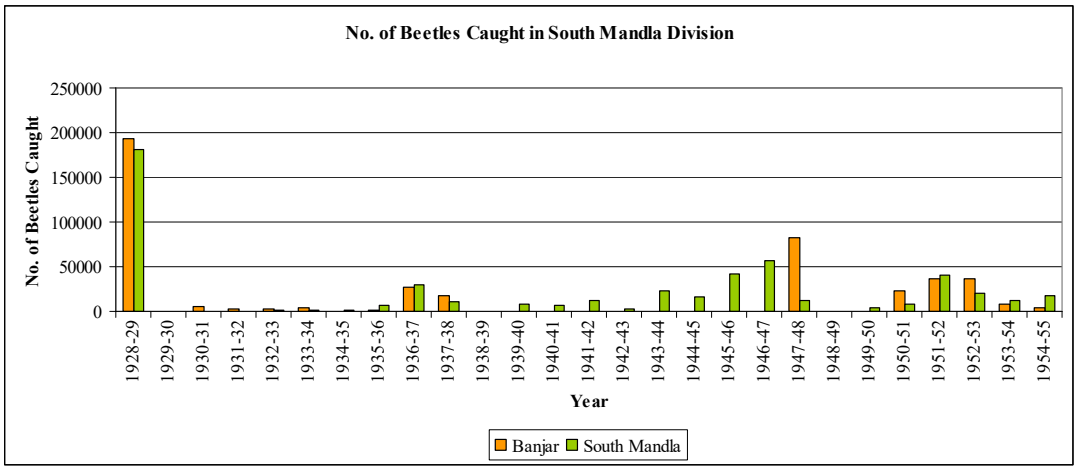
1940-41	-	7051
1941-42	-	11829
1942-43	-	3043
1943-44	-	23610
1944-45	-	16113
1945-46	-	42490
1946-47	-	57234
1947-48	82214	11788
1948-49	-	-
1949-50	-	4349
1950-51	22500	8672
1951-52	37037	40960
1952-53	36404	20431
1953-54	8645	11917
1954-55	4196	17062



The number of beetles caught in South Mandla Division (1963-64 to 1977-78 & 1994-95 to 1996-97) is presented as under:

Year	No. of Beetles Caught
1963-64	1865494
1964-65	419064
1965-66	161221
1966-67	93754
1967-68	57873
1968-69	5977
1969-70	31205
1970-71	6937
1971-72	-
1972-73	4074
1973-74	2326

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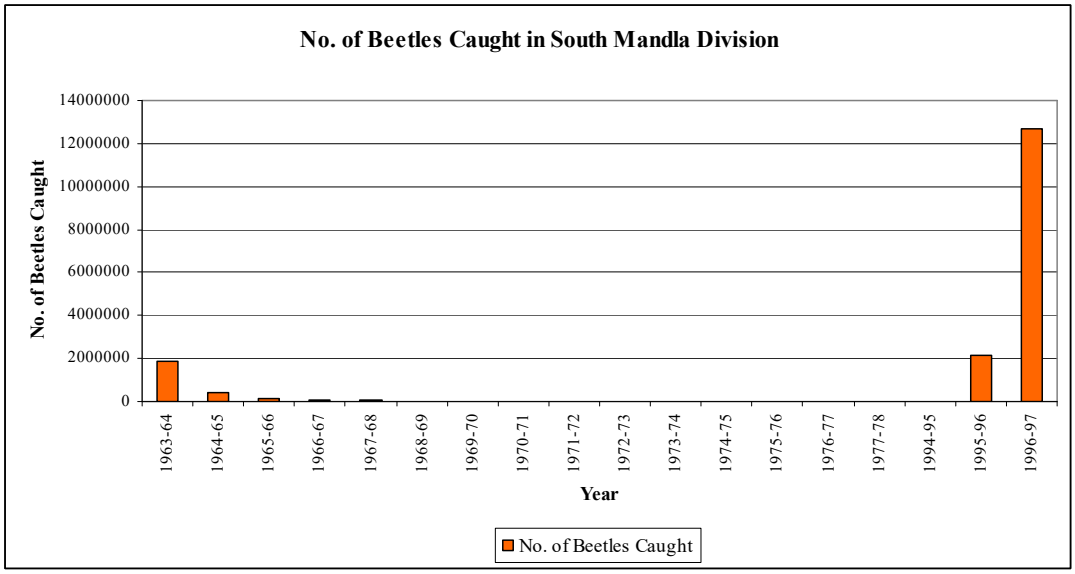
1974-75	4066
1975-76	392
1976-77	8685
1977-78	7145
1994-95	72
1995-96	2159739
1996-97	12650000



3.11.1.2 **Fluctuations in the Insect Population:** The sal borer shows conspicuous fluctuations in numbers in the sal forests of Madhya Pradesh. Such oscillations among foliage insects have also been reported from the European forests (Odum, 1971). Locusts and grasshoppers are also classic examples of insect population oscillations. The cycles of defoliating insects show an irregular periodicity, which is also discernable in the sal borer irruptions. In the northern part of North America, periodic outbreaks of the tent caterpillars and spruce budworms have been well documented.

As in other insect outbreaks, the sal borer population density normally remains stabilized at a low level. This is achieved by the combined effects of various density-dependent and density-independent factors. These factors are: weather, density-independent predation, possible parasitism on the nymphal and larval stages, apart from density-dependent predation by insectivorous birds on the adults. At times, this stabilizing effect fails on account of weather conditions, low parasitism, predation and man-made stresses. In such situations, the density "escapes" from the low level,

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resulting in a rapid, irruptive increase. Regulation of the insect population by birds is not possible at this stage since bird predators cannot increase at the same rate as the insects. Further, the possible parasites on the nymphal stage may also be affected by an increase in hyperparasites. In nature, this unlimited growth phase is stopped by the non-availability of food resources for the insect to complete its life cycle. Consequently, the population "crashes" along with the mortality of sal trees, which is further facilitated by birds, ants and parasites. However, if the crashing population finds congenial environment, then it may rise again for another irruption. Such a model of population dynamics has been elucidated for the psyllid insect (*Cardiaspina albitextura*) (Odum, 1971).

3.11.1.3 **Animal Response to Ecological Disturbance:** Animal species respond in various ways to the impact of any ecological disturbance like an insect epidemic. Such outbreaks bring in major changes in a wildlife habitat. The responses in animal species may be short term or long-term, positive or negative, depending on the species involved. Small gaps in a forest area usually foster a positive response. The new vegetation in such gaps provides low ground cover to gap species. Such gaps also provide sallying area for birds like the flycatchers, and have no negative effect on brachiators or canopy dwellers.

Large open areas in a habitat, as a sequel to insect outbreak, do bring in vegetational changes. Opportunistic species are readily attracted to such clearings. This in turn, eliminates the habitat of vertebrate/invertebrate canopy dwellers. Such habitat changes usually do not affect the small, ground dwelling mammals. Elimination of old tree growth exposes the area, and this may attract more grazing ungulates, leading to overuse. Insect outbreaks usually promote ground foraging birds, insectivorous birds and mammals, grub eaters and parasites.

The mosaic of shrubs, herbs, woody vegetation and gaps create a patchy environment. This enhances the edge effect, thereby fostering animal diversity.

3.11.1.4 **Assessment of Infestation:** Simultaneous infestation of the sal borer was reported in the year 1996-97 in several Forest Divisions of the undivided Madhya Pradesh, resulting in serious concern from different quarters. The infestation was also observed in Core Zone, and the Park Management decided to take it up as an

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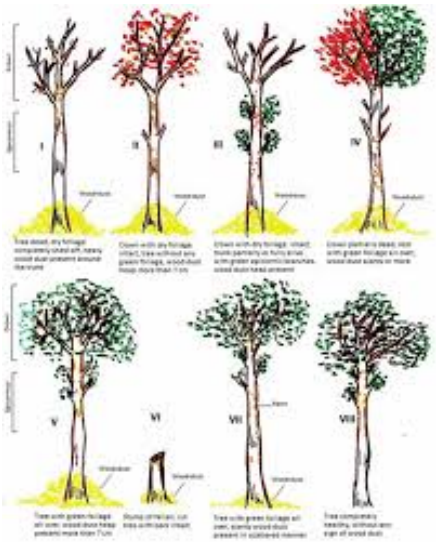
opportunity to monitor the trends, progression and regression, and magnitude of the scourge. The staff was acquainted with the various categories (1 to 7) of infestation as standardized by the Forest Department in various Working Plans. The monitoring was carried out every year in the month of December, and the observations recorded as to the girth class, number of infested trees and their categories. Every year the infested trees of the preceding year were also observed to access the progression/ regression of the disease. Resource persons also visited the Core Zone to assess the infestation and suggest control measures. The category 1 through 7 was considered as the progression of infestation, whereas the reverse (7 through 1) as regression.

3.11.1.5 **Intensity of Infestation:** Considering the intensity of the sal borer infestation, the following seven categories are identified and standardized in various Working Plans of the Madhya Pradesh Forest Department:

1. Crown leafless and dead; stem and branches leafless, large heap of dust.
2. Crown dead and brown; bark dead and brown; large heap of dust.
3. Crown dead and brown, bark of the upper part of stem dead, whereas that of the lower part alive.
4. Crown alive, green; bark green, large heap of dust.
5. Crown partially dead and green, brown; bark green; dust less than 3 inches high.
6. Stump with a large heap of dust.
7. Crown alive, green; bark green; with or without resin; dust scattered or very little.



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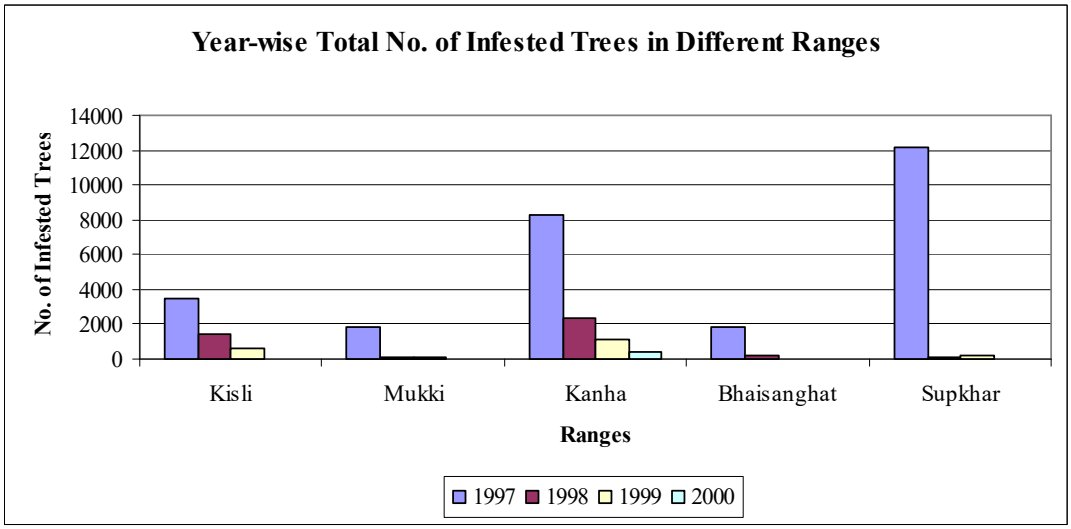
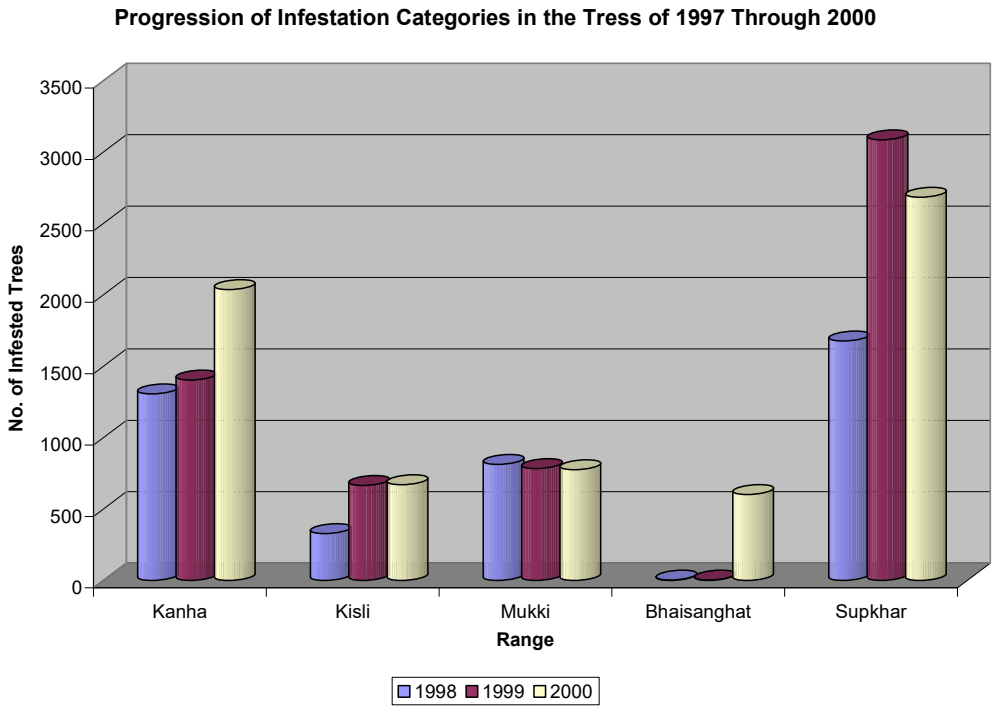
3.11.1.6 **Inferential Generalizations:** The observations relating to the sal borer infestation during 1997 to 2000 in the Core Zone has been graphically presented as under:





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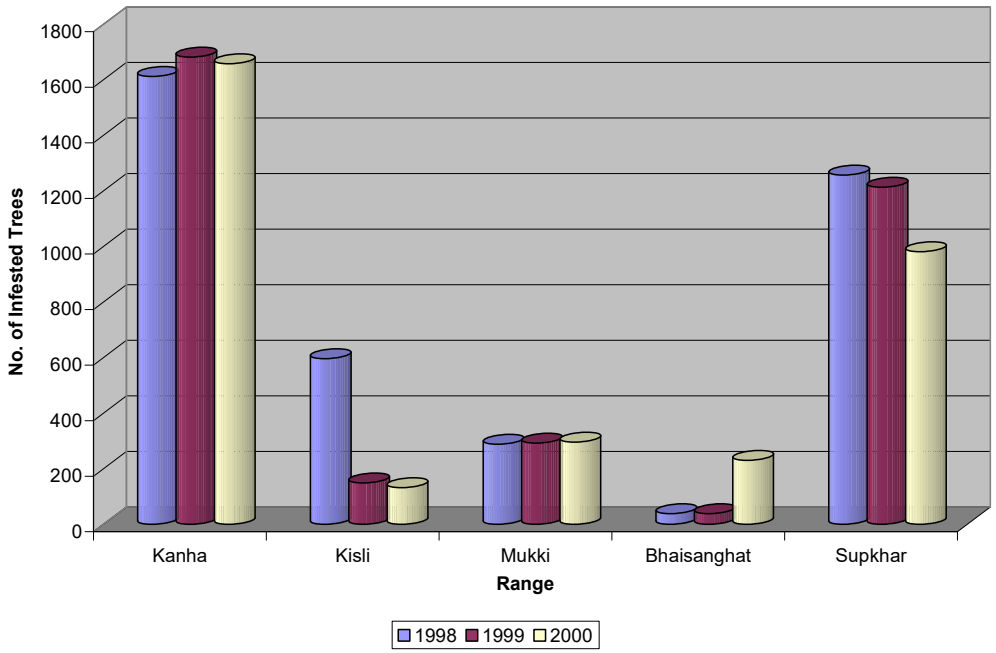
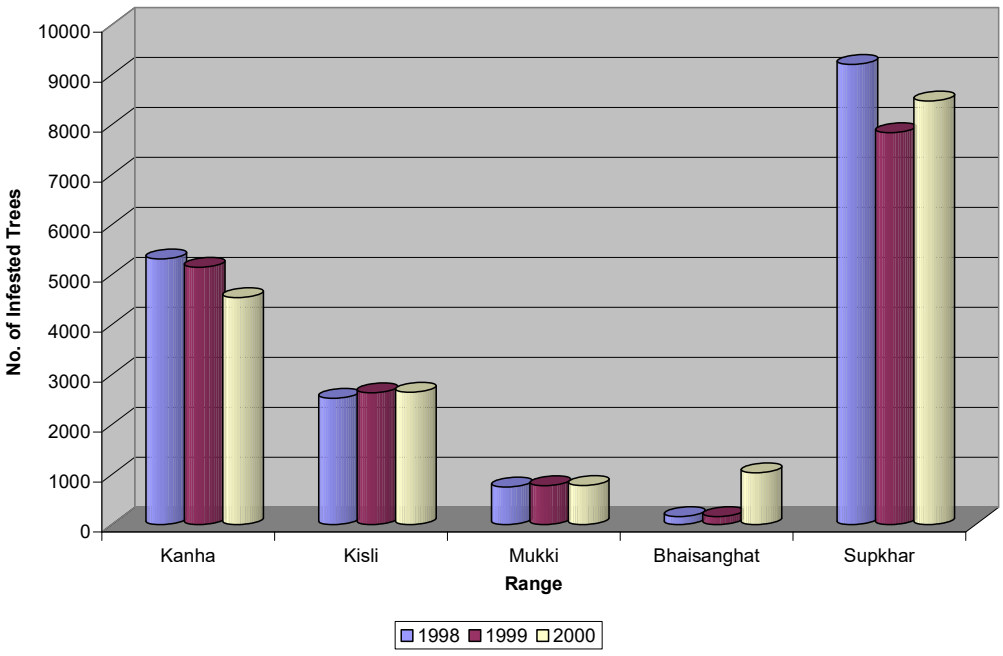
Regression of Infestation Categories in the Tress of 1997 Through 2000



Unchanged Infested Trees of 1997 Through 2000



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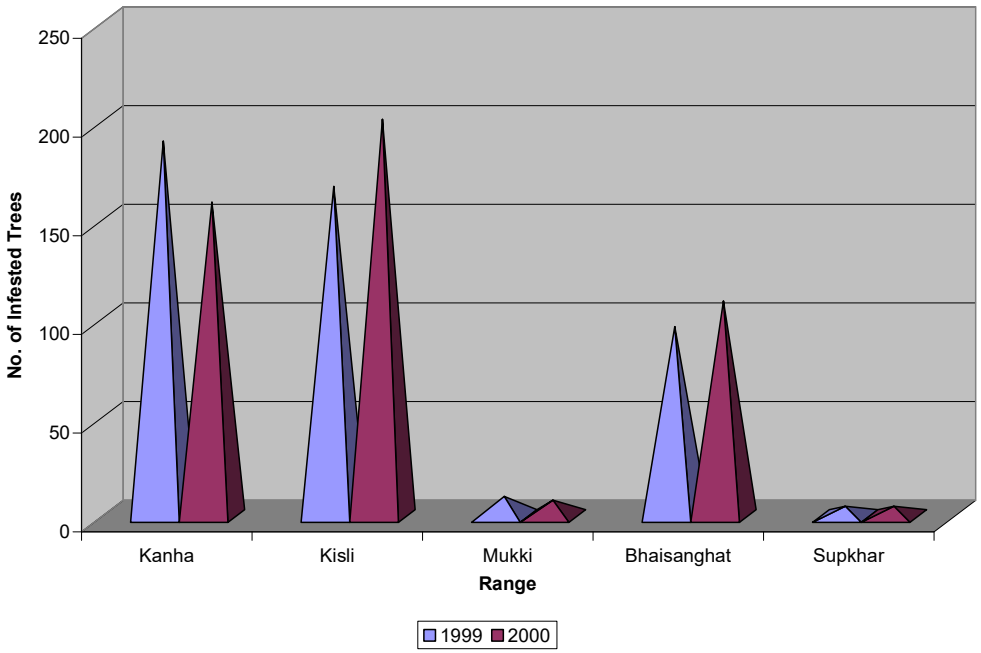
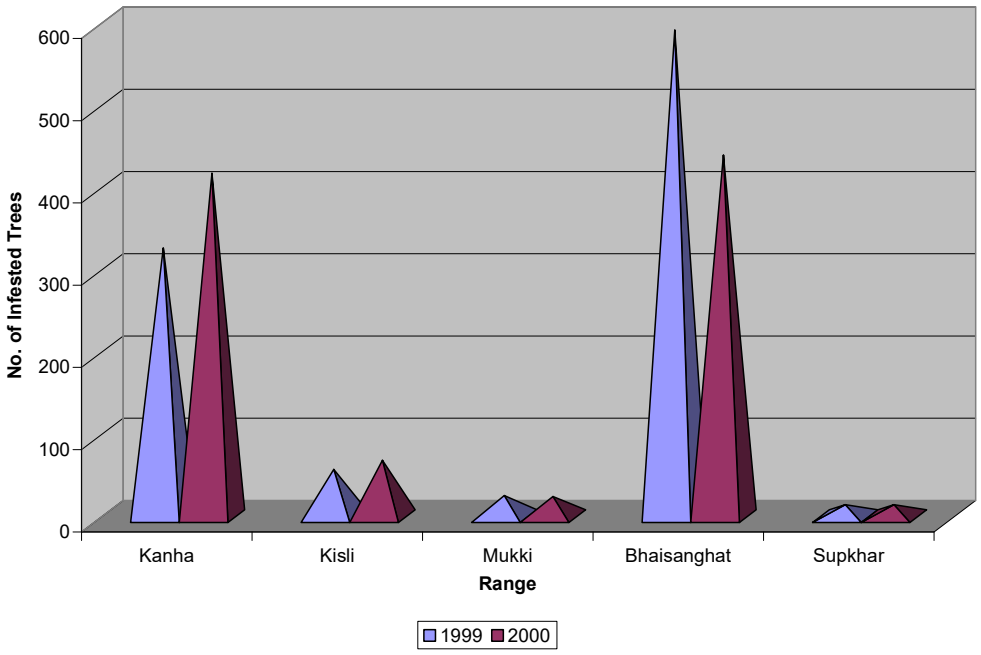
Progression of Infestation Categories in the Tress of 1998 Through 2000



Regression of Infestation Categories in the Tress of 1998 Through 2000



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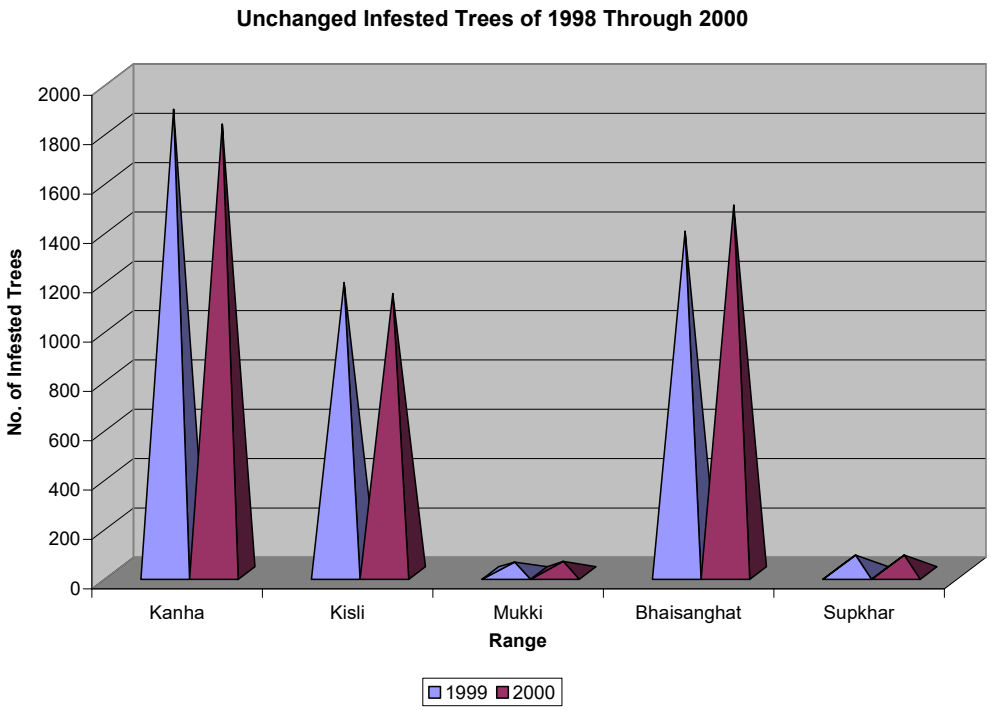

As stated earlier, since 1997 the assessment has been an exercise to get acquainted with the trend and dimension of the infestation in the Core Zone, using standard enumerative methods. The following inferences could be drawn from the above assessment:

- There was a gradual reduction in the size of beetles.
- A clear gradual decline of infestation was recorded with the decreasing number of infested trees from 1997 through 2000.
- Barring the Supkhar and Kanha ranges, and the Bhaisanghat range to some extent, there was no distinct progression in the categories of trees recorded in 1997.
- A distinct dynamics in the categories was recorded in the trees infested in the Supkhar and Kanha ranges, where the number of trees with "unchanged" category varied clearly.

The clear decline in the number of infested trees since 1997 suggested that the sal borer infestation should be monitored carefully, and allowed to take its own course in the protected area without any salvaging operations, and let it subside on its own accord, since timber extraction is not the mandate in the Core Zone. The enumeration

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of infested sal trees in the year 2000 indicated that the rate of infestation in the Core Zone was around 0.364 tree/ ha. This value was below the rate of epidemical infestation.

3.11.1.7 **Other Pathological Problems:** As far as pathological conditions relating to larger fauna is concerned, no epidemic has ever been reported since 1976, when the Rinderpest broke out and killed 52 gaur, 8 sambar and 35 chital.

3.12 Wildlife Tourism:

It can be safely assumed that the relationship between wildlife tourism and protected areas in our country is almost as old as protected areas themselves. Protected areas and tourism complement each other very significantly. While the relationship is complex and sometimes also adversarial, tourism is always a critical component for the management of protected areas.

Wildlife tourism is subordinated to the main objective of wildlife conservation in the Core Zone. The Kanha Management believes that the visitors should be provided a meaningful exposure to the wildlife ecosystem so that they can appreciate India's magnificent natural heritage and conservation benefits. One of the main objectives of the launch of Project Tiger is also "to ensure the maintenance of a viable population of the tiger in India and to preserve, for all times, such areas as part of our natural heritage, for the benefit, education and enjoyment of future generations" also sounds a similar note.

The Park Management has always strived to strike a rational balance between entertainment and wildlife education and awareness in the protected area with the active participation of local communities. The underlying principle is that tourism should be ecologically and socio-culturally sustainable. The Park Management understands that tourism depends on the quality of the natural resources of the protected area, and the impacts of visitations on these resources have to be carefully monitored, managed, directed and mitigated whenever and wherever possible. Even small levels of recreational use can lead to negative impacts. Wildlife tourism has been conducted in the Core Zone for many years, and has made the Park Management experienced enough to understand perfectly well how the negative impacts

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of tourism can be alleviated significantly by prescribing an effective code of rules and regulations and its stringent observance by tourists **(Appendix-12)**.

3.12.1 **Stakeholders in Tourism:** Wildlife tourism in the Core Zone has several types of stakeholders. Each group of these stakeholders has its own particular values and interests and culture. Understandably, this complex mosaic of stakeholder interests makes constant demands upon the Park Management. These groups also have a direct interest in the Core Zone and its tourism management policies, and are also affected by them in different ways. While, theoretically, there are many stakeholders in wildlife tourism such as park managers, tourists, local communities, indigenous communities, non-governmental organizations, hoteliers/ resort owners, tour operators, and media etc., for all practical purposes the most active stakeholders are as under:

- Park managers.
- Relocated communities.
- Local communities.
- Hoteliers/ resort owners.

3.12.2 **Tourism Zone:** Till 2007, wildlife tourism in the Core Zone was restricted to a small zone of 226.591 sq. km. This tourism zone at that time constituted around 25% of the total area of the National Park. The National Park had initially two entry gates, one at Khatia, around 65 kms. from Mandla and the other at Mukki, around 13 kms. from Baihar and 80 kms. from Balaghat. The area of tourism zone in the National Park was, however, expanded and a third gate opened at Sarhi in the 2008-09 tourism season with a view to regulating unequal pressures of tourists, minimizing their inconvenience, and improving the economy and living standards of the local people and providing them with alternative resources of income. The Sarhi gate is named after a village Sarhi located near the boundary of the National Park. The Sarhi gate is located inside the forest around 3 km. away from the village Chikalha which is around, 10 km. from Orai village situated on the Mandla–Raipur National Highway 12A. Orai is 38 km. from Mandla. The Sarhi gate is around 10 km. from Bichiya, a block headquarter.

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On the basis of the nature of tourism activities, the tourism zone of the Core Zone is assumed to have two zones, namely the interpretation zone and the safari zone. The major criteria for determining these two tourism management zone are:

- Visitors should have an easily understandable and entertaining experience of and exposure to wildlife interpretation in the protected area.
- Visitors should have the real feel of the conservation of forest and wildlife during jungle excursions in the Core Zone.

3.12.2.1 **The Interpretation Zone:** Located mainly in the Kanha range, the main objective of this small zone is to impart nature conservation awareness to the visitors and facilitate the interpretation of the intricacies of the Kanha wildlife ecosystem. The zone has an excellent interpretation complex and a canteen.

3.12.2.2 **The Safari Zone:** This zone provides vehicular excursions for the visitors to watch, enjoy and photograph wildlife, its habitats and birds, and also opportunities to understand the basics of wildlife conservation. This zone harbours wilderness area along with several patrolling camps.

3.12.3 **Sub-Zonation:** Presently, the total area of the tourism zone in the Core Zone is 347.746 sq. km. constituting around 37% of the total area of the protected area. The entire tourism zone has been divided into three sub-zones for the convenience of tourists and Park Management **(Appendix-13)**. The sub-zonation of the tourism zone is as under:

Zonation	Area (sq. km.)	Total Length of Forest Road (km.)	No. of Tourist Vehicles for Excursion
Kanha	189.061	165.00	70
Mukki	62.228	125.00	50
Sarhi	96.457	90.00	30
Total:	**347.746**	**380.00**	**150**

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Presently, on the basis of the carrying capacity of the tourist zone for tourist vehicles, a total of 150 vehicles are allowed into the three sub-zones. Tourism in these sub-zones are managed under the rules laid down by the Park Management to ensure observance of conservation objectives, hassle-free excursions for the visitors, and to avoid inconvenience, specially during the peaks of tourism season. Needless to add, the rules for tourism management are also changed as and when required depending upon ground situations. Whenever the number of tourist vehicles exceeds 35 through the Khatia and Mukki entry gates separately, the rest of the vehicles have to follow a certain route chart enforced by the Park Management **(Appendix-14)**.

3.12.4 **Tourist Influx:** The Kanha Core Zone is one of the finest wildlife tourism destinations in the country and receives thousands of national and international tourists in every tourism season. The information on average annual tourist influx of the past ten years (2000-01 to 2009-10) in the Core Zone is as under:

Average No. of Tourists	Average No. of Indians	Average No. of Foreigners	Average % of Indians	Average % of Foreigners
90871.60	81966.90	8904.70	90.20	9.80

Generally, the Core Zone remains open for tourism from the 16th October to the 30th June. Past experience has helped the Park Management identify tourism peaks in the protected areas. The number of tourist vehicles is relatively large during these peak tourism periods. The peak tourism periods include days of *Vijyadashmi*, *Diwali*, *Christmas* and New Year vacation. Besides, summer vacation of schools and colleges also draw visitors to the Core Zone. The number of visitors also shows a slight increase on the second and third Saturdays and Sundays and consecutive holidays of two or three days. The rest of the tourism season, however, has steady but low numbers of visitors.

3.12.5 **Tourist Accommodation:** The Park Management also rents out accommodations to visitors in the Core Zone. These accommodations belong to the Kanha management and the MP Forest Department, and are located at Khatia, Kisli and Mukki. While the accommodations are not fabulous and stylish, they are comfortable and cozy. These accommodations include forest rest houses, hutments and dormitories, and cater for

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the visitors of all income groups. The accommodations can be reserved in advance from the office of the Field Director, Kanha Tiger Reserve located at Mandla **(Appendix-71)**.

Accommodation Type	Number of Rooms	Number of Beds
Kisli FRH	7	14
Mukki FRH	4	8
Kanha Jungle Camp (Old)	18	36
Kanha Jungle Camp (New)	10	20
Khatia Dormitory	3	20

3.12.6 **Entry & Park Timings:** Visitors are allowed entry into the Core Zone for tourism through all the three gates after due registration and payment of prescribed charges. They are required to fill in an indemnity bond and other documents **(Appendix-15)**. Presently, only gypsies are allowed for jungle excursions. Each tourist vehicle has to be accompanied by a route guide. There is a provision for advanced online bookings for jungle excursions through www.mponline.gov.in/forest **(Appendix-16)**. The maximum quota (tickets) of visitations has been allotted to the online booking option. There is, however, also a provision of limited on-the-spot booking at the entry gates.

The Park Management has prescribed timings for the morning and evening entries of tourists into the Core Zone. These park timings are actually based on the sunrise and sunset times strictly within which tourism is allowed inside the protected area. Temperature in the summer and early dusk in the winter also have a bearing on different seasonal timings. Besides, as the sunrise and sunset times change seasonally, the Park Management has also prescribed seasonal timings for tourism as under:

16 October to 31 March	Sunrise to 12.00 pm	3.00 pm to sunset
01 April to 30 June	Sunrise to 11.00 am	4.00 pm to sunset
Entry Points: Khatia and Sarhi (Mandla District), and Mukki (Balaghat District) Only petrol Gypsy vehicles with 4-wheel drive (manufactured within the last 10 years) are allowed inside the Park.		

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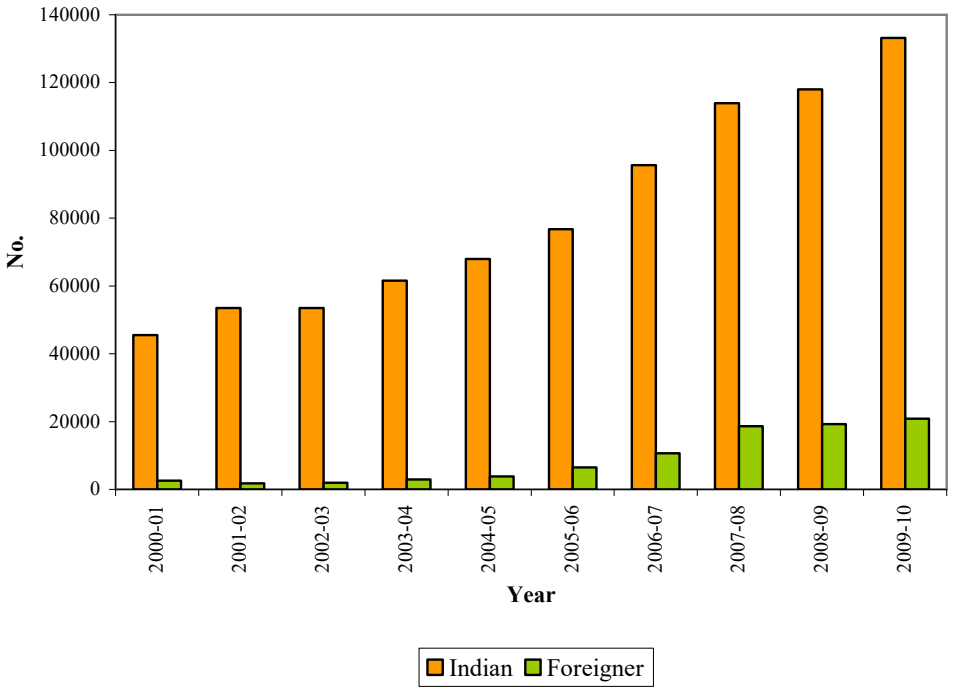
Total No. of Tourists Visiting in the Park
(During the Last 10 Years)

Year	Indian	Foreigner	Total
2000-01	45557	2570	**48127**
2001-02	53521	1784	**55305**
2002-03	53498	1977	**55475**
2003-04	61576	2970	**64546**
2004-05	67971	3811	**71782**
2005-06	76774	6490	**83264**
2006-07	95646	10651	**106297**
2007-08	113928	18673	**132601**
2008-09	118002	19293	**137295**
2009-10	133196	20828	**154024**

Total No. Of Tourists Visiting in the Park (During the Last 10 Years)



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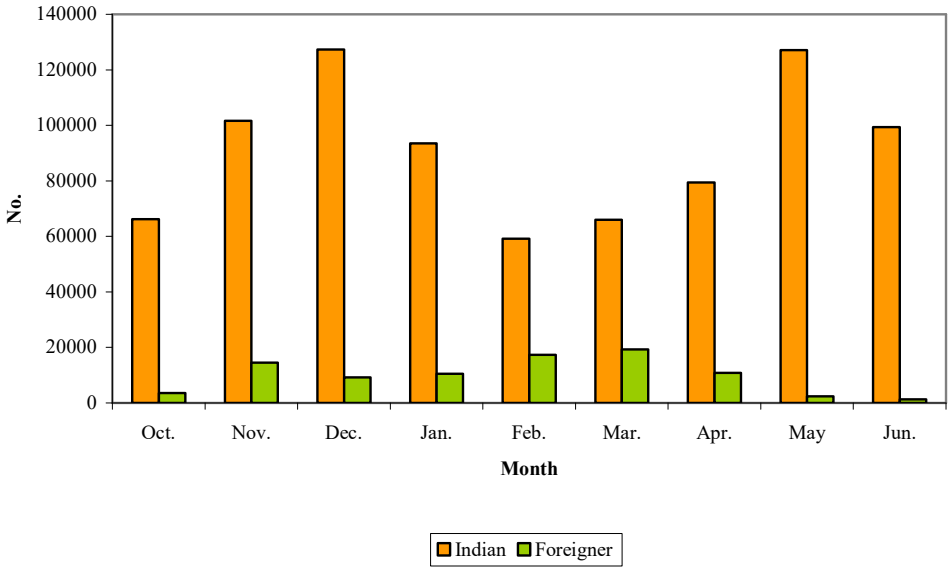
Average Influx of Tourists by Months in the Last 10 Years

Month	Indian	Foreigner	Total
Oct.	66221	3583	**69804**
Nov.	101600	14524	**116124**
Dec.	127327	9261	**136588**
Jan.	93523	10493	**104016**
Feb.	59156	17374	**76530**
Mar.	65988	19264	**85252**
Apr.	79414	10851	**90265**
May	127090	2381	**129471**
Jun.	99350	1316	**100666**

Total Influx of Tourists by Months in the Last 10 Years



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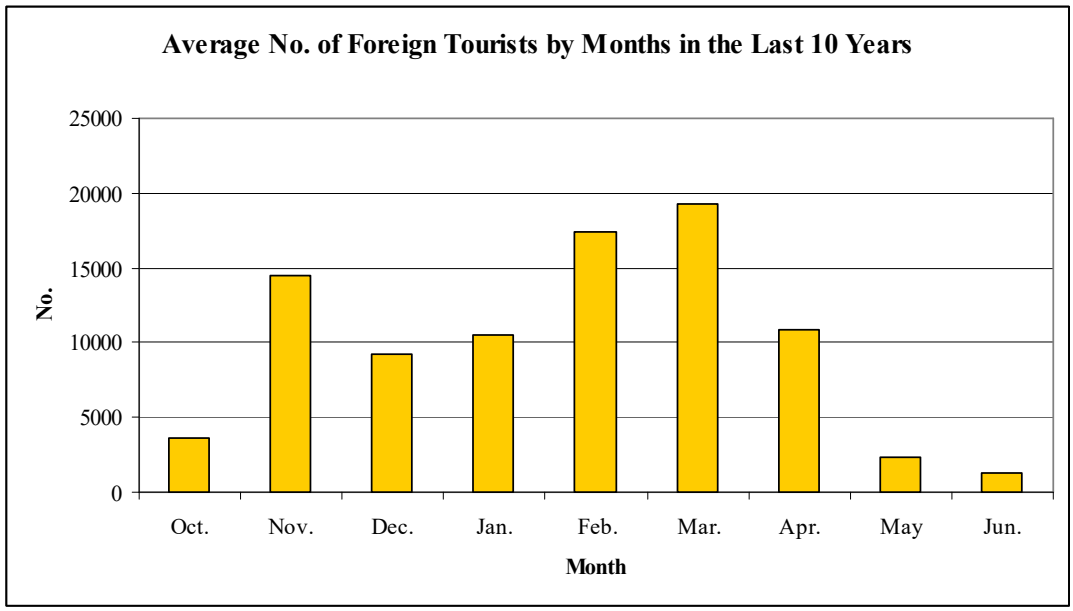
Average Influx of Foreign Tourists by Months in the Last 10 Years

Month	Foreigner
Oct.	3583
Nov.	14524
Dec.	9261
Jan.	10493
Feb.	17374
Mar.	19264
Apr.	10851
May	2381
Jun.	1316



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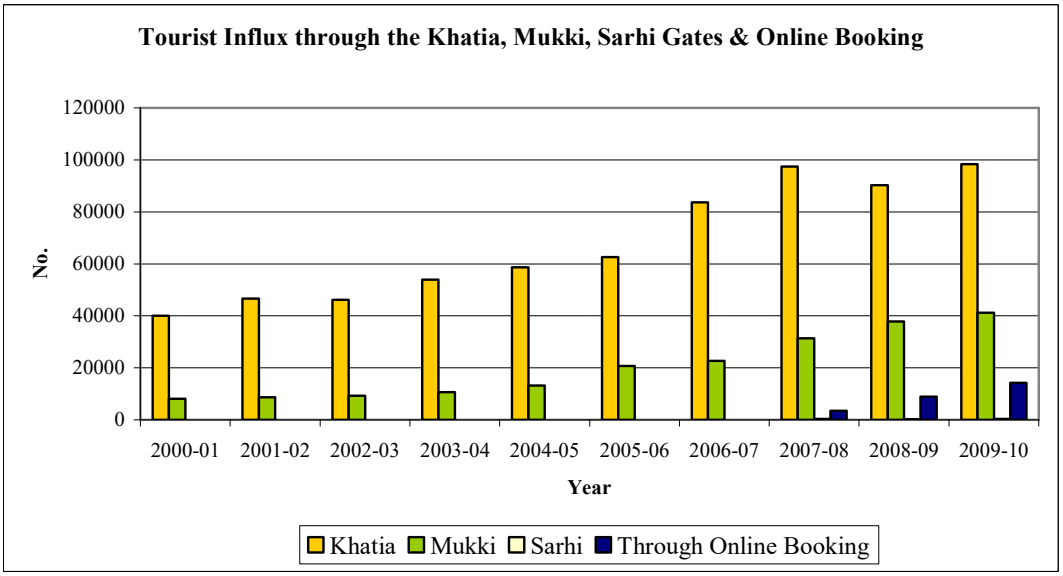
Tourists Influx through the Khatia, Mukki, Sarhi Gates & Online Booking

Year	Khatia	Mukki	Sarhi	Through Online Booking	Total
2000-01	40060	8067	-	-	**48127**
2001-02	46667	8638	-	-	**55305**
2002-03	46226	9249	-	-	**55475**
2003-04	53953	10593	-	-	**64546**
2004-05	58638	13144	-	-	**71782**
2005-06	62606	20658	-	-	**83264**
2006-07	83621	22676	-	-	**106297**
2007-08	97401	31410	290	3500	**132601**
2008-09	90226	37868	235	8966	**137295**
2009-10	98329	41204	311	14180	**154024**



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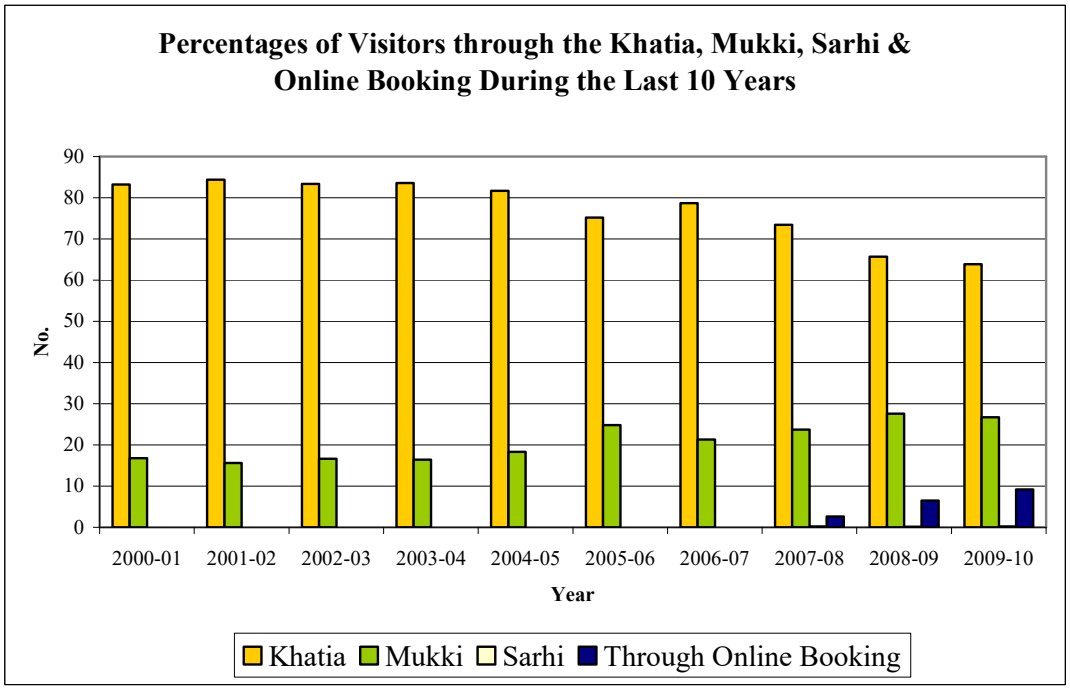
Percentages of Visitors through the Khatia, Mukki, Sarhi Gates & Online Booking During the Last 10 Years

Year	Khatia	Mukki	Sarhi	Through Online Booking
2000-01	83.24	16.76	-	-
2001-02	84.38	15.62	-	-
2002-03	83.33	16.67	-	-
2003-04	83.59	16.41	-	-
2004-05	81.69	18.31	-	-
2005-06	75.19	24.81	-	-
2006-07	78.67	21.33	-	-
2007-08	73.45	23.69	0.22	2.64
2008-09	65.72	27.58	0.17	6.53
2009-10	63.84	26.75	0.20	9.21



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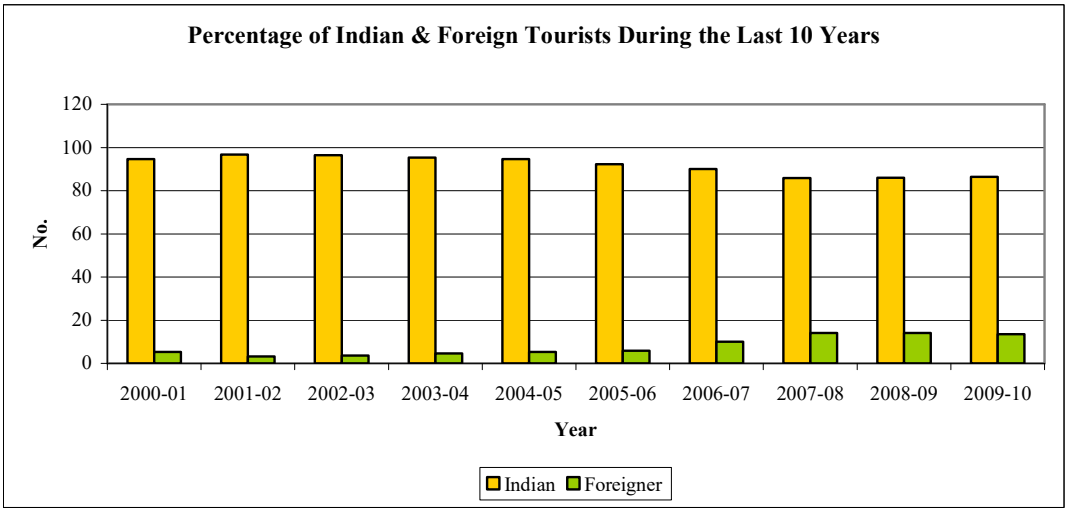
Percentage of Indian & Foreign Tourists During the Last 10 Years

Year	Indian	Foreigner
2000-01	94.66	5.31
2001-02	96.77	3.23
2002-03	96.44	3.56
2003-04	95.40	4.60
2004-05	94.69	5.31
2005-06	92.21	5.79
2006-07	89.98	10.02
2007-08	85.92	14.08
2008-09	85.95	14.05
2009-10	86.48	13.52



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3.12.7 **Tourism Facilities:** The Kanha National Park also enjoys the unique distinction of being the first protected area in the country to be selected for the launch of an excellent park interpretation programme in 1992. This was a most comprehensive educative, entertaining and interpretative programme. The entire package was designed by the Centre for Environment Education, Ahmedabad in collaboration with the United States National Park Service. This interpretation programme was later upgraded in 2005 under the 11th Finance Commission allocations. This interpretation programme aims at creating awareness, appreciation and an understanding of wildlife conservation in general public. There is a wide range of tourism facilities available in the Core Zone **(Appendix-17)** described as under:

- **Orientation Centers:** There are two visitor centres, one each at the two entry points at Khatia and Mukki. Through literature, sounds of the jungle, photographs, models, souvenirs, wildlife film show etc., an attempt is made to help the visitors in understanding the amazing beauty and complexity of the web of life in the Tiger Reserve.
- **The Kanha Museum Complex:** Displayed skeletons of larger mammals, interesting and illustrated notes, models, specimens of flora and fauna further add to the visitor's understanding of the intricacies of the jungle life. It is a very educative, informative and enjoyable experience.
- **Light & Sound Show:** A light-and-sound show has been developed in the interpretation centre to reconstruct and dramatize the sequence of tiger hunting a chital–an event rarely witnessed by visitors
- **Signages:** There are various types of signages at the park entrance and other places within the park. These have been so designed and coloured as to easily intermingle with the surroundings, and at the same time serve the purpose effectively. The types include:

    - Directional.
    - Identificational.
    - Informational.
    - Regulatory.

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The signages consist of an artificial log like structure, with the anox plate carrying the information. Apart from these, roadside guide marker posts are also provided at various points. In all, there are 79 signages within the park.

- **Amphitheater:** There is also an amphitheater located at Khatia entry point where amazing spectacles of wildlife can be viewed through many national and international CDs, Video Cassettes and 16 mm. films on nature and wild animals.
- **Vehicular Excursion:** Gypsies of the MPSTDC and private owners are available for hire at the entry points. There is a well planned large network of forest roads which ensures that vehicular excursions of tourists pass through almost all types of habitat, facilitating a good view of wild animals, grassy expanses and forests.
- **Route Guide Service:** Route guides, handpicked from indigenous communities with a well-developed jungle instinct, have also been deployed. The wildlife staff trains these guides so that they may identify the various wild animals, birds and plant species with their basic characteristics, and explain the same to the visitors. Such interpretative skills are of great help to the tourists.
- **Nature Trail:** Two nature trails, one each at Khatia and Mukki, have been created with waysides to explain various spots along the route. There is also a machan on each trail, which offers a panoramic view of the forest.
- **The Kanha Literature:** This ranges from highly technical research papers and bulletins to entertaining information on the history, flora and fauna, and local tribes of the National Park. For the visitors who want to carry home these publications for reference, the following are available: Kanha brochure, handbook, posters, picture post cards, wild animal folder, roadside guide, stickers, and tourist information leaflet.

  There is also a wide range of magazines and periodicals of lighter vein supplied by the Kanha library to those visitors who also want to stay in-touch with the world outside the Core Zone.

- **Touch Screen:** Available in the Kanha museum complex, the Khatia and Mukki orientation centres, the programme summarizes the entire conservation and

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management of the Kanha Tiger Reserve through interesting text, photographs and film footages.

- **Orientation Centres:** There are two visitor centres, one each at the two entry points at Khatia and Mukki. Through literature, touch screens, sounds of the jungles, photographs, models, souvenirs, wildlife film shows, etc., an attempt is made to help the visitors understand the amazing beauty and complexity of the web of life in the Tiger Reserve.
- **Forest Canteen:** There is a forest canteen, run by the Kanha Workers' Society, located at the heart of the Core Zone, providing snacks, and cold & hot beverages, and adding to the joy of tourists.
- **Medical Dispensary:** Considering all eventualities in a protected area, a forest dispensary has also been set up at Mukki to deal with the basic first aid emergencies.
- **Public Conveniences:** The well thought-out itinerary of tourists ensures the availability of clean and hygienic public conveniences at select places all over the park, facilitating tension free long excursions throughout the day.

3.13 Park Interpretation Programme:

A well-known park interpretation programme in the Core Zone, the first of its kind in India, was developed by CEE in collaboration with the US National Park Service and the Park Management in the early 1990s. After almost fifteen years it was upgraded in 2005 to integrate conservation history, new research findings, scientific management practices and new trends in wildlife management, and national and international tiger conservation perspectives. Top quality dioramas, life size models, panels and walk-over relief map presenting bird-eye-view of Kanha, nature trails, waysides, watch towers, gates, and high quality publications are some of the highlights of the new interpretive material.

The entire interpretation package consists of the following components/ programmes:

3.13.1 **Orientation/ Visitor's Centres:** There are two main entry gates to the Core Zone located at Khatia and Mukki. The former is used by around 70% of the influx of visitors. There is one Visitor Centre each at Mukki and Khatia for providing the basic orientation to the visitors. The chief aims of these orientation centres are to provide

information/ orientation and interpretation of Kanha's natural history, and sale of publication and tribal arts and crafts. Besides, the centres also land exposure to various themes relating to environment, forests and wildlife, and the calls of various animals and birds. The aim of the basic orientation at the "visitor centre" is to make the visit rewarding and meaningful for the visitors.

- **Items in the Visitor Centres:** Map of Kanha - wooden carved map with important features, 2 panels (1) wonders of nature (2) do's & don'ts, sales desk with a chair, book case, soft board to pin clippings etc., daily event board, suggestion box and exhibits etc.
- **Exhibits:** These include Island Cases with Models of: Tiger success story exhibit with digitized sound, tiger and chital exhibit (predator prey with digitized sound), silk-cotton tree and bird exhibit, wild boar exhibit and barasingha & myna exhibit. Five large sepia photographs have also been placed behind the island case models.
- **"Sound of the Season" Exhibit with Digitized Sound:** This is a single structure, having photographs of wild animals, viz. barasingha, sambar, panther and magpie robin. A brief description is indicated below each. A pressing button is provided at the base for hearing the call of the depicted animal. The calls include: Mating call of the barasingha, alarm call of the sambar, call of the panther and call of the magpie robin etc.

The visitor centre at Mukki is a replica of the one at Khatia, but for some changes in the exhibits. The details include the models of: barasingha success story exhibit with digitized sound, chital-langur relationship exhibit with digitized sound, sloth bear & termite exhibit with digitized sound, peepal tree and birds exhibit and dung beetle and dung exhibit etc. The sound of the season" exhibit, with digitized sound, includes call of the Indian cuckoo, howlings of jackals, call of the brain fever bird and call of the chital etc.

3.13.2 **Amphitheater:** There is also an amphitheater adjacent to the orientation centre at Khatia with seating a capacity of 100 seats. Visitors can daily enjoy amazing spectacles of nature and wildlife through many national and international CDs, Video Cassettes and 16 mm. films on nature and wild animals.

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3.13.3 **Nature Trails:** There are two self-guided nature trails close to the Khatia and Mukki entry points. These trails enable visitors to experience and discover the intricacies of nature first hand.

3.13.4 **Kanha Interpretation Complex:** The Kanha interpretation complex is located at Kanha and is comprised of several buildings/ rooms:

- **Building A – Room 1 (Monsoon Magic):** In this room, the information on the changed aspect of Kanha Tiger Reserve during the rainy season has been provided interestingly through various panels and models. With the advent of the monsoon, rapid flow of water is seen in rivers and streams, and the grasslands and vegetation turn a beautiful green. Reptiles and insects suddenly become very active, and ample food becomes available for herbivores. The Reserve Management conducts a special strategy "Operation Monsoon" during the rains for the protection of forest and wildlife.

- **Building A – Room 2 (History):** The room exhibits information on the history of Kanha Tiger Reserve and its contiguous forest tracts through several panels. The history describes the journey of Kanha from shooting blocks through wildlife sanctuaries, a National Park upto the present Tiger Reserve. Besides, many other important conservation milestones such as forest and wildlife protection, tiger conservation, special conservation of the barasingha, wildlife research and monitoring activities, and ecodevelopment have also been described.

- **Building A – Room 3 (Relief Map):** Through a 3D relief map with interpretation & wall mounted panels, the geographical situation of the Kanha Tiger Reserve, the main rivers originating from here, grasslands and other important geographical features have been described very interestingly. Besides, under the Tiger Reserve management, the areas of the Core Zone, National Park, Buffer Zone and the Phen Wildlife Sanctuary have also been shown.

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- **Building A – Room 4 (Then & Now):** In this room, the old Kanha has been compared with the present Kanha through the standalone structure panels and TV and VCD slide show. It has been shown very impressively that how effective forest and wildlife protection, judicious wildlife management, humane relocation of forest villages and effective ecodevelopment works in the villages have helped Kanha become one of the finest wildlife protected areas in the country.

- **Building A – Auditorium Room (Protection Strategy):** The auditorium has a capacity of 24 seats and is equipped with LCD projection TV and DVD player to show a very interesting movie "Protecting Paradise" on the protection of wildlife in the Kanha Tiger Reserve.

- **Building B – Room 1 (Insect):** The biology and ecology of insects have been described in this room through the standalone structures and models. Besides, total numbers of insects, their economic importance, and place in biodiversity conservation have also been described.

- **Building B – Room 2 (Bird):** Some main bird species of the Kanha Tiger Reserve have been exhibited through excellent photographs. Over 300 species of birds are found in the Tiger Reserve.

- **Building B – Room 3 (National & International Perspectives on Tiger Conservation):** In this room, information on the current population of tigers in its range countries, development of tiger and theories about its entry into India, causes of declining population, launch of Project Tiger and other conservation issues have been exhibited through the standalone structure panels and table top dioramas.

- **Building B – Room 4 (Pyramids of Kanha):** The important roles played by the main species of wildlife and vegetation in the Kanha ecosystem, and their inter-relationships have been shown in this room very interestingly through duratrans.

- **Building B – Room 5 (Reptile):** In this room, information on general distribution of reptiles and their importance in Indian culture, the species of snakes and lizards found

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in the Kanha Tiger Reserve, and their ecological role in nature and their conservation have been provided through the standalone structures and models.

- **Building C (Research):** In this building, scientific and technical information on prey base (skeleton exhibits), wildlife research, wildlife estimation, foods of tiger, grasses of Kanha, animal in action, satellite imageries, aerial photographs, tiger telemetry and its importance, a video film based on wildlife, and research papers etc. have been exhibited through various panels and models.

- **Building D – Room 1 (Jaws & Claws, etc.):** In this room, jaws, teeth, claws, horns and antlers of various species of wildlife have been exhibited.

- **Building D – Room 2 (Camouflaging/ Colourations):** The camouflaging/ deceiving colourations of various species of wildlife and their blending with natural environment have been explained through photographs.

- **Building D – Room 3 (Jungle Lore):** In this room, events occurring in the daily life of wild animals have been described. A kill scene of the tiger is also depicted as seen in the natural forests. The information on evidence left by wild animals has also been given.

- **Building D – Room 4 (Light & Sound Show):** A light-and-sound show has been developed in this room to reconstruct and dramatize the sequence of tiger hunting a chital – an event rarely witnessed by anybody.

3.13.5 **Wayside Exhibits:** These are outdoor interpretive exhibits, used primarily as orientation devices to emphasize the prominent features and sites. An anox plate is fitted with a brief description of the site so as to facilitate easy viewing from a vehicle. The materials used in the preparation of these exhibits are very durable, and can withstand the vagaries of climate. There are 30 such wayside exhibits. Here the interpretation is limited to things that are actually visible at the site (eg. common wildlife.

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3.13.6 **Signages:** There are various signages at the park entrance and other places within the park, viz. directional, identificational, informational and regulatory. The colours used match the natural surroundings. The signages consist of an artificial log like structure, with the anox plate carrying the information. Apart from these, roadside guide marker posts are also provided at various points. In all, there are 79 signages within the park.

3.13.7 **Publications:** The following publications have been produced in collaboration with the CEE, Ahmedabad.

- Poster, Post Card (Hindi/ English).
- Sticker, Brochure (Hindi/ English).
- Road Side Guide (Hindi/ English).
- Flyer on Animal (Hindi/ English).
- Tourist Information (Hindi/ English).
- Glimpses of a Tiger Reserve (Hindi/ English).
- Kanha Interpretation Booklet (Hindi/ English).
- Kanha Guide's Guide.

3.13.8 **Tourist Attractions:** There are some places of tourist interest in the Core Zone. These features pertain to natural beauty, religious myths and local folk tales, and are appreciated by visitors:

- **Kanha Meadows:** The Kanha meadows are perhaps the best place to view wildlife - favoured by the herbivores and therefore also by the predators. Many species of the herbivore such as the chital, barasingha, sambar and gaur can be seen either grazing or passing through on their way to the waterholes. And lurking in the thickets are predators like the tiger, panther and wild dog.
- **Sonf Meadows:** The abandoned site of the first forest village to be shifted out of the Park, the place attracted a few barasingha initially and later on proved to be an excellent restoration site for the dwindling numbers of the branderi barasingha. The area today is as good as the Kanha meadows for viewing wildlife such as chital, sambar, wild boar, jackal and occasionally dhole, gaur and tiger.

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- **Shravan Tal:** This small earth bund tank in the Central Kanha meadows is mythologically related to the death of the legendary Shravan Kumar at the hands of king Dashrath. It is a very important water body in the area, which attracts a lot of wild animals.
- **Shravan Chita:** Shravan Kumar, a dutiful son and the embodiment of total dedication to the parents, is said to have been cremated at this place, whose colour is strikingly different from its immediate surroundings and adds to the mystery of the above myth. The spot and can be seen from a distance while moving on the Bamhani dadar-Keraghat road.
- **Lapsi Kabar:** An expert hunter and guide, Lapsi is said to have been killed at this spot in 1930. The legend has it that Lapsi was accompanying tourists in the jungle when he had a close encounter with a tiger. He fought bravely and was killed. A gravestone has been erected here as a memorial to his courage.
- **Sondar Tank:** Located in the Mukki Range, it is one of the finest water bodies in the Core Zone. Besides attracting a variety of wild animals, it is a frequent haunt of the barasingha, which can be sighted there, feeding on the aquatic plants.
- **Babathenga Tank:** Also in the Mukki Range, this water body attracts a variety of birds. It is frequented by many species of wild animals, and also carries a high probability of the tiger and panther for the tourists.
- **Bamhnidadar:** It is one of the highest plateaus in the Core Zone and offers a beautiful panorama of the plains of Mukki, Oarie, Ghorella and Bishanpura, which were once forest village sites. The drive from Shravan Tal to Bamhnidadar adds tremendously to the joy of jungle excursions.
- **Bishanpura–Sondar–Ghorella:** These old village sites have now developed into beautiful grasslands with ample water and are a popular converging point for the herbivores.
- **Kopedabri–Naktighati Sector:** This lies between Mukki and Kisli, and provides wonderful views in the small openings of forests. The area also harbours, besides the tiger, a variety of herbivore species.

3.13.9 **Tiger Tracking/ Viewing:** Tiger tracking for tiger viewings/ shows is a very important wildlife tourism activity in the Core Zone. On the one hand, the tracked tigers facilitate arranged viewings for visitors from elephant back and, on the other,

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frequent monitoring of tigers also ensure a handle to understand their movements and well-being. The experienced mahouts, often accompanied by local officers, set out on elephant backs in the respective ranges at the crack of dawn. Having served the park for so many years, the mahouts already have ample idea about the whereabouts of the resident solitary males and females or females with cubs. Generally, the elephants radiate for the tracking from the spot where a tiger was last sighted. As the tracking starts, the mahouts very carefully look for direct and indirect signs of tigers. These include vocalization, fresh pugmarks, scats, kills scratches, scrapes, and alarm calls of herbivores and langurs. Tiger tracking is a very difficult exercise and requires a lot of physical endurance while negotiating undulating landscapes and inching through dense undergrowth. While on the move, the mahouts also communicate among themselves about the signs and movements of tigers through mobile wireless sets. Sometimes it takes as long as three hours to locate a tiger. And, of course, sometimes tigers also elude the tracking, and the team comes back. When a tiger is tracked, the team informs the respective range officers about the exact location of the tiger. These locations are generally very local geographic features/ landmark such as some hillock, nullah, groove, meadow, culvert, or forest road.

Visitors are required to fill in a prescribed form to see tracked tigers from an elephant back **(Appendix-18)**. Computerized tokens/ tickets are given to tourists on the first-come-first-served basis at Kanha, Kisli & Mukki, depending upon the location of tracked tigers. Visitors are then allowed to reach the elephant site from where they are carried to the tiger spot on elephant backs.

3.14 Ecotourism:

Ecotourism has gained popularity over the years and is also sometimes called nature tourism. Ecotourism is broadly defined as responsible travels/ journeys to those natural areas that conserve the environment and improve general well-being of local communities. The most important aspect of ecotourism, probably, is that part of income/ profit generated by tourism goes straight to local communities also responsible for the conservation of such areas. In this way, ecotourism aims at the enjoyment of nature and an understanding of the ecology, without causing the least destruction to its support system, leading to economic benefits for the indigenous masses. In sort, ecotourism is all about uniting conservation, local

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communities, and sustainable travel/ journey. Generally, it is expected that those who conduct and participate in ecotourism activities have the following basic ecotourism principles in mind:

- Minimum impact.
- Creation of conservation, environmental and cultural awareness.
- Positive experiences for both visitors and hosts.
- Financial benefits and empowerment for local people.

While ecotourism is not conducted in the strict sense of its definition, the potential of ecotourism involving local indigenous communities for their economic improvement has been recognized in the Kanha Tiger Reserve. Eco-tourism is not actually mass tourism, and it is multi-faceted, having various intricate linkages with different forms of human activity, with domestic, regional and international characters. In many countries, eco-tourism plays an important role in the shaping of national economies. The socio-economic and ecological impact of eco-tourism is relevant to a developing country like India, and it is evolving over the vicissitudes of time with new concepts and ideas.

3.15 Kanha *Vikas Nidhi* (Development Fund):

The Kanha *Vikas Nidhi* was constituted vide Govt. order No. F. 14/ 156/ 93/ 10/ 2 dated 25-02-1997. Under this novel venture, money received from tourists in the form of entry fees, accommodation charge, and elephant charges etc. is recycled into this fund. On an average, the Core Zone has generated around Rs. 1.35 crore per tourism year as *Vikas Nidhi* in the past ten years. This fund is used for the development of tourism infrastructure such as repairs of forest rest houses, special maintenance of roads in the tourism zone, and upkeep of park interpretation centres etc. Besides, every year, a certain percentage of this fund is also used for the development of forest villages in the Tiger Reserve. The main beneficiaries, in order of preference, are those 28 forest villages, which have been relocated outside the National Park. After these forest villages come other forest villages of the National Park and Buffer Zone followed by select revenue villages. This fund is used for the development of these villages. The Park Management has deposited, from its Vikas Nidhi, a total amount of Rs. 3.3541 crore with 152 EDCs (Ecodevelopment Committee). Some of the development works

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in these villages include: construction of drinking water facilities such as anicuts, stop dams, wells, etc.; construction of approach roads, community halls, school buildings; and leveling of agricultural lands etc. Besides, the needy villagers are also given soft-loans from this fund to set up their own small businesses such as grocery shops, cycle repairing shop, betel shops, iron smithy, copper smithy, wayside eating places, small restaurants, and low cost accommodation for tourists, purchase of buffalos and bullocks for agriculture etc.

The Kanha *Vikas Nidhi* fund is also used for the welfare of the Kanha staff. Generally, service conditions for the frontline staff in Kanha are very arduous, and it takes its toll gradually but surely. These are non-family postings and Forest Guards and their game watchers of deep-seated and interior patrolling camps have to face enormous difficulties. To get the best out of them good incentives are urgently required. Currently, the Forest Guards of the National Park are getting Rs. 4500.00 per year as an incentive from the Kanha *Vikas Nidhi*. Besides, daily wagers are also getting Rs. 3000.00 per year for their hard work in wildlife conservation. The money from this fund has also been given to some frontline staff to meet the expenses of medical treatments.

3.16 Constraints of Tourism:

The Park Management faces the following constraints of tourism in the National Park:

3.16.1 **Steadily Increasing Tourism Pressure:** The present Core Zone initially had a modest beginning of wildlife tourism in the early 1970s, and till 1975-76 fewer than 5000 tourist visited the protected area every year. In 1970-71 and 1971-72, the corresponding figures of tourists were 3470 and 3311 only. The Core Zone had recently been declared a Tiger Reserve, and it offered only a raw splendor of nature, including a wide range of ungulate species and, of course, tigers, which had always been in the limelight. The concept of wildlife tourism was nascent and alternative tourism attractions/ supplementary add-ons such as park interpretation and related programmes were either relatively unknown or unavailable due to financial constraints. Or, simply, the need was not felt at that time. In this way, the Kanha Management had nothing more to offer to the visitors except extensive jungle excursions for animal sightings and organized tiger-viewings from elephant back.

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The Park Management, to achieve the objectives of tourism, delimited a substantial and most potential area of tigers in the Core Zone as a tourism zone. This tourism zone consisted mainly of the lower slopes and valleys of the Core Zone, and supported excellent sal forests, bamboo and climber species, extensive grasslands and perennial streams and water bodies. Consequently, this zone harboured an outstanding plain mosaic of wildlife habitats. This habitat mosaic, specially the grasslands of the present Kanha and Mukki ranges, the mainstay of wildlife habitats, supported thousands of ungulate species and afforded easy and great sightings for tourists. A substantial prey base and well protected natal areas in the tourism zone automatically became a haven for an increasing number of tigers. In this way, an excellent road network through grassy expanses and flat and easily motorable terrain along with grand sightings of hundreds of ungulates, and a high probability of sighting tigers almost every day made the Kanha Core Zone immensely popular in the country.

During this time the visits of some statesmen and foreign royalties to Kanha were also much publicized, and the Core Zone always remained in the limelight. The number of tourists grew consistently over the years, with 14418 in 1980-81 and 34164 in 1990-91. Initially, there were only two entry gates to the Core Zone, one at Khatia and the other at Mukki. These entry points automatically became the hub of hospitality/ tourism business, and witnessed gradual mushrooming of private lodging and boarding accommodations. While the Khatia end developed rather rapidly, development at the Mukki end was slow due to the late inclusion of this area into the National Park. The Park Management also had to cope with the yearly increasing influx of tourists with more professional attitude towards wildlife tourism. This resulted in new government accommodations for tourists, museums, orientation centers and availability of publicity material about the Core Zone.

In the early '90s when tourist influx into this protected area was relatively low and the need for future projections of tourism pressure was not felt, only prime wildlife habitats were incorporated into tourism zones of the Core Zone. The sub-prime areas of the protected area were hardly exploited for tourism. In spite of continuously growing tourism pressure in these areas over the years, the above practice continued and now the tourism zone started reflecting its fragility/ vulnerability in several ways.

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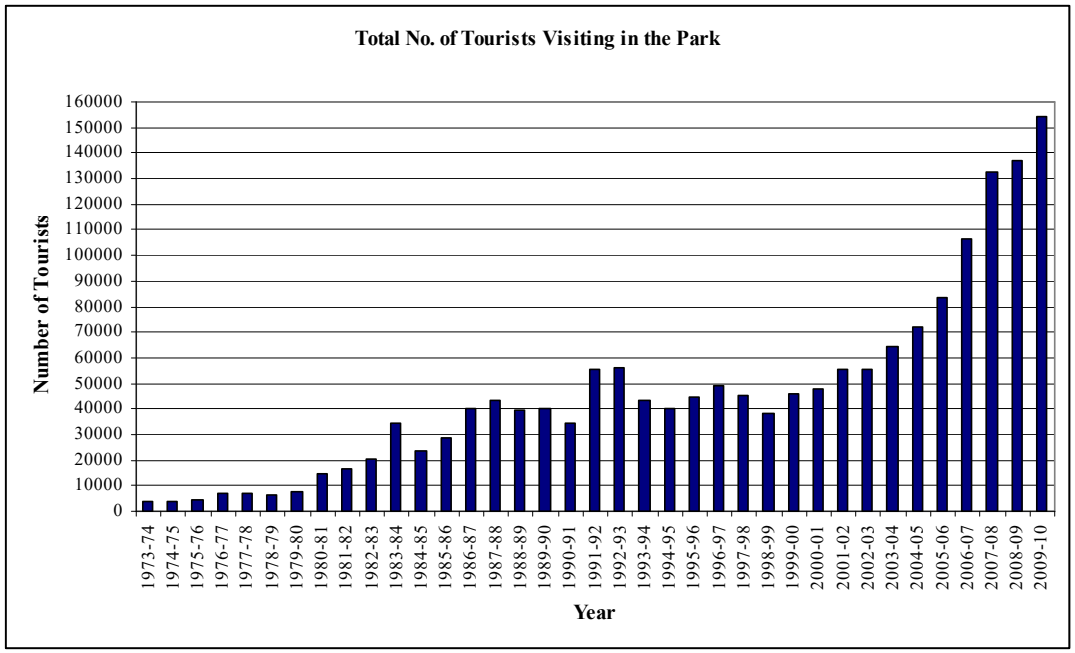
3.16.2 **Tiger-Centric Tourism:** The number of tourists grew steadily, and crossed the one lakh mark (106297) first time in the year 2006-07 and, naturally, the Park Management also started feeling the heat of the increasing number of tourists. Over the recent years, an incomprehensible mentality of the tourist influx has started taking its toll on the habitats of the tourism zone. Wildlife tourism has become tiger–centric in Kanha. The tiger-centric tourism has prevailed over sightings/ enjoyment of other wildlife species, including birds. This attitude has led to the crowding of tourist vehicles along only certain roads and in the areas having the most chances of tiger sightings. Tour operators and tourists always insist on conducting special viewings of this super cat. While the Core Zone has excellent park interpretation facilities for the creation of conservation awareness, they generally remain deserted, specially when such special viewings are being conducted by the Park Management. As the guides and drivers of tourist vehicles have a good knowledge of the timings and movements of resident tigers, tourists do not mind waiting *ad infinitum* to see them. In spite of strict control over organized tiger-viewings from elephants, the Park Management finds tourists often unmanageable, resulting in day to day unpleasant situations and controversies.



3.16.3 **Palpable Impact:** While no research has been conducted on this, at least in India, it is generally accepted that tourists and nonstop viewing of a detained animal can cause

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changes in its behavior and physiology, including increased levels of stress hormones and reduced time spent on feeding or resting. Empirical observations in Kanha clearly suggest that probably excessive tourism is responsible for aberrative behaviour of some tigers in the tourism zone. The resident tigers have no avoidance of humans, having almost daily been in close proximity to them ever since they were categorized as large cubs, and were allowed to be seen by tourists.

Increasing number of tourists/ tourist vehicles is also taking their toll on prime wildlife habitats. Noisy crowds of tourists at canteens/ interpretation centres in the heart of the Core Zone, dusty road-sides and grassland edges, the shifting of home ranges by wild animals and obstruction of animal movements by tourist vehicles etc. are some of the main problems posed by tourist pressure. Needless to add, unpleasant situations, including strong altercations with tourists/ tour operators often arise out of the proper enforcement of tourism rules and regulations.

The Kanha management is realistic and accepts that it is almost impossible to reduce the number of tourist vehicles entering the Core Zone every day. It will be a most unpopular decision, and will evoke resentment and frustration in tourists in general and hoteliers/ resort-owners in particular. It is, however, high time to strike an effective balance between the impact of wildlife tourism and tiger conservation in the Core Zone so that both the practices can achieve sustainability.

3.16.4 **Disappointed Local Communities:** Local communities in and around the Core Zone are the most important stakeholders in ecotourism. These communities, mostly the aborigines, are responsible for/ credited with the well being/ ecological health of the protected area and its surroundings. A large number of these villagers, traditional forest dwellers, have been relocated outside the present Core Zone. The relocated have had to sacrifice their forest rights and concessions they have been enjoying for several generations. Other villages surrounding the National Park have also had to meet the same fate as the protected area now no longer remains a managed forest where they can exercise their traditional rights. While the National Park has become a place of national and international renown, with a flourishing tourism industry run by millionaires, the relocated/ local communities find themselves at the receiving end. They also feel that wildlife is being conserved at their expense, while the

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opportunities of making money are being availed of by rich people. This heartburn has resulted in their extreme reluctance in cooperating with protected area for strengthening wildlife conservation in the region. Besides, villagers are being persuaded to sell their lands to businessmen for constructing their hotels, and they are straying away from their traditional lifestyle. These innocent villagers are lured into cutting down trees on their land and selling them, adding to the fragmentation of the landscape.

3.16.5 **Mushrooming of Hospitality Ventures:** There is also mindless mushrooming of hotels/ resorts/ dhabas near the entry gates and close to the National Park. These buildings obstruct animal movements and defeat the concept of ecological corridors between two wildlife protected areas. All these buildings have boundary walls, and even soldout plots of land have been fenced in with barbed wires. Needless to add, these non-porous boundaries obstruct the movements of wild animals, including tigers with their characteristic high mobility. Some buildings have been constructed very close to watercourses to exploit the full potential of the natural resource for their daily needs. While everybody swears by wildlife conservation in the area, sensibilities to make small changes in favour of conservation are yet to be seen on ground. The total number of beds in these hotels/ resorts has already exceeded the maximum number of visitors (900) allowed to enter the Core Zone through all the three entry gates on a single day. Now it is inconceivable what role the construction of many more future buildings are going to play in wildlife tourism. All these hospitality ventures lie in the eco-sensitive/ eco-fragile zone surrounding the protected area, which has a significant bearing on the perpetuity of the protected area. The proposal for the management of these zones is already pending at the Govt. level for notification.

3.16.6 **Early Opening of the Park:** Till a few years back, the Core Zone used to be opened for tourists from the 1st November. Later, as per govt. instructions, the Core Zone used to be opened from the 1st October on a trial basis. This practice continued for some years, and presently the Core Zone is opened from the 16th October. The Park Management faces the following important managerial and ecological problems due to this early opening:

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The Core Zone supports the only world population of the hard ground barasingha. The females either remain gestated in the late September or October, or some of them also deliver their fawns during this time. As the barasingha habitat is also part of the tourism zone, hectic field works and tourism activities make these female barasingha stressed, which is not good for their health. Road repairing works in the barasingha habitat also involve the clearing/ opening of some roadside areas through which jackals approach the hidings of the female barasingha and carry off with newborns. This selective predation adversely affects the already small population of this deer species.

During the monsoon, the staff of the Core Zone remains busy in special monsoon patrolling, and has to be called back in the first/ second week of September for the maintenance of all the departmental tourist accommodations and arrangements of other tourism related activities. In this way, the Park Management has to compromise on protection as there is an immense biotic pressure on the peripheral areas of the National Park during monsoon.

Tourists themselves have to face problems. Sometimes, their vehicles get stuck on muddy forest roads, and the management has to make special arrangements for their safe arrival back at Kisli/ Mukki.

Road repairing works are generally carried out in the month of October after the rains are fully over. But if the Core Zone is to be opened from the 16th October, this exercise has to be carried out in the month of September when the National Park still receives rains. Besides, in the month of October, a few showers in the first or second week do considerable damage to the road repairing works and the roads of the tourism zone have to be re-repaired. Needless to add, a lot of money goes waste.

Besides, the Park Management sometimes does not allow tourists to enter the Core Zone due to unexpected heavy showers in late October, damaging forest roads. Under these circumstances, tourists have to wait for another day or two until the weather gets clear. In this way, they have to unnecessarily spend money on their futile stay for wildlife tourism. And during such spells, the management has to receive a lot of flak from such tourists.

3.17 *In-situ* Enclosure for Tigres:

A radio-collared tigress was killed in a fierce fight with a resident male on the 4th June 2005. The tigress had 3 small cubs, one male and two females, aged around 25 days. The Park Management launched an extensive search for these orphaned cubs and took them immediately under care. The three cubs were first kept in a makeshift cage in the Kanha Range for around 3 months, and were later shifted into the Mukki quarantine house, which had a larger area to suit the movements of these cubs.

Initially, the Kanha Management kept these cubs on a diet of milk and soft meat etc. Later, when they grew larger in size, they were brought up as per their dietary requirements. The Park Management ensured that these cubs were minimally exposed to human contact. Regular health monitoring of these cubs was also ensured. As these cubs were ageing and growing in size, the Park Management decided to shift them into a specially designed large *in-situ* enclosure (around 35 ha.) constructed at Ghorella in compartment number 24 of the Mukki range. The idea behind this decision was to give these super cats an opportunity to learn the ways of the jungle, including predation and free movement in a larger area of a typical tiger habitat. On 17-02-2008, while the two tigresses were shifted into the above *in-situ* enclosure, the male was kept in a small cage close to the enclosure.

Reintroduction of tigers into the wild has always been an uneasy and perplexing task. There are numerous incidents and stories of reintroduced tigers killing humans or easily getting killed themselves in fights with their conspecifics. These captive cubs had natural predation instincts and had to be developed out of dormancy, as they had not been trained by the mother tigress. The cubs needed to be trained in their natural habitat to hunt free ranging animals – their natural prey.

These tigresses had been preying upon specially driven-in chital and wild boars in the enclosure successfully for the past around three years. While the tiger and one of the tigresses have already been transferred to Van Vihar National Park, Bhopal and the Panna Tiger Reserve respectively, the remaining tigress is under consideration for translocation and release into some other National Park where a low density of tiger and a good prey base may help this tigress survive in its natural habitat.

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3.18 Translocation of Wildlife:

In the recent past, under the instructions and guidance of the Principal Chief Conservator of Forests (Wildlife), Madhya Pradesh, the Park Management successfully translocated several tigers/ tigress and gaur to different National Parks of the State.

3.18.1 **Indri Tigress to the Panna Tiger Reserve by Air:** The Indri tigress of the Core Zone was successfully immobilized, radio-collared, and measured as per protocol, and was translocated to the Panna Tiger Reserve on 9th March, 2009 by a helicopter of the Indian Air Force. The tigress was first released into a specially designed *in-situ* enclosure for several days, and later released into the wild. This managerial intervention was carried out to improve the skewed ratio of male-female tigers in the Panna Tiger Reserve. The tigress is reported to be doing well in the protected area.

3.18.2 **Male Tiger to Van Vihar National Park:** As already mentioned above, this tiger was one of the three orphaned cubs. The tiger was translocated to the Van Vihar National Park by road on 15th May, 2008. The animal is doing well there.

3.18.3 **Gaur to Bandhavgarh Tiger Reserve:** Madhya Pradesh has over the years enjoyed an enviable status of harboring an effective network of wildlife protected areas, and conserving a wide range of wildlife and their habitats, including some endangered species. While there are many finer objectives of the management of these wildlife protected areas, the basis of conservation philosophy lies in biodiversity conservation. And conservation practices in these protected areas aim at the maintenance of species diversity and prevention of species extinction where species are preserved as part of functioning ecosystems.

The Bandhavgarh Tiger Reserve is one of the most beautiful protected areas of the state. Harboring lush forests of sal, bamboo and miscellaneous species, the tiger reserve is renowned worldwide for tigers and many other wildlife species. Till around 15 years back, the National Park also supported a small population of the Indian bison (*Bos gaurus gaurus*), or the gaur, regarded as the largest species of wild cattle. These mammoth animals live in social groups, and due to their formidable body size and

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power they have few natural predators. Tigers, however, sometimes kill even full-grown bulls.

This small population rose to 38 animals in 1990 and later a steady decline was recorded coming down to 30 animals in 1995. And after this, no herd was seen either in the National Park or in the surrounding areas. While the local extinction of this species was a blow to conservation and caused serious concerns, its existence in several other wildlife protected areas somehow lessened this anxiety. No major managerial interventions in protected areas at that time were possible due to various financial and infrastructural inadequacies and limitations, and this beautiful National Park carried on without gaur.

As this species is generally not poached due to religious sentiments, the causes of this local extinction that readily come to mind are: bovine diseases, selective predation by tigers, upsetting the sex-ratio; the small population itself, but most importantly, local migration away from the National Park. Though very unlikely, small populations are also challenged by a number of limiting factors that increase the chances of the population going extinct simply because the population is small.

Dr. HS Pabla, Principal Chief Conservator of Forests (Wildlife) and also former Director of the Bandhavgarh National Park in the late 1980s, had been pursuing the idea of reintroducing Indian bison into these wilds. He viewed such managerial interventions essential for promoting species diversity of endangered animals and breeding of lesser wildlife species. He had been in touch with a lot of experts of different disciplines simultaneously in India and abroad for the past almost five years. The entire exercise also resulted in receiving cooperation from Taj Safaris (Taj Group of Hotels) of India and “And Beyond Africa” (previously known as Conservation Corporation Africa) of South Africa, promoters of responsible wildlife and adventure tourism. These organizations also arranged services of three experts for this reintroduction programme, which was otherwise fraught with many risks.

Mr. Les Carlisle, Group Conservation and Sustainability Manager of “And Beyond Africa” was a very experienced professional and had so far caught and relocated thousands of larger African mammals. Dr. Dave Cooper was the Senior Wildlife

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Veterinarian of Ezemvelo KZN Wildlife, a government organization of South Africa, and had handled a vastly wide range of wild animals for immobilization and treatment. Mr. Jeff Cooke, the Head of the Game Capture Unit for Ezemvelo KZN Wildlife, had been credited with the success of many translocations of wildlife in South Africa. Besides these South African experts and naturalists of Taj Safaris, experts from the Wildlife Institute of India, Dehradun and wildlife veterinarians of the Kanha, Pench and Panna Tiger Reserves and the management of Kanha and Bandhavgarh Tiger Reserves were also involved in this enormous conservation venture. It was well known that Kanha has a sizeable population of the Indian bison.

The entire field operation was discussed and planned in great detail on the 20th January, 2011. Duties were assigned, medicines and equipment were rechecked, and a mock field trial with ground crews was also carried out to make doubly sure that everything was fine and would go as planned. The Kanha Management had already got an iron-sheet structure called boma built and set it up at Kisli to temporarily house the captured bison for some time. The boma was connected to a specially designed large trailer having several compartments to lodge captured bison safely. Openings were provided in the closed trailer for proper ventilation and even administering injectables to the animals in transit.

In the early morning, Mr. HS Negi, Field Director of the Kanha Tiger Reserve, took command of the field operation and led the teams on elephants' backs searching for a bison herd. After almost two hours, he saw a large herd grazing on a wooded slope. As the terrain was not fit for immobilizing the animals, the grazing herd was gently moved to a suitable terrain.

Then one of the animals selected by experts was immobilized by a dart gun. The rest of the herd was lightly moved away by elephants and the teams got off the elephants to radio-collar the animal and record required veterinary health parameters and to attend to any health eventuality. The unconscious animal was then quickly pushed onto a specially designed stretcher handled by 16 crews and loaded onto a vehicle. The animal was offloaded into the boma and the veterinarians revived it in seconds by giving a sophisticated antidote. The boma already had feeds consisting of several palatable species of leaf and grass to sustain the captured animals for some hours. The

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same capture operation was repeated several times a day for a few days and 20 bison were captured for translocation under mild sedation.

Later, these animals were lured and pushed into the trailer with the help of an electrically charged stick. The captured bison were transported to the Bandhavgarh National Park under a prescribed speed limit. Wildlife veterinarians, experts and other staff also accompanied the trailer to Bandhavgarh. All the animals were later released into a large solar powered electric fence surrounding a typical wild habitat of bison. These animals remained in the fence for several weeks under a prescribed monitoring protocol and later released into the wild.

This was a unique and historic translocation, and wildlife conservationists hope that this initial population, with subsequent translocations in future, will rise gradually and reach a safer status adding to the biodiversity of the National Park.

3.18.4 Tigress to the Panna Tiger Reserve: One of the two tigresses kept in the *in*-situ enclosure was translocated to the Panna Tiger Reserve on 26th March, 2011 by road. There was no soft release this time, and the next day, the tigress was released straight into the wild. She is reportedly doing fine.

3.19 Research & Training:

3.19.1 **Research:** It is to the immense credit of researchers and explorers like Guy Mountfort, Sir Julian Huxley and Max Nicholson who contributed enormously to the launch of Project Tiger in India. Now research is regarded as a very important component of wildlife conservation in the country. The Kanha Core Zone prides itself on being the first protected area of a very significant study of wildlife biology/ ecology in India during the mid-1960s. George Schaller, an American field biologist, stayed for about 14 months (between 1963 and 1965) in the National Park and conducted a most insightful study on the wildlife of the National Park, and also made it into a classic book named "The Deer & The Tiger".

Decisions about the wise use and manipulation of resources in a wildlife protected area largely depend upon the results of quality research. There is now growing

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realization that ignorance of science, like ignorance of law is an unacceptable excuse for shortsightedness of wildlife management and failings in conservation. Wildlife research is essential to the understanding of an ecosystem and its components. Responsible decisions in the backdrop of current human and livestock pressure on, and general degradation of wildlife habitats are possible only on the basis of a scientific understanding of the natural and human social systems of the area. In this way, a strong research arm is necessary for guiding a programme of scientific wildlife management.

The importance of research in the Core Zone has also been recognized as such, and the protected area has been developed as a good research centre as envisaged in the Plan Outline of the Project Tiger. Research and monitoring constitute a very important aspect of effective management of wildlife protected areas. Research based wildlife management is crucial for the success of any National Park. This is a legitimate activity, and must also be compatible with the objectives of a wildlife protected area.

The protected area has gradually progressed into a study centre for national and international wildlife researchers, and has 9 Ph.D. and 1 D.Sc. theses to its credit on various aspects of wildlife science. Besides, over 100 research and technical papers relating to the wildlife biology and ecology of the Kanha ecosystem have been published in various national and international journals. Some of the prominent studies for doctoral and post-doctoral degrees are as under:

- **George B Schaller:** Ecology of the Tiger and Ungulate Species.
- **Claude Martin:** Status and Ecology of the Barasingha.
- **Paul Newton:** Ecology and Social Organization of Hanuman Langurs.
- **PC Kotwal:** Evaluation of Wildlife Habitats & their Utilization by Major Mammals.
- **RK Pandey:** Ecology of the Grasslands with Reference to Wildlife Management.
- **Rajesh Gopal:** Biology & Ecology of the Hard Ground Barasingha.
- **HS Negi:** Protected Area & Managed Forest: Comparison of Prey-Predator Abundance, Distribution, Habitat Utilization & Biotic Pressure with Special Reference to Kanha Tiger Reserve & Surrounding Forests.
- **K Nayak:** Evaluation of the Barasingha Habitats in Kanha National Park.

Besides in-house studies, various collaborative and institutional studies are also conducted in the Core Zone. Such institutions include various universities, Wildlife Institute of India, Dehradun, Centre for Cellular & Molecular Biology, Hyderabad, Indian Space Research Organization, Zoological Survey of India, Tropical Forest Research Institute, Jabalpur, State Forest Research Institute, Jabalpur and Wildlife Disease Diagnostic & Research Centre, Jabalpur etc. There is a well-equipped field laboratory at Kanha to support field studies, and also a good network of computers and facilities pertaining to information technology at the Mandla head office. In-house field research activities in the Core Zone include the following:

- Monitoring tigers, co-predators, prey and their habitats (a MP Forest Department – NTCA, New Delhi – WII, Dehradun collaborative project).
- Identification, capture and aerial reintroduction of a suitable tigress into the Panna Tiger Reserve.
- Utilization of AWS/ AMS data for agriculture, forestry and hydrological applications (under ISRO–GBP EMEVES & PRACRITI Project).
- Estimation of tiger population in Kanha Tiger Reserve by DNA method from scat samples (CCMB, Hyderabad).
- Study of leopard's axial and apendicular skeletons for forensic purposes (WDD & RC, Jabalpur).
- Incidence of parasitic infections in the barasingha population of Kanha National Park (WDD & RC, Jabalpur).
- Estimation of tiger and leopard population in the landscape of Madhya Pradesh by fecal DNA method (Smithsonian Institute, USA).
- Ecological monitoring of the 60 research plots spread all over the National Park following Sykes & Horrill, 1977 **(Appendix-19)**.
- Well documented description, evaluation & classification of habitats.
- Identification of limiting/ inimical factors.
- Data collection on population dynamics, dispersal pattern of wild animals, intra & inter-specific relations, feeding habits of herbivores & carnivores.
- Ecological monitoring of weather/ physical factors.
- Reptilia of Kanha Tiger Reserve (Zoological Survey of India, Jabalpur).

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- Development and maintenance of a herbarium.
- Check-listing of flowering plants.
- Entomological Survey of Kanha National Park (TFRI, Jabalpur).
- Check-listing of birds.
- Avifauna of Kanha Tiger Reserve (Zoological Survey of India, Jabalpur).
- Use of Landsat imageries & space photographs to study the habitat parameters.
- Preparation of cover maps based on aerial photographs.
- Use of radio-telemetry for studying land tenure of 10 tigers.
- Ecological studies on grasslands of Kanha National Park with special reference to wildlife management (State Forest Research Institute, Jabalpur).
- Standardizing chemical immobilization techniques.
- Translocation of barasingha to an alternate habitat.
- A doctoral study exclusively on the Central Indian barasingha covering several aspects like anatomy, physiology and health, karyotype mapping, ethology and population dynamics.
- Molecular characterization/ genome analysis from DNA samples of central Indian barasingha.
- Study of sal borer infestation.

3.19.2 **Training:** The way public is becoming forest and wildlife conservation conscious, and new policies, Acts and Rules are being framed, it is of utmost importance for the officers/ staff of the Core Zone to always remain updated for effective discharge of conservation duties. Besides, the staff also needs to be updated on technical practices of wildlife management.

Since long the old staff of the Core Zone involved in wildlife conservation has been gradually replaced by new ones who need special attention. Besides regular wildlife training/ orientation courses earmarked for the frontline staff, internal workshops/ field technique exercises held by trained officers and resource persons are the main source of capacity building. With the opening up of state-level institutions, the Park Management always encourages the staff to undergo orientation courses. Some of the main such workshops/ sessions/ trainings held in the Core Zone are appended **(Appendix–20)**.

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3.19.3 **Estimation of Wild Animals:** The estimation of carnivore and herbivore populations in the protected area was one of the most important exercises used to be carried out every year till 2004. While the pugmark method was employed to count tigers and panthers and other co-predators in the winter, the block count or direct sighting method was used to count herbivores after the first showers of the monsoon. Needless to add, such information is essential to monitor changes in the population trends over time or among habitats, and evaluate the success of wildlife management programmes **(Appendix-70)**.

Later, however, these methods were replaced by a new and holistic protocol conceptualized and successfully tested in a joint pilot project of the MP Forest Department, National Tiger Conservation Authority, New Delhi and Wildlife Institute of India, Dehradun.

3.19.3.1 **Critique of the Pugmark Method:** The estimation of tiger population in the Core Zone used to be conducted by the "Cooperation Census" methodology, involving a large number of the Reserve personnel during the estimation week in the winter. The concept of this indirect method of counting tigers, taken as a total count, is based on the identification and documentation of the pugmarks of tigers, tigresses and their cubs in the wild. Adopted many years back, this was regarded as the most reliable, cost-effective and user-friendly method. The staff searched for tiger pugmarks all over the Core Zone everyday, and the imprinted pugmarks on different soil covers of forest roads, firelines, specially prepared pressure impression pads (PIPs) and near water bodies were secured, traced and made into plaster-casts with relevant details. As a rule, only the left rear pugmark was taken into account for the counting exercise. The left and right pugmarks of the tiger were easily distinguishable by the position of the lead toe. In the left pugmark, counting clockwise, the lead toe was seen to occupy the third position, whereas in the right pugmark, it occupied the second. The shapes of frame they fitted into also differentiated between the male and female pugmarks. While the male pugmark fitted into a squarish frame, the female into a rectangular one. Even the male and female pugmarks themselves were highly individualistic on account of their morpho-metric differences, facilitating the counting of tigers. Besides, a rule of thumb was that the pugmarks of an around six-month old

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tiger cub were almost similar in shape and size to those of an adult panther, but such cubs were always accompanied by their mother-tigresses, hence a good cross-check.

Assumptions: The population data was analyzed on the basis of the following broad assumptions in the old methodology:

- The pugmark of each tiger/ panther was distinct.
- The final acceptance of a tracing/ plaster cast of a tiger/ panther pugmark was taken as a count of an individual animal.
- In good habitats with optimal prey base, adult tigers showed clear territoriality.
- In medium habitats with relatively low prey base, adult tigers were not entirely territorial.
- In poor habitats, adult tigers roamed about more or less as transients.
- In a week's time all tigers were deemed traceable despite terrain and poor soil substratum, which did not yield pugmark imprints.

All such data of pugmarks were corroborated with a lot of other information, recorded by forest guards throughout the year during their routine patrols, and analyzed before arriving at a range of tiger population in the Core Zone.

Shortcomings: Based on the fact that there is a clear cut difference between the pugmarks of a tiger, tigress, and a cub, and even among tigers and tigresses each animal has individualistic pugmarks to facilitate their distinct identity, the method, however, has its own quota of shortcomings and limitations, the critics argue. One pugmark may register different imprints on different substrates and be made into tracings and plaster-casts of different dimensions, leading to an over count. Besides, areas occupied by tigers may not have proper substrates to register these pugmarks, hence always a chance of an undercount. The method also aims at counting all the tigers of an area and giving an exact number of tigers, an unrealistic approach. As the method is regarded subjective and based on expert knowledge system, it lends ample scope for conjectures and arguments, and thus also for controversies. Further, the method does not have any scope for assessing the suitability of habitat conditions for

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tigers, so important for effective conservation. Besides, only tiger pugmarks, and no other signs of tigers, were taken into account for this methodology.

3.19.3.2 **The New Methodology:** In the above backdrop, some forest officers and field biologists came up with a new methodology or a comprehensive monitoring protocol, known as "Monitoring Tigers, Co-predators, Prey and their Habitats". The proposed new technique, to a large extent, was tested in a pilot project of the MP Forest Department, National Tiger Conservation Authority, New Delhi and Wildlife Institute of India for monitoring and evaluating tiger habitats in the Satpuda-Maikal landscape of Madhya Pradesh.

Conservation science in our country started developing since the mid 1970s, and new field methodologies, concepts and ideas gradually got infused in tiger conservation practice. At that time there was no computer, and the main thrust of conservation was on overall preservation of wildlife species. Later, in the backdrop of new ideas, new refinements in existing methodologies were incorporated with the help of the latest IT resources.

The new technique broadly has two components: extensive and intensive data collection in the field. The extensive data collection is carried out by forest guards in their respective beats, while the intensive by technical persons. Field data is collected under six prescribed formats containing a host of enquiries. These formats have been specially designed after prolonged discussions to make them as much user friendly as possible for forest guards. Besides, two phases of training and a dry run in between before the actual field exercise have also taken care of all probable doubts and problems. These formats will later furnish a lot of relevant spatial (relating to space) information on the signs of carnivores, sightings of ungulate species; vegetation, human disturbance, and herbivore pellets. Besides, the attribute information like human and livestock density, road network, forest type, meteorological information, socioeconomic parameter, and poaching pressure are also acquired from the forest department as secondary data. The relevant satellite imageries/ data and vegetation maps are used for the final analysis. Under the intensive field data collection, technical persons collect data in their respective sampling areas throughout the state, using standard methodologies like camera traps and transects for effective

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corroboration of data. Besides, DNA profiles prepared from the scats of tigers and digital photography of tiger pugmarks in Tiger Reserves also give an insight into tiger populations. The researchers of the Wildlife Institute of India, Dehradun analyze the above spatial and a spatial data on the entire forestland of the state, for declaring various results on the population range of tigers, panthers and other wildlife species along with information on habitat conditions. The data is analyzed in a GIS (Geographical Information System), and, using various statistical frameworks, will also model tiger occupancy and population range in different forest units of the state. The method, however, does not give the exact number of tigers in the state, which has been a traditional, and unfortunately scientifically absurd, as experts say, way of declaring results. Instead, tiger populations are declared in the density classes of high, medium and low per hundred sq. km. of a particular forest unit. The high and low density classes, for instance, may mean that there are more than 8 tigers and 1 to 2 tigers per hundred sq. km. respectively. Besides, density estimates of the prey base and habitat conditions in each forest unit are also given as results. All such results in the forms of maps, indices and classes give in totality a picture of populations of the tiger, other carnivores, and prey base along with the general health of tiger habitats in the state. The system also has an audit mechanism to check data collection, compilation and analysis. Experts say that the method can also be institutionalized for continuous monitoring and evaluation of tigers and their habitats in every tiger landscape complex in the country.

Under frequent meticulous reviews and monitoring by the PCCF of the wildlife wing of the state and his Bhopal team, and coordination of the Field Director of Kanha Tiger Reserve, the ambitious field exercises for this new monitoring protocol were conducted in January, 2006 and February, 2010 in around 8500 forest beats of the state. As the quality of data collection can make or mar this proverbial Herculean effort, forest officials throughout the state worked tirelessly for the above four-yearly population estimation exercises. All the states of country undertook the above monitoring protocol for population estimation.

3.20 Administrative Setup:

As stated above, the Core Zone and the Buffer Zone Division are under the unified control of the Field Director. The Core Zone along with the National Park is in charge of a Deputy

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Director of the rank of Deputy Conservator of Forests, with headquarters at Mandla. Besides, three sub-divisions and six forest ranges, including range assistant circles and beats, constitute the field structure of the protected area. The details/ strength of the office and field staff of the National Park are appended **(Appendix-21)**.

3.21 Communication Network:

Effective protection of forest and wildlife resources in the Core Zone makes it imperative to have a reliable and efficient communication network to ensure quick and timely exchange of commands and messages/ responses. The protected area has been making efforts consistently to develop a very effective communication network. Presently, this network consists of a sufficient number of fixed and mobile wireless sets, Personal Digital Assistant (PDAs) and cell phones. While the fixed and mobile wireless sets are installed all over the Core Zone, cell phones (Closed User Group) and PDAs have been allotted to officers and field staff. The Park Management ensures that the entire network remains operative round the clock throughout the year for quick communications within the field, and also between the Mandla office and the field. The head office at Mandla controls the entire communication system. Besides, the availability of Internet and facsimile facilities at the Mandla office makes it well connected with the rest of the country. While the locations of this network in the Core Zone are appended **(Appendix-22),** the strength of communication network is as under:

Type of Wireless Set	No.
Fixed Set (Base Station)	110
Hand Set (Walky-Talky)	254
Mobile (Vehicle)	15
Total:	**379**

PDA Set & Mobile SIM Information

Particulars	No.
PDA	130 (13 Non-functional)
Mobile SIM	63

3.22 General Issues & Problems:

The Kanha Core Zone has a long history of wildlife conservation practices, and has had a succession of very good officers and committed frontline staff. While the past has been a

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great learning process for the adaptive management of the Core Zone, issues/ constraints still crop up from time to time and are addressed timely and adequately. The socio-economy, ecology and history of the protected area, however, have given rise to an almost permanent background of several issues and problems having a strong bearing on management strategies. Some of them are as under:

3.22.1 **Demographic Pressure & Backwardness:** The location of the Core Zone more or less resembles that of an island in a vast sea of human settlements. Tribals constitute the majority of population, and illiteracy and backwardness hamper efforts of creating conservation awareness considerably.

3.22.2 **Relocation History:** While the latest relocation (2010) of Jami forest village from the Core Zone was carried out under option-I, and was totally transparent and hassle-free, the people of the 27, forest villages relocated from the National Park in the past still nurture animosity and acrimony towards the Park Management. This relocation history also requires tremendous efforts on the part of the Park Management for credibility building.

3.22.3 **Over-Dependence on Forests:** The area still carries a touch of aboriginal way of living and most of the local populations depend on forests for their day to day sustenance. With gradual increase in population, this has degenerated into a vicious circle of overuse, resulting in overall degradation of the forest area and loss of corridor connectivity outside the core conservation unit.

3.22.4 **Lack of Awareness:** Due to abject illiteracy and ignorance, there is a sheer lack of awareness and perception about developmental activities. They strongly believe that the Park Management will do everything for wildlife at their expense.

3.22.5 **Natural limiting Factors:** The anthropogenic meadows of the Core Zone are getting invaded by woodland species, requiring the arrest of this ecological succession for maintaining meadows to foster ungulate population.

3.22.6 **Human Population & Growth:** There are still 17 forest villages in the National Park, and the populations also affect the protected area to some extent. Besides, there are

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many forest and revenue villages just outside the National Park in the Buffer, forming a significant impact zone. This population also undergoes the typical Indian decadal demographic growth.

3.22.7 **Livestock Population & Growth:** There are around 8,000 cattle heads in the National Park showing the usual population growth and defective animal husbandry practices.

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CHAPTER – 4

BARASINGHA CONSERVATION PRACTICES

4.1 Introduction:

First systematically described by RI Pocock in 1943 and Ellerman and Morrison-Scott in 1951, and named after the famous British forest officer AA Dunbar Brander, the hard ground barasingha, also known as the central Indian barasingha (*Cervus duvauceli branderi* Pocock, 1943) is one of the two sub-species of the nominate species of the Indian swamp deer (*Cervus duvauceli duvauceli* Cuvier, 1823), found in the Dudhwa National Park and several wildlife sanctuaries and forest divisions of Uttar Pradesh, though in very small numbers. While it is known as the north Indian sub-species, the north-eastern sub-species of this deer, (*Cervus duvauceli ranjitsinhi* Groves, 1985), occurs probably only in the Kaziranga National Park. Each one sub-species slightly differs from another morphologically.

An endangered sub-species, the hard ground barasingha has responded well to various special managerial initiatives in the Kanha Core Zone. The historical range of this cervid once covered several districts of the present states of Madhya Pradesh, Maharashtra, Orissa and Andhra Pradesh, is now endemic only to the Kanha Core Zone, Madhya Pradesh, and forms the only world population. Due mainly to timely interventions in the early Seventies, and later concerted efforts under Project Tiger, this sub-species has virtually been brought back from the verge of extinction. The central Indian barasingha is a food specialist and an exclusive graminivore, and needs special managerial inputs for long-term survival (Gopal & Shukla, 2001).

4.2 Background Information:

Experts suggest that the barasingha or the swamp deer is confined exclusively to the Indian biogeographical limits. Mukherjee (1974) has indicated the past distribution of the deer from the marshy tracts of *terai* and *duars* of Northern part of the upper Gangetic plain to Assam, eastern Sundarbans and Central India. It is also stated that in the early part of the present century the species was extremely common in Pachmari (Central India). The species has now disappeared from the swamps of Sundarbans. Finn (1929) has reported the presence of

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barasingha in the swampy plains of Indus, Bahawalpur, Rohri and upper Sind till the end of the 19th century. According to Mukherjee (1974), the size of the range of barasingha represents about 4.4% of that at the start of the present century. Regarding the distribution of the barasingha, Sterndale (1884) has quoted from Jerdon's (1874) "Mammals of India": "In the forest lands at the foot of the Himalayas, from the Kyarde Doon to Bhotan. It is very abundant in Assam, inhabiting the islands and churs of the Berhampooter, extending down the river in suitable spots to the eastern Sundarbans. It is also stated to occur near Monghyr, and thence extends sparingly through the great forest tract of Central India". Sterndale (1884) has recorded the abundance of barasingha in the Raigarh-Bichia tracts of Mandla, in the open valleys (studded with sal forests) of the Thanwar, Halone and Bunjar tributaries of the Nerbudda. He has also indicated the probability of its occurrence in the Golcondah Zemindary near Daraconda. Blanford (1888-91) also gave a wide distribution of the species in the past century. The Mandla district gazetteer (F.R.R. Rudman, 1912) mentions about the barasingha as the "commonest deer" - found in the dry and high lying jungles of the north of Shahpur, the Raighat and the Jagmandal reserves, the "principal haunt" being the Banjar Reserve, with several thousand heads. To a lesser extent it occurred in the Motinala and the North/ South Phen Reserves also.

The Balaghat district gazetteer (C.E. Low, 1907) states that the barasingha was found in all parts where sal forests existed. In one case it was also reported in the mixed forest and bamboo jungle. Brander (1923), Burton (1952), Clutton-Brock (1965), Prater (1934), have also discussed the distribution of the species. Randhawa et.al. (1969) have reported the presence of fossils of Cervus duvauceli Cuv. (allied to the modern barasingha), in the Narmada Valley between Hoshangabad and Narsinhpur. The abundance of the species in the grasslands of Northern India has been discussed by many - viz. Champion (1927), Inglis (1892), Pollock and Thom (1900).

4.3 Distribution & Status:

Captain James Forsyth (1889), a naturalist and forest officer, gives a vivid account of the abundance of this species in central India. At that time the species was found widely distributed from Hoshangabad in the west to Chhindwara, Seoni, Balaghat, Mandla (Kanha National Park, Motinala and Karanjia ranges), Durg, Bilaspur, Raipur and Baster (Kutru in Toynar and Bhairamgarh ranges) districts of Madhya Pradesh, Bhandara and Chanda

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Districts of Maharashtra and several areas in Bihar and Orissa contiguous with bordering tracts in Madhya Pradesh. Brander (1923) reported the presence of this deer species in the Chhindwara, Mandla, Raipur, Balaghat, Bilaspur and Bastar districts of Madhya Pradesh and in the Chanda district of Mahatrashtra. But the distribution of the subspecies must also have extended into the States of Bihar and Orissa.

Records of the subspecies are scarce for the period between Brander (1923) and Schaller (1967). Although Schaller referred to a piece of information, saying that about 100 barasingha were surviving at the Madhya Pradesh–Orissa border between 1960 and 1965. It is, however, doubtful whether by 1965 any larger herd existed outside the Kanha National Park. Since then no barasingha was recorded in central India except in the Kanha National Park (Panwar, 1973). However, Krishnan (1972) found a barasingha antler in the Bastar district in 1970. Yet today it is very unlikely, that barasingha survive outside the Kanha National Park in central India.

4.4 Brief Specific Attributes:

The Central Indian barasingha is a food specialist, and an exclusively graminivorous deer species. Its eyesight and auditory capabilities are moderate and olfaction is acute. The animal has a highly specialized niche and is totally dependent on grasslands. In the *terai* region, the extensive *terai* savannas and marshy tall grasslands favour these animals. But, in central India, the branderi subspecies has adapted itself to the hard ground conditions. In this region, the deer favours grassy areas in moist pockets; the animals never move far away from water. Tall grass cover is extremely essential for breeding success (Panwar, 1978; Gopal, 1995). Rutting stags require mud wallows. The species is capable of quick population growth once its habitat requirements are available (Panwar, 1978). In the Kanha Core Zone the peak rut occurs from mid-December to mid-January. In northern India the rutting takes place in November and December and antlers are shed by April. The commencement of rut in the park is easily marked by prominent behavioural changes in these animals. The gestation period of barasingha has been monitored to be usually between 240 to 250 days. The females usually participate in reproduction when they are just about two years old, and the first fawn is born at the age of about 3 years; one fawn is born at a time, the animal being monoestrous and monotocus. The animal peacefully interacts with blackbuck and spotted deer. Martin (1978) found a correlation of barasingha and chital pellet frequencies which

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suggested common utilization of the grasslands by the two species. However, the pattern of utilization varies between the two species.

The central Indian barasingha, though adapted to the hard ground conditions, still reveals its ontogenic preference for swamps. It shows a preference for aquatic plants, and often the animal wades in water, frequently dipping its muzzle to feed on the water plants. The males wallow in shallow muddy pools during the rutting period in winter.

As stated earlier, the animal has been conclusively studied by several workers to be a graminivore, feeding preferably on *Sacharum spontaneum* throughout the year. However, the seasonal diet comprises of many common grasses found in the habitat. The cervid shows seasonal movements within the habitat. After the rutting season, stags usually form bachelor herds, though mixed groups are also occasionally noticed. During the monsoon, these animals move away from the meadows of Kanha to dense forest patches interspersed with grassy clearings. This is the time when the does are seen in advanced stage of gestation (Gopal, 1995). In November, these animals again appear in the open meadows along with their young fawns. The evacuated site of the erstwhile Sonf village, situated seven kilometers to the north of Kanha, along with a similar adjoining patch at Ronda, serve as a monsoon abode for the majority of barasingha. Martin (1974) has made comparative studies of the composition and height of the grass cover for different openings of the park and correlated the same to the migrations and food preference of the barasingha.

The animal is sympatric with the spotted deer and the latter also has similar food requirement. Martin (1987) and Gopal (1995) observed that tall grass areas and moist open grasslands reduce the competition pressure. The competition is severe on dry open grasslands.

4.5 Prelude to Decline:

As stated in the preceding chapter, these forest tracts were once some of the finest and hitherto untouched wilderness areas in the country. The dense unfragmented multitiered woodlands, large grassy expanses and water bodies resulted in many ecotones and settings for the wildlife. The region was then only sparsely dotted by small and sleepy human habitations, including marginal agriculture with an aboriginal touch. The barasingha roamed these grasslands in large numbers, and had safe and unobstructed access to most of its habitats for

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its forages, breeding and parturition. Consequently, the large population of this deer, albeit fragmented, with good recruitments every year could survive the slow but sure onslaught of poaching and habitat loss due to encroachment for agriculture and altered land use patterns. In 1938, a census of this deer population was conducted in and around the present Kanha Core Zone which indicated that there were around three thousand animals.

Later, however, it appeared that the die was almost cast for this deer species. In spite of several existent Acts and Laws related to forest and wildlife protection, the wilds were under pressure of illegal hunting and poaching which was unfortunately increasing day by day. Wildlife habitats were subjected to illicit felling, encroachment, cattle grazing and fire. Shifting cultivation or slash and burn practice by the local tribes, specially the Baigas, was rampant. Large chunks of forest were clear-felled and meadows converted into agricultural lands in no time to grow marginal crops. Such lands were retained only for 3-4 years and abandoned again for new ones. Besides, such destruction was getting more and more mechanized and efficient. British forest officers were also exploiting these forests to the fullest. Sal trees were being cut down and transported for making railway sleepers. Around the time of our independence, a tremendous emphasis was being given on growing more food. Consequently, larger chunks of forestland were being brought under the plough and gun licenses granted generously to villagers for protecting their crops from herbivores. As the hard ground barasingha is said to have low self-preservation instincts and confiding nature, remaining close mostly to human habitations, it had to bear the brunt of this onslaught. The deer were continually hunted by villagers chiefly for its meat for consumption, though not greatly relished, and occasional sale of trophies. Wildlife classics on the natural history of this region of the country are replete with references to how this deer was snared, pursued, poisoned and killed by villagers. Fortunately, in the meantime, some Indian and British forest officers and naturalists closely acquainted with this region, were persuading the government to take some immediate measures for the conservation of wildlife. These measures included stringent enforcement of the existing Acts and Laws and declaring the potential wildlife areas as sanctuaries. The barasingha population was gradually sliding to the brink, and the MP govt. had to impose a ban on the hunting of this species in 1954. These measures, however, were too late to be effective and illegal hunting and poaching continued unabated, restricting the barasingha population only to the Kanha National Park where the population had declined to an all time low of a merely 66 animals in 1970. Its fate was almost sealed (Shukla, 2009).

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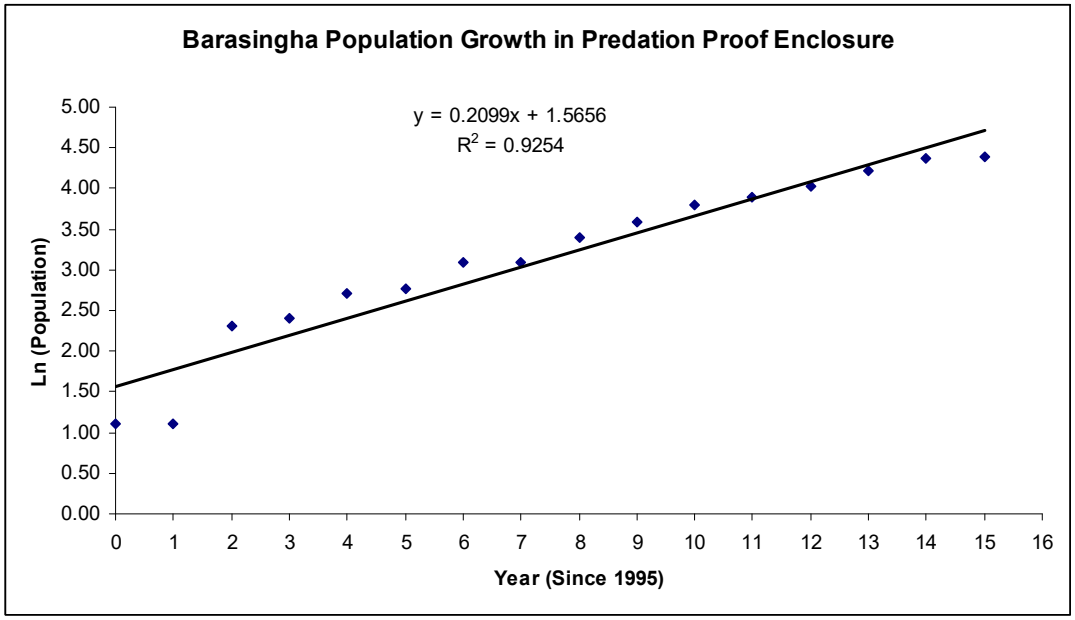
4.6 The Kanha Enclosure:

The steep decline of the hard ground barasingha population brought it into sharp national and international focus. In the above background, Kanha Management undertook comprehensive conservation measures to check this decrease and somehow stabilize the declining population. One such measure was the construction of an in-situ carnivore proof enclosure in the Kanha range. The enclosure was initially built way back in 1972 to ensure a safe multiplication of a founder population, and gradual release of animals into the wild. The area of this enclosure was 27 ha. and it encompassed a typical habitat of this species, with grassland, water bodies, small groves of sal, and wallows. As the enclosure was carnivore proof, the barasingha population grew steadily. During these years, animals used to be released into the wild by the Kanha Management. In 1995, a founder population of 3 animals, 1 male and 2 females was again kept in the enclosure. Naturally, in the absence of predation, the founder population multiplied and grew progressively. In 2006, however, it was felt that the enclosure was small for the growing population, and it was expanded to around 50 ha. The population increased steadily and reached 81, growing at around 21% per year.



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P critical	5.0%	Interactive Linear Regression With Excel Functions			
Regression Statistics					
r^2	0.925427	Move Slider to Adj Regr Start Yr		Move Slider to Adj Regr End Yr	
r^2 adjusted	0.920				
Standard Error	0.293672	Regr Start	0	Regr End	15
Observations	16				

Anova	DF	SS	MS	F	Signif of F
Regression	1	14.983	14.98343422	173.734745125	0.0000
Residuals	14	1.207	0.086243165		
Total	15	16.191			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	1.565553	0.1402083	11.165905	0.000	1.265	1.86627
Slope	0.209926	0.0159266	13.180848	0.000	0.17577	0.24409

	St Yr Offset	0		End Yr Offset	100
St	0	0	2		
End	15	15	17		

Trend Line Notes Calculations
1 +
Y=1.566+0.210X
Interactive Regression - Years: 0 to 15
r2= 0.93 - Sig of F test: 0.0%

SE_{slope}	0.015926593	0.140208304	$SE_{Intercept}$
r^2	0.925426697	0.293671866	SE_y
F	173.7347451	14	df
SS_{regr}	14.98343422	1.207404305	SS_{resid}

4.7 Concept of Small Populations:

Charles Darwin, while discussing about the phenomenon of extinction in his famous book "The Origin of Species by Means of Natural Selection; or, The Preservation of favoured Races in the Struggle for Life", has aptly written that ***"species generally become rare before they become extinct—to feel no surprise at the rarity of a species, and yet to marvel greatly when the species ceases to exist, is much the same as to admit that sickness in the individual is the forerunner of death—to feel no surprise at sickness, but, when the sick man dies, to wonder and to suspect that he died by some deed of violence".***

There are several endangered species the world over surviving in very small populations and facing the risk of extinction. Such small populations are being studied form the stand point of small population biology. The main objective of single species conservation is to reduce or delay the risk of the extinction of target populations. The first step in achieving so is to identify those factors that can potentially cause serious reverses or even extinction.

This is now a proven fact that if a population is declining and no managerial strategies are adopted to reverse the trend then extinction is imminent. However, even if small population is not declining, or even it is increasing, its fate is uncertain. Small populations are challenged by a number of limiting factors that increase the likelihood of the population going extinct simply because the population is small. Challenges to small populations can be categorized as intrinsic (random variations of genetic and demographic events within the population occurring without reference to environment events) or extrinsic (environmental

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events acting on the genetics and demography of a population). Demographic variation is the normal variation in the birth and death rates and sex ratio of populations caused by random differences among individuals in the population. The population can experience fluctuations in size simply by these random differences in individual reproduction or survival. These randomly caused fluctuations can be severe enough to cause the population to go extinct.

Similar consequence could result from the coincidental effects of high death rates or low birth rates. However, these risks are practically negligible in large populations. In general, the effect of any one individual on the overall population trend is significantly less in large populations than small populations. As a result, demographic variation is a relatively minor challenge in all but very small populations (Ballou, 1995). A more significant extrinsic threat to small populations is environmental variation. Variation in environmental conditions clearly influences the ability of a population to reproduce and survive. Populations susceptible to environmental variation fluctuate in size more than less susceptible populations, increasing the danger of decline/ extinction.

The hard ground barasingha is not only an endangered deer species, its being the only world population endemic to the Kanha Core Zone also makes it a very significant conservational cause in India and the world as well. This tremendously adds to the constant need to develop new perspectives and practical approaches to prevent its decline/ extinction and reintegrate the population into the Kanha ecosystem. In order to successfully manage such a critical population under restricted conditions imposed by various biotic, environmental and complex genetic factors, traditionally applied measures and understandings are not comprehensive enough to address critical threats to the existing population. In this way, it is high time to take a fresh look at this species from the standpoint of the small population biology, and apply the basics to the scientific management of the barasingha in the Kanha Core Zone.

Currently, there are 475 barasingha in the Core Zone. The combined sex and age class structure of this population (September, 2010) is given below:

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Range	Patrolling Camp	Habitat	Male	Female	Fawn	Total
Mukki	Bisanpura	Bisanpura Meadow	10	14	4	**28**
	Sondar	Sondar Meadow	18	33	10	**61**
	Orai	Orai Meadow	14	21	5	**40**
	Ghorella	Khurd Meadow	6	10	3	**19**
Sarhi	Sonf-I	Sonf-I Meadow	13	63	24	**100**
	Ronda	Ronda Meadow	18	36	9	**63**
B'ghat	Ronda	Ronda Meadow		2		**2**
	Adwar	Adwar Meadow	2	7	1	**10**
Supkhar	Ladua	Ladua Meadow	4	6	1	**11**
	Budelabehra	Budelabehra Meadow	2	3		**5**
	Budelabehra	Katrakhol Meadow	3	3	2	**8**
	Chakarwah	Kashiplot Meadow	1	6		**7**
Kisli	Kisli	Chuppe Meadow	1	1	1	**3**
Kanha	Kanha	Kanha Meadow	11	21	5	**37**
		Barasingha Fencing	26	25	30	**81**
	Total:		**129**	**251**	**95**	**475**

4.8 Metapopulations in the Core Zone:

Three geographically and reproductively isolated metapopulation groups of the branderi barasingha have been identified in the Kanha Core Zone (Gopal, 1995). All these metapopulations themselves consist of several interacting sub-populations or "population patches". The movement patterns and periodic distribution of these sub-patches depend upon the availability of food and water, breeding season and parturition and postnatal care by the females in suitable areas.

Indicative metapopulation structures of barasingha in the Core Zone are shown as under:

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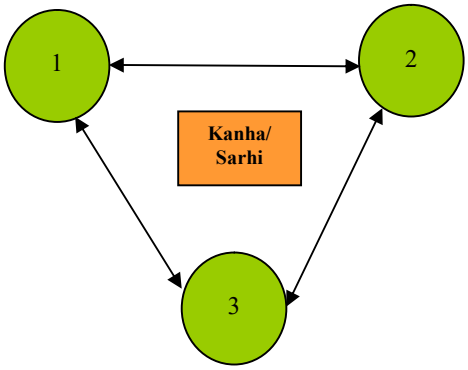
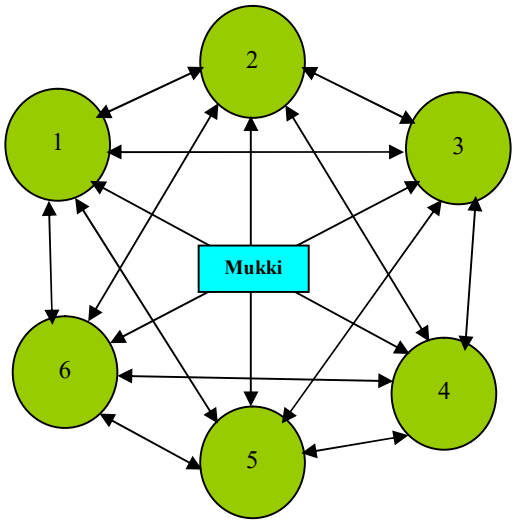
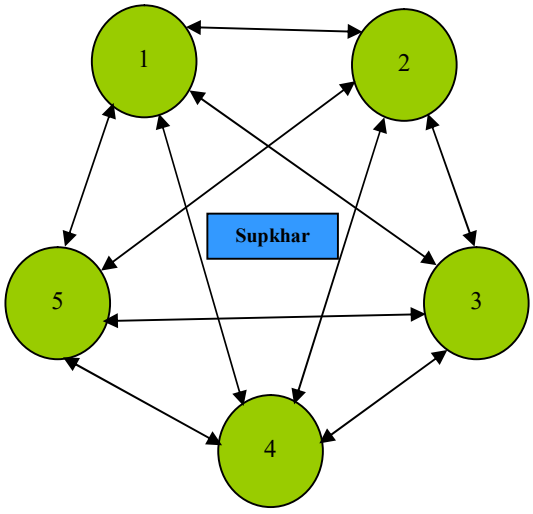
Metapopulations (Indicative) of Barasingha in the Core Zone



Kanha/Sarhi	
1	Ronda
2	Sonf-I
3	Urnakhero



Mukki	
1	Orai
2	Ghorela
3	Shringarpur
4	Sondar
5	Baiganala
6	Bisanpura



Supkhar	
1	Baspehra
2	Jatadabra
3	Ladua
4	Katrakhol
5	Budelabehra

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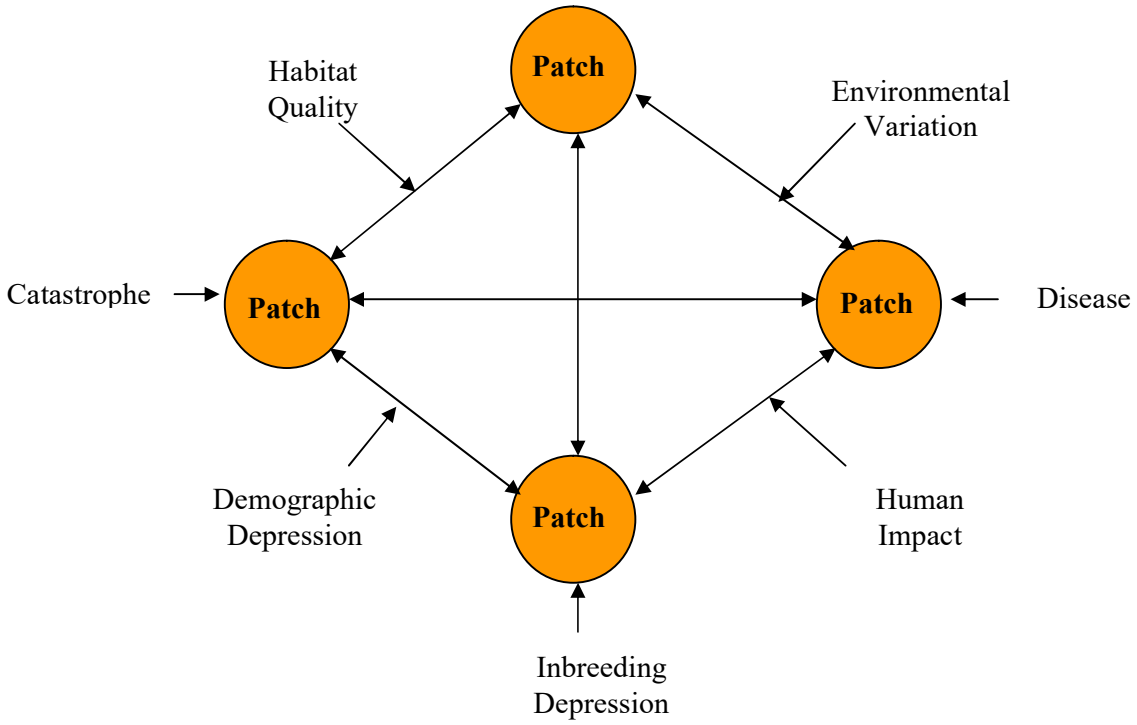
As the overall population of the barasingha in the Kanha Core Zone is relatively small, a proper understanding of the dynamics of these three metapopulations has become very important for evolving/ changing conservation strategies. Apart from general wildlife conservation practices carried out for the entire Kanha ecosystem, the management of the hard ground barasingha in the Core Zone should also be viewed from the standpoint of the metapopulation structures.

Metapopulations



(From Ballou, 1995)

The Interaction between population "patches" results in a metapopulation structure. When there are several interacting populations, and the dynamics of any single population is affected by the dynamics of the other due to movement, the group of interacting populations is called a metapopulation. In other words, the metapopulation system is a group of sub-populations or "patches" of different sizes and separated from one another by varying distances. The most important consideration here is patch extinction between patches. The management must consider the spatial distribution of patches and its effect on correlated extinctions and recolonization between patches (Ballou, 1995).

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Spatial distribution between patches is important managerially, since the probability of extinction of any one patch should not be correlated with the other, otherwise the entire metapopulation may become extinct. On the other hand, spatial distribution affects recolonization rates between patches, viz. the closer the patches one to one another, the higher the probability of a patch being recolonized from a nearby patch.

In small population biology, patch extinction and recolonization also affect the retention of genetic diversity in the metapopulation. Isolated, small populations lose genetic diversity rapidly. However, repeated migration between patches increases gene flow and ensures genetic diversity.

The genome of the central Indian barasingha has been analyzed, and a high level of genetic homogeneity has been observed from the limited number of DNA samples (Sher Ali et. al., 1998). Therefore it is imperative to maintain the hard ground barasingha as populations distributed over several patches, as in the long run this is safer than keeping one population at a single site. Management interventions should not only facilitate gene flow between such patches, but also has to take care that various metapopulations and their patches are not prone to same kind of threats.

All the three metapopulations of barasingha follow the typical Model, and the sub-populations are dynamic moving from one site to another. The Park Management has to ensure that the migration between the sub-populations remains dynamic throughout the year, so that a drop in the migration rate may not result in the permanent extinction of local populations across the range of the metapopulation structure. As the metapopulations are monitored daily, the Park Management has to meticulously ensure that the dispersal/ migratory routes between the sub-populations remain unobstructed. Every precaution should be taken that no development inputs such as fences, tanks and roads in the park should disturb smooth dynamics between the sub-populations. This is further facilitated by identifying potential dispersal routes, and develop the same for managing the metapopulations.

More efforts have to be made to acquire a deep understanding of these metapopulation dynamics and restoration of lost habitat and dispersal routes. Further habitat fragmentation

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may sometimes have the effect of changing a large, continuous population into a metapopulation in which small, temporary populations occupy habitat fragments. When population size within each fragment is small and the rate of migration among fragments is low, populations within each fragment will gradually go extinct and recolonization will not occur.

4.9 Expanding Dispersal of the Barasingha:

Commendable protection and special habitat improvement measures for the barasingha in the past so many years, however, have also held a bearing on its distribution within the National Park. Till around 1992, no barasingha was seen in the central meadows of the Kanha range. The entire metapopulation was restricted to the Sonf meadow (now in the Sarhi range) and its surroundings, and almost no movement of animals was recorded between Sonf and central meadows. By 2003, not only a few animals started being seen in the central meadows, fawning was also reported in these areas. The free ranging population of the central meadows of Kanha rose gradually and reached around 35 in 2010 (May). As stated above, this exchange between the two habitats is very encouraging and indicative of expanding dispersal of population. Further, in the past, these cervids were never seen in the main meadows of Kisli and Indri of the Kisli range. Presently, however, a few animals are also sighted in these meadows in the winter. These animals traverse from the Sonf meadow to Kisli through the Digdola area. Similarly, the Supkhar metapopulation also started picking up, though very slowly. Currently, there are around 40 animals, distributed in various habitats. The Bhaisanghat range, till only a few years back, never supported barasingha, and no animal used to be reported from this range. Now a few animals have been reported from Lanjhiabehra, and areas near the Balda patrolling camp and in the Ronda clearings. These animals have broken away from the Supkhar population and, traversing through Otesarra and Ronda, have established themselves in and around Lanjhiabehra.

4.10 Low Growth Rate:

Increase in barasingha population in the Core Zone has been very slow for the past several years. There is no abnormality in this trend, and is also a characteristic of a small population. There are, however, several views and perspectives on this plateau population. There are opinions that the prime habitats of the barasingha have deteriorated over the years and the

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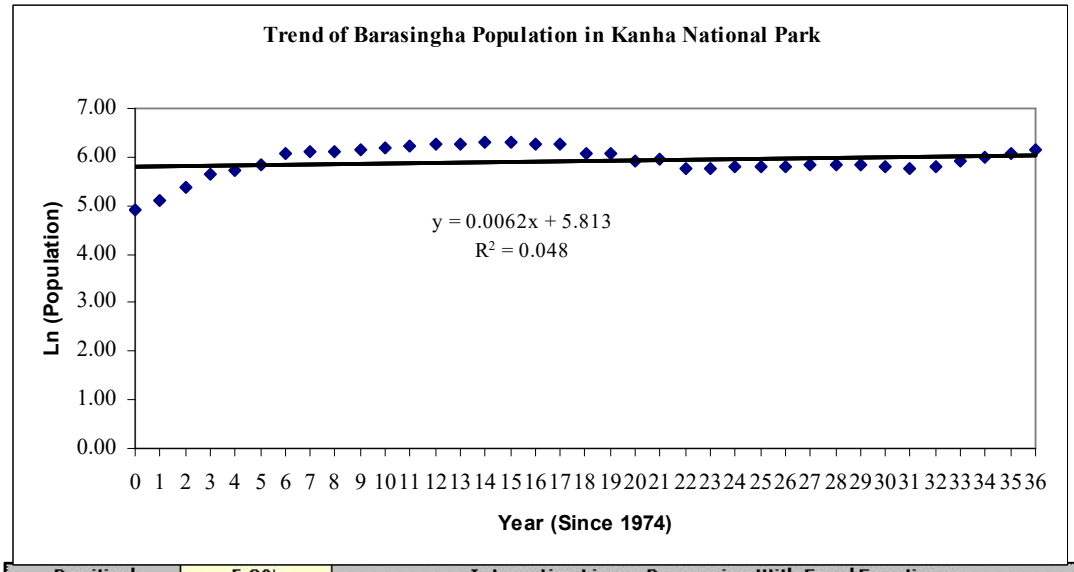
composition of grassland communities have changed, with growth of weeds and unpalatable grasses, and this has contained the population. Besides, the species also requires tall grass cover at the time of parturition for rearing the fawns, protecting them specially from small carnivores like jackals. These grasslands have been under severe grazing pressure of ungulates and past arbitrary burning practices and have consequently degraded, losing most tall grass cover. Another important view is that this population is also predation regulated, and has consequently more or less stabilized. The regression analysis shows that the overall annual average growth rate of the species between 1974 and 2010 in the Core Zone is below 1%.



P critical	5.0%	Interactive Linear Regression With Excel Functions				
Regression Statistics						
r^2	0.047977		Move Slider to Adj Regr Start Yr		Move Slider to Adj Regr End Yr	
r^2 adjusted	0.021					
Standard Error	0.305513		Regr Start	1974	Regr End	2010
Observations	37					
Anova	DF	SS	MS	F	Signif of F	
Regression	1	0.165	0.164631182	1.763818444	0.1927	
Residuals	35	3.267	0.093337941			
Total	36	3.431				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-6.519472	9.3706862	-0.695730	0.491	-25.543	12.50403
Slope	0.006247	0.0047041	1.328088	0.193	-0.00330	0.01580

	St Yr Offset	0		End Yr Offset	100
St	1974	1974	2		
End	2010	2010	38		

Trend Line Notes Calculations		
1	+	
Y=-6.519+0.006X		
Interactive Regression - Years: 1974 to 2010		
r2= 0.05 - Sig of F test: 19.3%		

LINEST Results			
Slope	*0.00624745*	-6.519472	*Intercept*
SE_{slope}	0.004704092	9.370686169	$SE_{intercept}$
r^2	0.04797702	0.305512588	SE_y
F	1.763818444	35	*df*
SS_{regr}	0.164631182	3.26682794	SS_{resid}

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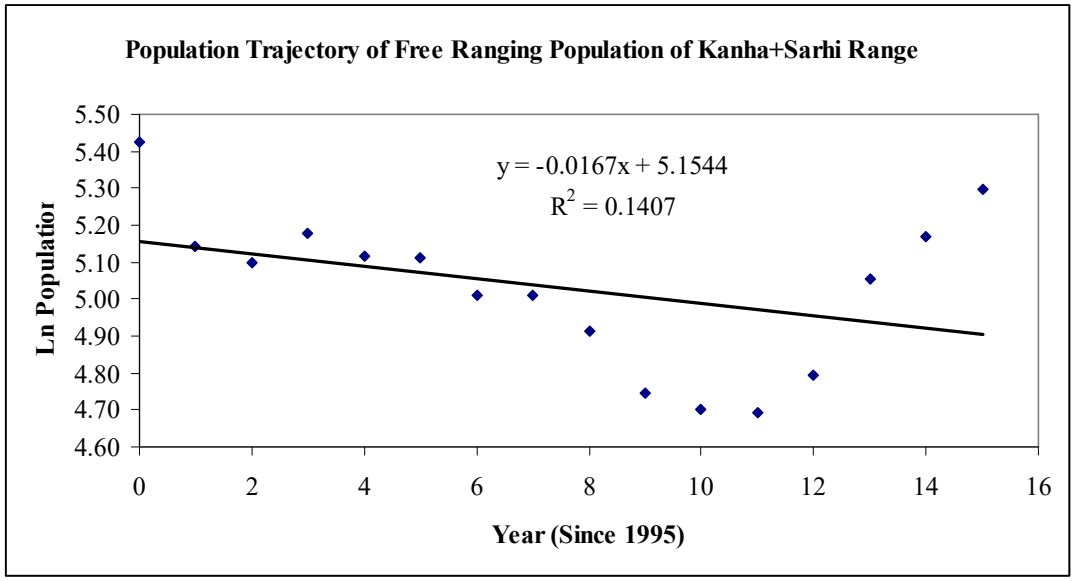
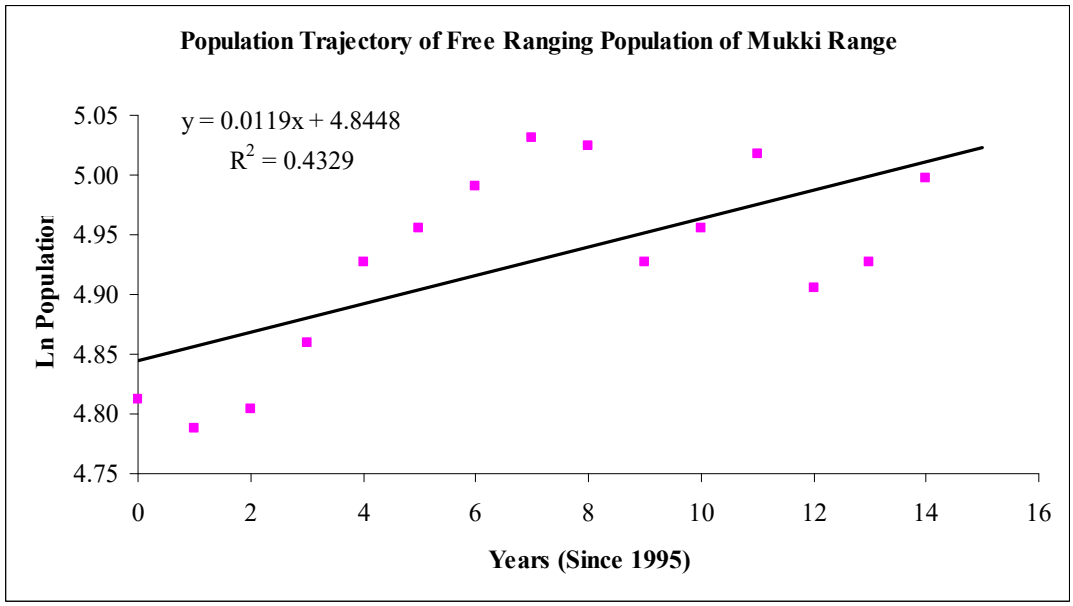
The regression analysis (1995 to 2010) of the free-ranging populations of the Kanha and Mukki ranges are as under. While the Kanha-Sarhi population shows an overall annual growth rate of -1.67%, the Mukki populations shows that of 1.19%.





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4.11 Threats to the Barasingha Population:

The barasingha populations in Kanha Core Zone face the following threats to their survival:

4.11.1 **Problems in In-Situ Enclosure:** While the barasingha enclosure had proved very effective over all these years for the management of this small population, the Park Management was faced with some new problems/ concerns. As the enclosed area had undergone chronic grazing pressure for the past many years, it resulted in the typical degradation of most part of the *in-situ* habitat, including infestation of weed and unpalatable species, specially *Desmostachya bipinnata*. Besides, visiting veterinarians and the findings of past post-mortems of some of these animals also floated a view that the restricted and unburnt area of the barasingha enclosure had resulted in the infestation of ticks, fleas, mites and manges in the enclosed grasslands. As per wildlife veterinarians, these ectoparasites troubled these animals immensely, causing dermatitis, alopecia, and were also contributory factors to anemia. The postmortems of some dead animals also showed the presence of *Haemonchus* and *Strongyloides* spp. in their bodies. *Haemonchus* spp. is bloodsucking internal parasites found in the abomasums, the 4th compartment of the stomach of the barasingha, a ruminant. This pathogen causes acute anemia. *Strongyloides* spp. occurs in the rumen and, besides making it anemic, it also causes nutritional deficiency in this species. Some adult animals of this enclosure had fallen prey to these parasitic infections and had become weak. It was also practically not possible to burn the enclosed small grassland to rid of these parasites. While the growth of this founder population, a very small stock, was never considered from the standpoint of genetics, specially inbreeding depression, a specialized field well outside the sphere of the Kanha Management, this phenomenon might also have been causing some problems.

4.11.2 **Predation Regulated Population:** The free-ranging populations of the barasingha in the wild are predation regulated. A comparative study of the rates of annual growth of the enclosed and free-ranging populations clearly suggests this. Besides larger carnivores, the jackal has also been observed to prey upon the fawns of barasingha. Many instances of jackals intruding into the aggregations and fawning sites of the barasingha, and killing/ carrying off with the fawns have been recorded. Due to this reason, recruitment to the populations in the wild is also very low as a large

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percentage of newborns fall prey to scavengers. This selective predation by the jackal is also a serious problem in the management of this small population. Though the chital population acts as a buffer species for the barasingha, and accounts for the highest percentage of predation by the carnivores, the predation pressure only adds to the already vulnerable barasingha population.

4.11.3 **Sympatric Competition:** Due to excellent conservational and developmental inputs, and a high degree of protection under Project Tiger, there has been a tremendous increase in the herbivore population, specially the chital, in the Core Zone. The total population of the chital at present is around 25,000. In the Kanha Range itself, there are around 10000 chital. Such steadily large population of chital has led to a sympatric competition with the barasingha. The question of competitive exploitation becomes crucial when a highly endangered species is involved. Observations in the National Park suggest that there is a pronounced overlap in the grass diet of both the species. As the chital is less selective in its dietary preference, it may also switch to browsing in summer when the grass cover turns dry. However, the tall grass cover habitats have been observed to reduce the competition by fostering segregation between the two species.

4.11.4 **Highly Specialized Niche:** The branderi barasingha is a food specialist and has a highly specialized niche. It is basically a graminivorous species and feeds on a small range of grass species. This specialized niche has rendered the species highly susceptible to niche availability.

4.11.5 **Degradation of Grasslands/ Fawning Cover:** The species also requires high grass cover at the time of parturition for rearing the fawns. The grasslands/ meadows of the Kanha Core Zone are mainly old village settlements now relocated outside the park. These meadows have been maintained very assiduously and methodically for a long time to sustain the grazing herbivores. Due to excellent conservational/ developmental inputs under Project Tiger, there has been a steady increase in the population of herbivores. The increased population, along with hilly topography surrounding such areas, has resulted in severe grazing pressure on these grasslands leading gradually to their degradation. As already mentioned, woody species from the periphery are also invading these grasslands.

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4.11.6 **Restricted Distribution within the Park:** The populations of the hard ground barasingha are restricted to several pockets of the Core Zone, which harbour suitable habitat conditions for the species. As no significant migratory tendency over long distances in a short time has been observed, the populations become highly prone to resident predators and limiting factors of habitats.

4.11.7 **Low Self-preservative Instincts:** Based on field experiences, the inference has been drawn that the species has relatively low self-preservative instinct against predators. To quote AA Dunbar Brander "compared with most animals they are tame and confiding, and are lacking in the instincts of self-preservation when hunted. If stalked and charged by a tiger they only move a short distance, and get stalked and charged again. Owing to the country they live in, enabling one often to see them at great distance, and also permitting one to approach closely without disclosing one's presence, no animal gives the field naturalist more opportunities observing his habits". George Schaller (1967) believed that the inference regarding inability in self-preservation is not correct. However, the anti-predatory behaviour of the barasingha in the Core Zone has been observed as typical of the species, and could also be attributed to its high predation.

4.11.8 **Catastrophes:** Natural catastrophes such as fatal epidemic, drought like conditions affecting grasslands, scarcity of water, and fire, specially during pinch period, may cause dramatic fluctuations in the population levels of the barasingha in the Core Zone. While Brucellosis, suggested by Schaller (1967) as one of the main causes of the decline of barasingha, has clearly been ruled out, these anthropogenic grasslands may pose threats of fetal epidemics due to their long pastoral history. The barasingha, however, should be considered as relatively resistant to common diseases prevalent in livestock, since no such epidemic has been reported in the species so far.

4.12 Timeline in Barasingha Conservation:

Barasinha conservation in the Kanha Core Zone has now acquired a tremendous significance in wildlife conservation in India. Some important events in the timeline of barasingha conservation in the Kanha Core Zone are as under:

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1889	Captain James Forsyth's account of barasingha in "The Highlands of Central India".
1923	AA Dunbar Brander's "The Wild Animals of Central India" brought attention to the status of the deer.
1933	Banjar valley notified as a Sanctuary (233 sq km).
1935	Halon valley declared a Sanctuary (around 400 sq. km.).
1938	A departmental census estimated the population of barasingha at 3038 in and around the present Kanha.
1954	The govt. imposed a ban on barasingha hunting in the state.
1955	Kanha declared a National Park.
Late 1950s	The barasingha wiped out from the Supkhar area.
1964	Tiger baiting started in the Kanha meadows, another likely cause of depletion.
1965	Population estimated at around 100.
1969	Relocation of Sonf forest village for additional habitat, and cattle grazing stopped in some grasslands.
1969	Tiger baiting site shifted in favour of the barasingha.
1969	IUCN sent a team of international experts to study the barasingha problem.
1970	A sharp decline in population, with only 66 animals, and the construction of an *in-situ* enclosure for the safe multiplication of this cervid.
1972	Besides five barasingha, a few chital and blackbucks also introduced into the enclosure.
1973	Kanha notified as a Tiger Reserve.
1974	Supkhar range declared a sanctuary, merged with the National Park.
1981	Reintroduction of 8 barasingha into the Supkhar range, one of them later died.
1982	Abortive attempt to translocate 12 barasingha into the Bandhavgarh National Park, all but one died in Kanha
1982	Translocation of 8 barasingha into the Supkhar range, 4 of them died a few days later.
1990	Translocation of 8 barasingha into the Supkhar range, 2 of them died during the operation.
1993	Daily monitoring strengthened.
1995	Special biological and ecological studies concluded.

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1999	Comprehensive monitoring started.
2007	The Kanha *in-situ* enclosure expanded to around 50 hectares.
2010	*In-situ* population released from the Kanha enclosure.
2011	A founder population of 7 animals (2 males & 5 females) introduced into the *in-situ* enclosure.

CHAPTER – 5

LAND USE PATTERNS & MANAGEMENT ISSUES

5.1 Introduction:

Land use classification is actually a systematic categorization providing information on land cover, and the types of human activity involved in land use. Land use classification is defined as the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it. In this way, the definition of land use establishes a direct link between land cover and the activities of people in their environment.

5.2 Land Use Patterns:

The entire protected area has been a National Park and Reserved Forest since 1955 and 1976 with all the legal bindings/ provisions envisaged in the Wildlife (Protection) Act, 1972 (as amended upto 2006) and the Wildlife (Protection) Madhya Pradesh Rules, 1974, and there is no question of any major anthropogenic changes in the land use dynamics. While forest, grassland and water constitute the major land cover classes in the Core Zone, conservation initiatives and managerial inputs over all these years have created some land use classes in the protected area. There are still 17 forest villages with their settlements and cultivation lands in the National Park. Besides, artificial water bodies **(Appendix-23)** and natural rivers and streams **(Appendix-24)** along with all types of buildings **(Appendix-25)** may also be technically classified as land use classes in the Core Zone. In this way, the entire landscape of the National Park can be classified into the following land use classes:

5.2.1 **Grassland:** While grasslands are generally categorized as a land cover rather than a land use class, in the Core Zone these grasslands have been subject to intensive managerial interventions for the past many years. These grasslands/ meadows have actually been "arrested" in ecological succession for the benefit of wild ungulates.

5.2.2 **Forest Village Settlement:** The settlements of 17 forest villages consist of huts, cowsheds, barns and other temporary structures.

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5.2.3 **Cultivation Land:** The cultivation lands of forest villages are agricultural fields, orchards, and patches of vegetables and marginal produce.

5.2.4 **Building:** This land use class covers all official and residential buildings, including offices, patrolling camps, forest rest houses, and interpretation complex etc.

5.2.5 **Civil Structure:** This includes all concretized/ masonry structures such as anicuts, bridges, culverts, wells, saucers etc.

5.3 Socio-Economic Profile of Villages:

Presently, of the 17 forest villages (Jami already relocated) located in the National Park, 7 forest villages fall within the Critical Tiger Habitat. The Park Management has already proposed to relocate all these 7 forest villages outside the Core Zone under the new Relocation Policy, and villagers have also given their consent. The remaining 10 villages of the National Park (outside the CTH) will either be pushed into the Buffer Zone by redrawing the boundary of the National Park or be relocated outside. The majority of the villagers (almost 65%) belong to the Scheduled Tribe, mainly the Gonds and the Baigas. Given the background of these forest villages, including illiteracy and the constraint of being far away from the mainstream of development, they are all socially backward and very poor. The villagers depend solely upon marginal agricultural, and each family of these forest villages was allotted 2.5 ha. of land as per Section 28 of the Indian Forest Act, 1927 and under the MP Forest Village Rules of 1977 for marginal cultivation as their main livelihood. All these cultivable lands depend essentially on rains and produce marginal crops. There is no irrigation facility, and a failed monsoon or erratic rains can seriously upset their harvests. Besides, the typical defective animal husbandry practice is a common sight in these forest villages. Most of the domesticated livestock is unproductive, and depends completely on the vegetal biomass of the forest compartments earmarked for grazing. Whenever possible, the villagers also find employment as daily labourers in the various managerial/ development works of the Core Zone, Buffer Zone and *Panchyats* to supplement their income. The villagers have gradually come to terms with the reality that unless they move out of the National Park and resettle outside there will not be any substantial opportunity for their social and economic development. The information on the forest villages of Kanha National Park is as under:

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Range	Forest Village	No. of Families	Total Population	Land (In ha.)
Sarhi	Bhilwani Cluster	351	1902	562.010
Sarhi	Jhapul	72	349	294.611
Sarhi	Kariwah	23	111	75.271
Bhaisanghat	Dhaniajhor	43	255	195.612
Bhaisanghat	Kadla	93	491	185.747
Supkhar	Patua	162	744	281.969
Supkhar	Chhatarpur	165	414	143.662
Supkhar	Ranwahi	79	167	187.703
Supkhar	Janglikheda	33	202	53.002
Mukki	Mukki	91	626	277.612
Bhaisanghat	Jholar	90	555	312.012
Bhaisanghat	Ajanpur	100	643	574.653
Bhaisanghat	Sukdi	92	605	508.068
Supkhar	Bithli	55	242	152.561
Supkhar	Benda	26	170	184.950
Supkhar	Linga	54	300	243.621
Supkhar	Rol	31	220	140.423

5.4 Resource Dependence of Villages:

The National Park with 17 forest villages located inside presents a typical scenario of the dependence of forest villages on a protected area. As the villagers have remained isolated from the mainstream of progress and improvement for so many years, the lack of special facilities, traditional cultivation practices, deprivation, and poverty have a strong bearing on their continued dependence on the forest resources of the Core Zone. They all depend on forest resources for every conceivable produce. While the Park Management ensures that the villagers and their cattle do not use the forest resources lying outside the forest compartments allotted to them for *nistar* (bonafide use), the decadal population growth does make a perceptible impact in the vicinity of these settlements. Besides the collection of fuel wood, and poles for construction, grazing by livestock, the villagers also try their best to partake of most available minor forest produces, including mahua, aonla, tendu and mahul leaves, and

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barks of different species. However restricted the dependence on forest resources may be, the signs of this impact become visible sooner or later in a protected area. In spite of stringent protection and confidence building measures/ persuasions, the villagers miss no opportunity of sneaking into the Core Zone to collect whatever they can lay their hands on. Such villagers can find the salability of fallen antlers, honey, parakeets, and resin etc. somewhere or other. In this way, population pressures of both human as well as cattle in the National Park tend to dislocate the linkage between the local people and the wilderness. Consequently, this may culminate in the overuse and abuse of the wildlife ecosystem.

5.5 Human-Wildlife Conflicts:

It is not very common in the Core Zone, nevertheless it is an issue the Park Management never disregards, and takes swift action to control the situation arising out of such incidents. As stated above, the villages in the protected area are dependent upon forest resources to some extent. This dependence is actually also responsible for conflicts for space and resources between man and animal. Generally, these conflicts take place under two situations. The villagers intrude into the Core Zone for collecting kindling/ fuel wood, minor forest produce or grazing their cattle illegally, sometimes in the most unearthly hours of morning, and get killed or sustain serious injuries. Tigers and leopards have large home ranges, and they at times stray into habitations inadvertently, or for easy preys, and run into villagers, killing them instantly or injuring seriously. Crop depredations by ungulates in the National Park and around the periphery also sometimes pose serious interface problems. In short, on the one hand, these conflicts result in the loss of human lives and serious injuries, and on the other, in revengeful killings of wildlife by poisoning, snaring and trapping etc.

Sloth bears are the most unpredictable animals and can often charge unprovoked. The Core Zone has a good population of this species, and over the years they have mauled several people seriously, including some frontline employees of the protected area. Tigers have also killed several people under the same circumstances. Sometimes people have tried to drive tigers away from their kills, startling the animals and getting themselves killed. Leopards also operate in the vicinity of villages for small-sized prey such as goats and dogs. They have also attacked small boys and girls, mistaking them for their natural quarries, specially in the darkness of late evenings when it was still early for people to stay indoors.

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Regardless of whose fault it is, these man-animal conflicts become a serious cause for concern for the Park Management. While the Park Management feels heartfelt grief for the affected family, such cases also trigger anti-park stand of the villagers. In these situations, the Park Management has to work overtime to console the family, make the prescribed ex-gratia payment at the earliest, and mollify the anti-park anger/ protests of the villagers at the same time **(Appendix-26)**. The Park Management also ensures to spread awareness about the inviolability of the Core Zone boundaries through public announcements (*munadis*) and distribution of pamphlets in the villages so that such instances of man-animal conflicts may be kept at minimum.

5.6 Assessments of Inputs of Line Agencies/ Other Departments:

The Park Management understands perfectly well the importance of cooperation and inputs from the district administration of the Mandla and Balaghat districts and other departments in effective wildlife conservation. The major inputs generally received from other departments are as under:

5.6.1 **District Administration:** Generally, the district administration plays a coordinating role between the Core Zone and various other departments to expedite and meet deadlines of important processes/ undertakings in the interest of the Core Zone. Besides, the district administration and the Park Management also work in close cooperation during the visits of State Guests and VIPs.

5.6.2 **Police Department:** The police also lend full support at the request of the Park Management in various eventualities. If required, they help park officers raid places and seize wildlife products, and also assist in the capture of absconded offenders. The role of police also becomes very important at the time of protests/ sit-ins staged by crowds against the Core Zone and government policies. At the district level, important intelligence relating to wildlife offences and offenders is also shared between the Park Management and police department.

5.6.3 **District Rural Development Agency (DRDA):** Sometimes the Park Management also requests the DRDA to allocate funds for some important field works in the Core Zone to supplement the budgets received from the NTCA, New Delhi and State Govt.

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The Core Zone has received funds from the DRDA, Mandla for wildlife and fire protection in the current financial year under the Mahatma Gandhi National Rural Employment Guarantee Act.

5.6.4 **Health Department:** The Core Zone has remotely located patrolling camps with staff and 17 forest villages with a population of around 8000 people. The Park Management also regards itself responsible for dealing with health related issues of its staff and villagers. At the request of the Park Management, the Mandla and Balaghat health departments have to play an important role to organize health camps in various places to treat staff and villagers. Besides, they also take swift medical action at the time of the outbreak of any epidemic etc. The department also recommends medicines for the first-aid boxes for the staff.

5.6.5 **Veterinary Department:** The Mandla and Balaghat veterinary departments play an important role in the vaccination/ immunization of the cattle of the forest villages located inside and those outside close to the periphery of the protected area. Besides, in emergencies, the veterinarians also conduct postmortems on wild animals. District veterinarians also support the Park Management at the time of the outbreak of any infectious disease in the livestock of any forest village.

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CHAPTER – 6

STATUS OF TIGERS, CO-PREDATORS & PREY BASE

6.1 Introduction:

The Kanha wildlife ecosystem supports a wide range of carnivore and herbivore populations that is naturally managed and regulated under more or less a well-defined predator-prey relationship. General response of these species to conservation practices in the Core Zone over the years has been encouraging, and their populations have registered a normal increase. Stringent protection and various management practices in the National Park have ensured a good prey base for three main species of carnivores, namely the tiger, leopard and wild dog. The carnivore species in turn successfully survive by strategic segregation and unique predation techniques.

6.2 New Methodology for Monitoring Habitats & Wildlife:

As stated earlier, a new methodology has been introduced to monitor wildlife habitats and wildlife populations in wildlife protected areas in the country. Status of tigers, co-predators and prey in India (NTCA & WII, 2008) outlines the following method based on a four-staged approach:

6.2.1 **Phase I - Spatial Mapping & Monitoring of tigers, prey and habitat:** For estimating the distribution, extent and relative abundances of tigers, other carnivores, and ungulates data were collected in simple formats on carnivore signs and ungulate sightings in forested areas of the region within each forest beat. Data were also recorded on indices of human disturbance and habitat parameters. Over 88,000 copies of the field guide for data collection were printed in nine regional languages and given to beat guards of all beats. Six regional workshops were conducted to train officials for field data collection. The trained forest officials in turn trained field staff by subsequent workshops. These constituted the Phase I data and were collected by the State Forest Department between November 2005 to March 2006. A total effort of 491,648 man days was expended to sample 460,920 km of carnivore sign survey

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walks and 184,368 km of transect walks. This probably constitutes an unpresidented effort for any wildlife survey conducted in the world. This stage consists of mapping:

- Tiger presence and relative abundance.
- Tiger prey presence and relative abundance and.
- Habitat quality and anthropogenic pressures at a high spatial resolution of 15-20 sq. km.

A forest beat (an administrative unit, 15-20 sq km in average size, delineated primarily on natural boundaries) was considered as the unit for sampling. Since each beat is allocated to a beat guard for patrolling and protection, the boundaries of a beat are well recognised by forest staff. The sampling was systematically distributed in all beats of potential tiger occupied forests (tiger reserves, revenue and reserve forests). Thus, in effect, the entire landscape where tigers are likely to occur is sampled (beats are not stratified or randomly sampled, but all beats were sampled as large human power was available for sampling). In forest areas, where beat boundaries are not delineated (< 20 per cent of tiger occupied forests in the country) such as the northeast 15-20 sq km sampling units were identified on the basis of natural boundaries (ridges, drainage, etc). The detailed methodological approach for sampling carnivore signs, ungulate encounter rates, pellet/dung counts, habitat and anthropogenic pressures are presented in the 'Field Guide'. The target data were extremely easy to collect did not require high level of technical skills or equipment. It is crucial that the forest department staff is primarily responsible for the data collection due to the sheer magnitude of the task involved. Furthermore, the involvement of the forest department staff instills ownership and accountability of this agency which is primarily responsible for the protection and management of wildlife resources. The forest department staff was trained in the data collection protocol. The spatial data generated was scientifically robust, amenable for statistical analysis and inference. Since several replicate surveys were taken in each beat, tiger occupancy, detection probability of tiger signs, and relative sign density could be modeled at a high spatial resolution (stratified on the basis of ecological characteristics, range or a superimposed grid of varying scale). Since the data was analysed in a GIS domain, several spatial and attribute data like human density, livestock density, road network,

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topographical features, forest type and cover, meteorological data, poaching pressures and landscape characteristics was used as covariates to model tiger occupancy and relative abundance in a landscape and individual forest patches. Time series analysis of the data at a larger spatial resolution is likely to have sufficient precision for monitoring spatial occupancy of tigers in association with changes in tiger prey, habitat quality and anthropogenic pressures. The issue of reporting inflated numbers by laying emphasis on animal signs instead of numbers has also been addressed to a large extent. Furthermore, the resolution of the data generated will be reduced to four-five categories (high, medium, low and absent). Several corroborating variables like prey encounter rates, pellet group counts and habitat condition will help in ensuring quality data; discrepancies in reporting were relatively easy to pinpoint. There was an audit mechanism in place to scrutinize the data collection, compilation and analysis. National and international experts acted as observers while officers in-charge ensured adherence to the prescribed protocol and transparency of protocol implementation. The system, once institutionalized and implemented, will not only serve to monitor tiger populations but will also monitor the status of other biodiversity resources of all tiger occupied landscapes, truly exemplifying the role of the tiger as a flagship. It will serve as an effective tool for decision makers, managers and conservationists alike and will help guide and plan land use policy at a landscape level.

6.2.2 **Phase II - Spatial & Attribute Data:** The spatial data that are likely to influence tiger occupancy of a landscape will be used for modeling in a GIS domain. The vegetation map, terrain model, night light satellite data, drainage, transportation network, forest cover, climate data, Normalised Difference Vegetation Index, livestock abundance, human density, socio-economic parameters, etc were used for modeling habitat condition and tiger occupancy. Beat-wise vegetation sampling was done to generate broad vegetation map. IRS (LISS3 and AWiFS), LANDSAT and AVHRR satellite data was used. Part of this component was done in collaboration with Forest Survey of India and Survey of India. This modeling helped in determining current spatial distribution of tigers, potential habitats, threats to crucial linkages between occupied landscapes and conservation planning. Digitized beat maps of Madhya-Pradesh, Andhra-Pradesh, Karnataka, and Tamil Nadu were used to spatially link the Phase I data in a Geographic Information System. In the absence of digitized beat maps, hand held Global Positioning System units were used in the remaining

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states for determining the beat locations. These were mapped and Phase I data of these states attached to these coordinates in a GIS.

6.2.3 **Phase III - Estimating the Population of Tigers & Its Prey:** Phase III of the methodology answers the question of how many tigers and ungulates are there. Teams of researchers were deployed in each landscape complex for estimating tiger density and ungulate densities within stratified sampling units. The double sampling approach was used by sampling the entire landscape for occupancy and relative abundance related indices along with other covariates (human disturbance and habitat quality – Phase I & II data) and a sub sample for estimating absolute density. Indices were then calibrated against known absolute densities for extrapolation in that landscape.

6.2.3.1 **Tiger Numbers:** Each landscape was stratified into tiger sign abundance classes of high, medium, low and no tiger sign at the beat and larger spatial resolution (100 km2). In each of these strata, within a landscape actual tiger density in 5 to 13 replicates of sufficient size (100-200 km2) was estimated. Remote camera traps were primarily depended upon to identify individual tigers based on stripe patterns, population estimates based on mark-recapture framework were done using CAPTURE, CARE 2 and Density 4. These densities were then extrapolated for the areas under various density classes within the landscape to arrive at a tiger population estimate. It is realized that these population estimates have high variances, but since these estimates are not be used for monitoring trends (which is proposed to be done through the site occupancy and relative abundance data), they should suffice the need for converting a relevant ecological index to a more comprehensible concept of numbers. The tiger population reported by us throughout the report are tigers above 1.5 years of age. Captures of cubs and juveniles for population and density estimation was not considered as this age group is under represented in camera trap studies.

6.2.3.2 **Tiger Prey:** Phase I of the protocol would be reporting encounter rates on line transects these would suffice for monitoring trends in ungulate population and site-specific occupancies as the same transects would be sampled during subsequent surveys. To convert encounter rates to density, an estimate of the effective strip width of these transects would be essential. The effective strip width of a transect primarily depends on the visibility (vegetation and terrain type), ability to detect ungulates by

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different observers and animal behaviour. Effective strip widths in different vegetation types of a landscape were modeled using double sampling technique, wherein a team of researchers sampled the beat transects in each habitat type using distance sampling technique. Pellet group counts on transects would serve as an index to the presence and relative abundance of ungulates. The entire process from conceptualization to implementation (Phase I to Phase III) was transparent and open to scrutiny by independent National and International Peers. A public debate was invited over email by the Tiger Task Force on the methodology which was also critiqued by International peers selected by the IUCN and the MoEF. Independent National and International observers participated in field data collection and compilation. This process of review greatly refined the methodology and data collection procedure.

6.2.4 **Phase IV - Intensive Monitoring of Source Populations:** It is proposed that source populations of tigers (tigers in tiger reserves and protected areas) in each tiger landscape complex be monitored intensively. The following methodology for this monitoring is proposed: *Photo registration of tigers:* Pictures of individual tigers obtained by camera traps or by regular cameras should be maintained in the form of a photo identity album. Records should be kept on the location, condition (breeding status, injury, etc) and associated tigers whenever a tiger is sighted. This will provide crude data on ranging patterns, demography and mortality. *Tiger pugmark and other signs:* Regular monitoring of tiger signs (pugmark tracings, plaster casts, etc) should be undertaken in every beat at a weekly interval with monthly compilation of data. With experience and exposure to the resident tigers and their pugmarks, the forest staff may be able to identify individual tigers from their track set characteristics. Sign surveys and individual tiger monitoring should become a regular task for every guard as was the practice some years ago and is currently practised in some tiger reserves. The monthly data should be mapped and maintained to analyze trends. *Monitoring by telemetry in select areas:* Use modern technology of VHF, GPS and satellite telemetry to study and monitor aspects of demography, metapopulationdynamics (dispersal, ranging patterns), mortality, predation ecology and behaviour. In all source populations, tiger abundance and density should be estimated using camera traps, digital images of pugmarks and/or DNA profile from non-invasive methods biannually.

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It was not possible to conduct a beat wise survey in all the forests of the North Eastern Hills Landscape and in the Sundarban Landscape. For the North Eastern Hills surveys were conducted in expedition mode based on supervised knowledge of tiger presence. This approach permitted us to use the data for mapping tiger occupancy but it was not possible to extrapolate tiger densities for the landscape from this data. Since Sunderbans is a unique and hostile tiger habitat, a separate protocol has been evolved for evaluating tiger, prey, and habitat status for the Sunderban landscape. Population estimates and detailed status report would be provided later as per the protocol. Herein we provide data on tiger distribution and occupancy of this landscape.

6.3 **Modeling Tiger Occupancy & Densities:**

The historical tiger distribution map was constructed for the past 150 years (before the commencement of Project Tiger) through a literature survey. A total of 140 records where mention of the tiger could be attributed to a geographical location were used for developing this map. Geographical locations mentioned in the literature were mapped to current districts in a GIS with a link to the referenced report. Data was compiled on tiger presence reported at the tehsil level for the past 5-6 years (1999-2004) through a questionnaire addressed to the Chief Wildlife Wardens of all tiger-states by the Project Tiger Directorate. Though several states had data on tiger numbers in some tehsils (especially in protected areas), only the reported presence of tiger(s) in the past six years were used to score a tehsil as "occupied by tigers" or not. Since tigers were unlikely to live outside of forests, forest cover map was superimposed on the tehsils occupied by tigers, and non forested areas were eliminated from further analysis. The tiger occupied tehsils were further divided into three groups, tehsils that had reported tigers (a) only for 1 year, (b) for 2-3 years and (c) for more than 3 years between 1999-2004. To compare the historical tiger distribution with the current tiger distribution, the information on current tiger distribution at the tehsil resolution was converted to the coarser scale of districts. The districts in which tigers have become locally extinct were marked (Figure 1.1). Tigers seem to have been preferentially exterminated from the Western and Northern population limits. The Western districts have dry thorn/deciduous forests with low productivity, while the Gangetic Plains have been heavily exploited for intensive agriculture.

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6.4 Distribution:

Considering the area of the Core Zone, it has good populations of some of the major ungulate species, and there exists a natural segregation amongst themselves on the basis of ecological niche partitioning that include food habits, habitat separation and specific ecological requirements. Nature has helped these species evolve different feeding strategies to reduce interspecific competitions. Body size and metabolic rates of different ungulate species also have to play an important role in this. Besides, in the National Park, geographic barriers and some prime areas have also resulted in creating several habitat pockets characterized by large aggregations of ungulates. Generally, valley meadows and undisturbed habitat mosaics of the Kanha and Sarhi ranges support such huge assemblages. Conversely, some ridges, rugged terrains and biotic pressure prone areas of the Bhaisanghat and Supkhar ranges sustain only small assemblages of herbivores. The distribution of carnivores, including the tiger-the main predator, and the leopard and wild dog-the co-predators, is also regulated by the presence and movements of these ungulate species.

6.5 Abundance Status:

The estimation of carnivore and herbivore species has always been considered a very important and serious field exercise. While the new methodology for wildlife estimation has replaced the old one, the Park Management does conduct the block counting exercise sometimes to have a grasp of the trends of ungulate populations in the Core Zone. After the declaration of the results of the 2010 estimation exercise by the National Tiger Conservation Authority, New Delhi in March, 2011, the MP Forest Department proposed to re-conduct the exercise in the Kanha landscape area to correct some past shortcomings. This exercise was undertaken in April, 2011, and the data are already with the Wildlife Institute of India, Dehradun for analysis. Now as the results are not expected before July, 2011, the figures of block counting estimation of July, 2010 are being used in this chapter. The population figure of the tiger for the Core Zone is from the 2006 all India wildlife estimation, while that of the leopard has been determined by the researchers of the Wildlife Institute of India, Dehradun to estimate densities by camera traps (effective trapping area 325 and 241.609 sq. km.). The range-wise population figures for different wildlife species in the Core Zone are as under:

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Animal Species	Kisli	Kanha	Sarhi	Mukki	Bhaisanghat	Supkhar	Total
Chital (*Cervus axis*)	4264	10184	4846	4820	257	1514	**25885**
Sambar (*Cervus unicolor*)	832	655	214	461	472	833	**3467**
Barking deer (*Muntiacus muntjak*)	177	191	97	201	247	211	**1124**
Barasingha (*Cervus duvauceli branderi*)	3	118	163	148	12	31	**475**
Blue bull (*Boselaphus tragocamelus*)	43	-	37	-	2	-	**82**
Chousingha (*Tetracerus quadricornis*)	21	42	14	9	21	39	**146**
Gaur / Indian Bison (*Bos gaurus*)	498	332	209	221	135	259	**1654**
Langur (*Presbytis entellus*)	1143	1299	349	706	519	1269	**5285**
Wild pig (*Sus scrofa*)	1370	1788	610	1281	1334	1357	**7740**
Sloth bear (*Melursus ursinus*)	29	35	12	21	19	35	**151**
Indian wild dog (*Cuon alpinus*)	53	112	42	27	45	73	**352**
Jackal (*Canis aureus*)	38	72	34	107	58	92	**401**
Tiger (*Panthera tigris*)	89 (Kanha Landscape: Excluding tiger cubs)						
Leopard (*Panthera pardus)*	78 (Kanha Landscape: Excluding leopard cubs)						

The seasonal sex ratios of the male and fawn per 100 females of different ungulate species are as under. Seasonal variations in the sex ratios are observed:

Range	Season	Chital		Sambar		Barasingha		Gaur	
		Male	Fawn	Male	Fawn	Male	Fawn	Male	Fawn
Kanha	Summer	48.42	28.74	61.34	34.43	37.55	15.24	53.23	26.34
	Rain	53.32	24.23	59.54	38.59	42.85	10.16	41.34	21.43
	Winter	51.25	23.57	46.39	29.43	52.15	35.15	32.43	19.42
Sarhi	Summer	45.39	25.68	62.13	35.13	35.87	18.35	55.24	27.84
	Rain	51.21	23.18	59.87	38.89	41.11	14.17	42.22	21.89
	Winter	49.59	21.62	47.59	29.67	55.35	33.95	31.42	18.42
Kisli	Summer	42.29	35.78	50.15	28.54	32.30	10.18	48.55	35.25
	Rain	52.21	40.85	45.25	32.45	39.42	8.35	34.52	28.19
	Winter	35.42	28.12	51.71	33.54	49.34	29.87	40.15	29.24
Mukki	Summer	31.90	13.49	52.15	31.85	38.35	18.29	57.10	25.80
	Rain	49.78	13.89	63.07	22.14	45.33	13.01	51.72	25.61
	Winter	45.52	17.99	65.85	32.83	54.45	39.37	43.06	23.10
Bhaisanghat	Summer	28.80	12.22	42.23	27.55	29.84	11.45	52.21	20.50
	Rain	40.21	15.77	48.11	20.75	38.70	8.07	48.34	23.45
	Winter	43.11	18.09	65.85	29.85	48.34	29.45	39.64	20.42
Supkhar	Summer	30.10	12.88	54.10	32.54	35.68	14.11	55.20	24.60
	Rain	48.25	12.05	65.58	24.64	41.01	9.78	52.48	25.89
	Winter	47.01	19.55	67.24	34.05	54.51	25.27	45.78	25.22

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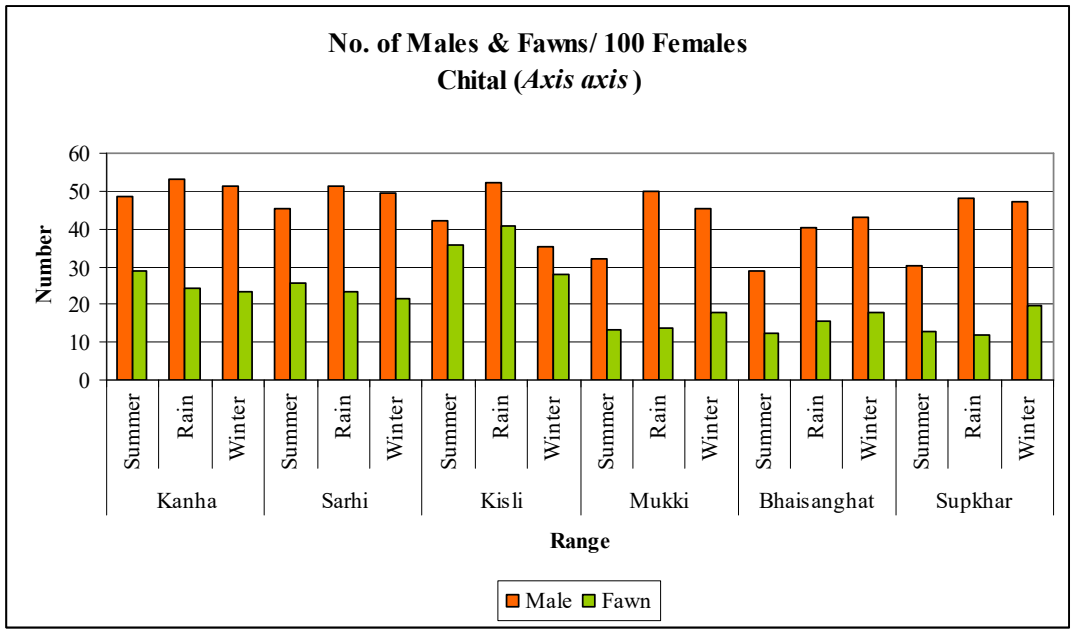

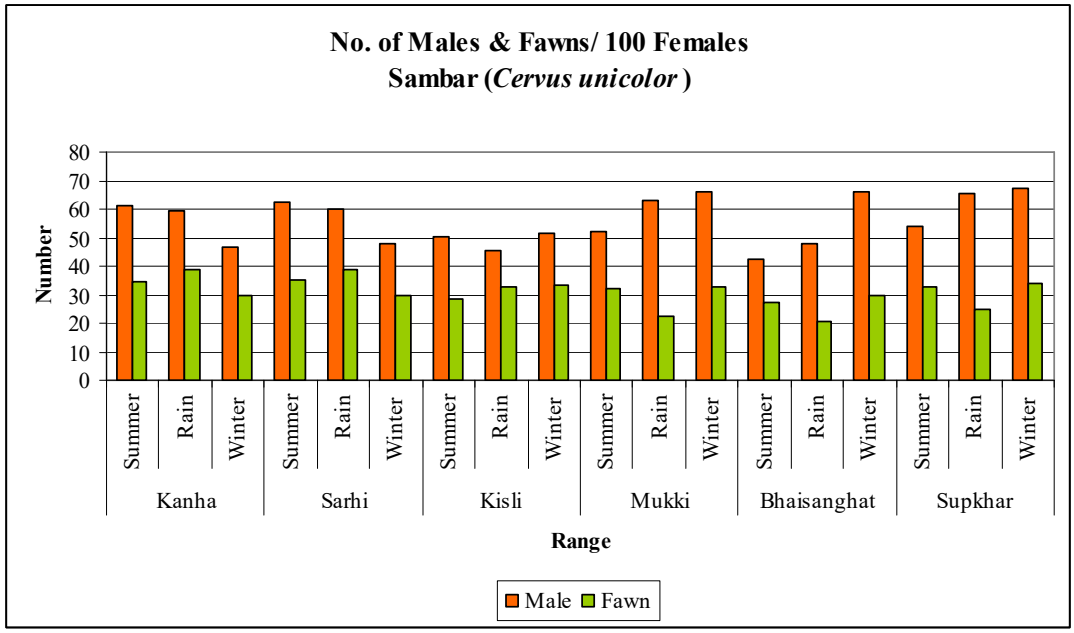

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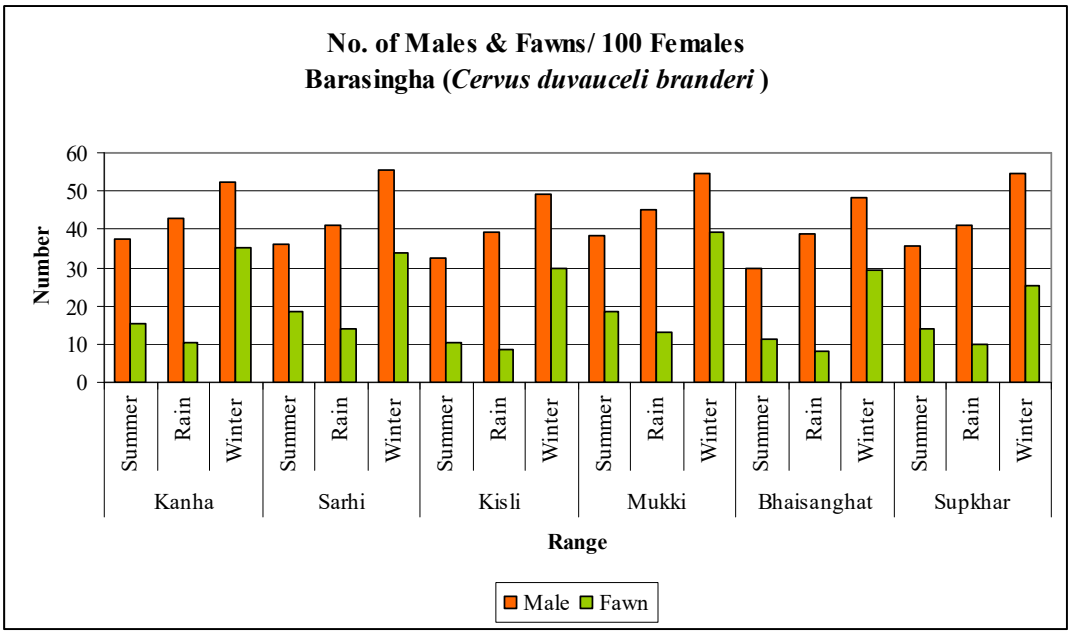

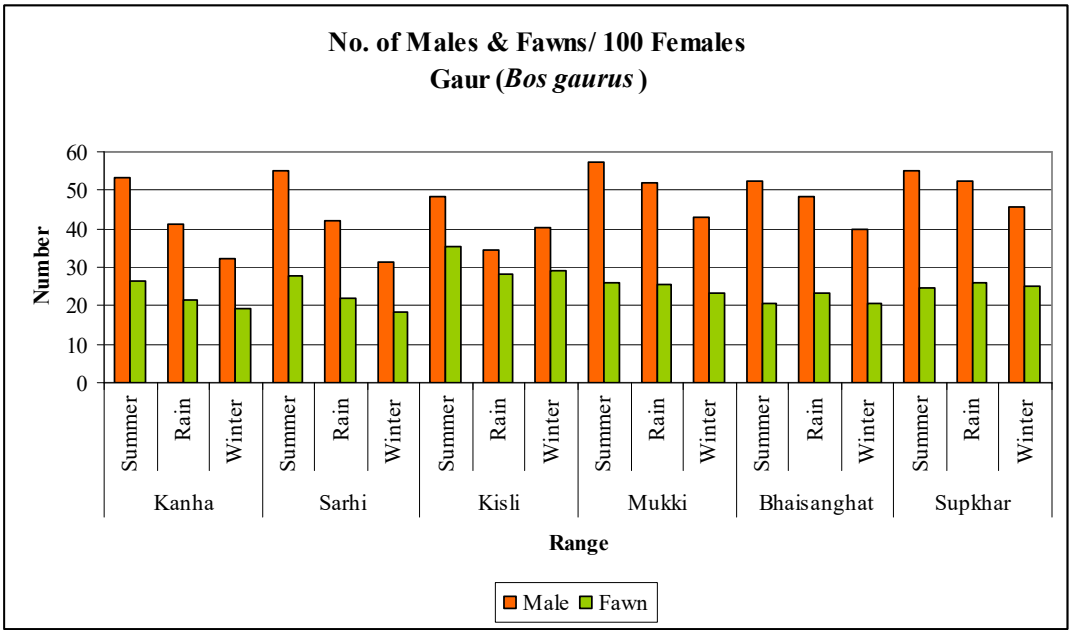

6.6 Results of Phase-IV Monitoring:

The researchers of the Wildlife Institute of India undertook monitoring under Phase-IV in collaboration with the Core Zone staff in 2011, and published the results in the document

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"Status of Tigers & their Prey in Kanha Tiger Reserve - Phase IV (2012)". The main objective was to obtain a minimum number of tigers in a Tiger Reserve but also to permit biologists to generate data for any in-depth statistical analysis including spatially explicit mark recapture analysis using SPACECAP or DENSITY software.

6.6.1 **Tiger Population Estimate:** Camera traps were deployed in 490 sq. km. and 150 sq. km. in Kisli, Sarhi- Kanha-Mukki (Kanha block) and Supkhar-Bhaisanghat (Supkhar block) respectively for capture mark recapture population estimation based on information generated through reconnaissance survey and through the interaction of local beat guard, a set of **89 pairs** of camera traps in Kisli-Sarhi Kanha-Mukki and **38 pairs** in Supkhar were deployed with one camera station in each 05 sq. km. grid cell **(Fig.1.1).** Camera traps were placed in a manner to maximize the chance of photo capture of tigers in that grid cell. Each camera trap location was recorded by hand held GPS and marked on the digitized map of Kanha Tiger Reserve. Camera trapping was done over a period of 37 and 40 days with an effort of 3293 and 1520 camera trap nights respectively in Kanha and Supkhar block. Annual capture-mark-recapture study is expected to result in the robust estimates of tiger densities, numbers and vital rates of this source tiger population (Pollock et al. 1990, Karanth et al. 2006).

Individual capture histories were constructed for all the identified individual tigers using a standard 'X matrix' format (Otis et al. 1978, Nichols, 1992). In the prescribed format for capture history, occurrence or capture of each individual during each occasion (one occasion for this study was a trap night) was recorded as '1' and its absence as '0'. Camera trap data for each session was subjected to close test (Stanely & Richards, 2005) to test for population closure. Population in the sampled area was estimated by sight-resight framework in software CAPTURE (Otis et al. 1978, Rexstad and Burnham 1991). We used the best model selected on the basis of highest discriminate score. In this we modelled capture probabilities by assessing the discriminant function model selection statistics for seven likely models (Otis et al. 1978) for tiger data: M_o (constant capture probability), M_h (capture probability heterogeneous among individuals), M_t (capture probability vary with sampling perios), M_b (capture probability vary with behaviour e.g. trap shy and trap happy), M_{bh} (behavioural response in capture probability with heterogeneity among individuals), M_{th} (capture probability affected by time and heterogeneity) and M_{tbh}

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(capture probability affected by secondary sampling period, trap response, and heterogeneity). We estimated the area effectively sampled ($\hat{A}$) as the convex polygon connecting the outermost camera traps plus a buffer area whose width ($\hat{w}$) is an estimate of half of the "mean maximum distance moved (1/2 MMDM)" by tigers captured on more than 1 occasion to estimate the buffer width (Wilson & Anderson, 1985). Non tiger habitat was removed from the density estimation by using mask file in a GIS domain using ArcGIS® 9.3.

The maximum likelihood spatially explicit capture recapture framework (MLSECR) executed in software DENSITY 4.4 (Efford, 2009) for estimating Tiger density was also used. MLSECR is a set of methods for estimating the density of an animal population from capture-recapture data collected with spatially defined an array of "detectors" ~ camera traps. In MLSECR, a model of the population and the detection process is fitted to the spatial detection histories. The resulting estimates of population density are unbiased by edge effects and incomplete detection.

6.7 Results:

6.7.1 **Population Estimation of tiger in Kanha-Kisli-Mukki-Sarhi Block:** Total 44 tigers have been captured and 3293 trap nights have been expended. Out of 44 identified individuals 12 males, 19 females and 13 unsexed were photographed, in addition to these 16 cubs that were less than 12 months have been also photographed. Density and population estimates for adult tigers (>1 year) are shown in **(Table 1.1).**

6.7.2 **Population Estimation of tiger in Supkhar-Bhaisanghat Block:** Total 13 tigers have been captured and 1520 trap nights have been expended. Out of 13 individuals 03 Males, 06 females and 04 unsexed have been photographed. In addition to this old cub (< 2 month) has been photographed. Density and population estimates for adult tigers (>1 year) are shown in **(Table 1.1)**.

6.7.3 **Population Estimation of tiger in Kanha Core Zone (Both blocks combined):** Fourteen males, 25 females, 17 unsexed adults and 17 cubs of less than 12 months have been photographed i.e. **total minimum population of 73 tigers** (including cubs) were photographed in Kanha Tiger Reserve. The Adult Tiger population in Kanha Tiger Reserve was estimated to be **61 (59-64 SE range). Adding the minimum no.**

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of cubs to the estimate given us a population estimate of 78 tiger in Kanha Tiger Reserve. Adult Tiger density was computed using half mmdm to be 7.2 (0.55 SE) in Kanha and 3.2 (0.5 SE) in Supkhar **(Table 1.1.).** Numbers of Tigers operating in different ranges of Kanha Core Zone have been shown in **(Fig 1.2).** Range wise details of stripe patterns of tigers for identification purposes are also given below:

Table 1.1: Abundance estimate of tiger in Kanha Tiger Reserve 2011-2012

Sampling Area	Effort (Trap Nights)	Trap Days	ETA (1/2 MMDM) in sq. km.	M_{t+1} (Adults)	M_{t+1} (Adults+ Cubs)	Ň Adults	Ď 1/2 MMDM per 100 sq. km.	Ď MLSECR per 100 sq. km.	Best Model
Kanha	3293	37	664 SE 22	44	60	48 SE 2.17	7.2 SE 2.17	5.7 SE 0.8	M_h
Supkhar	1520	40	350 SE 30	13	14	13 SE 0.77	3.7 SE 0.5	2.89 SE 0.8	M_{th}

ETA- Effective Trapping Area; **Ň-** Population of Tiger; $\mathbf{M_{t+1}}$ **-** Unique individuals; **MLSECR –** Maximum Likelihood Spatially Explicit Capture Recapture; **MMDM –** Mean Maximum Distance Moved by Tiger; **SE –** Standard Error

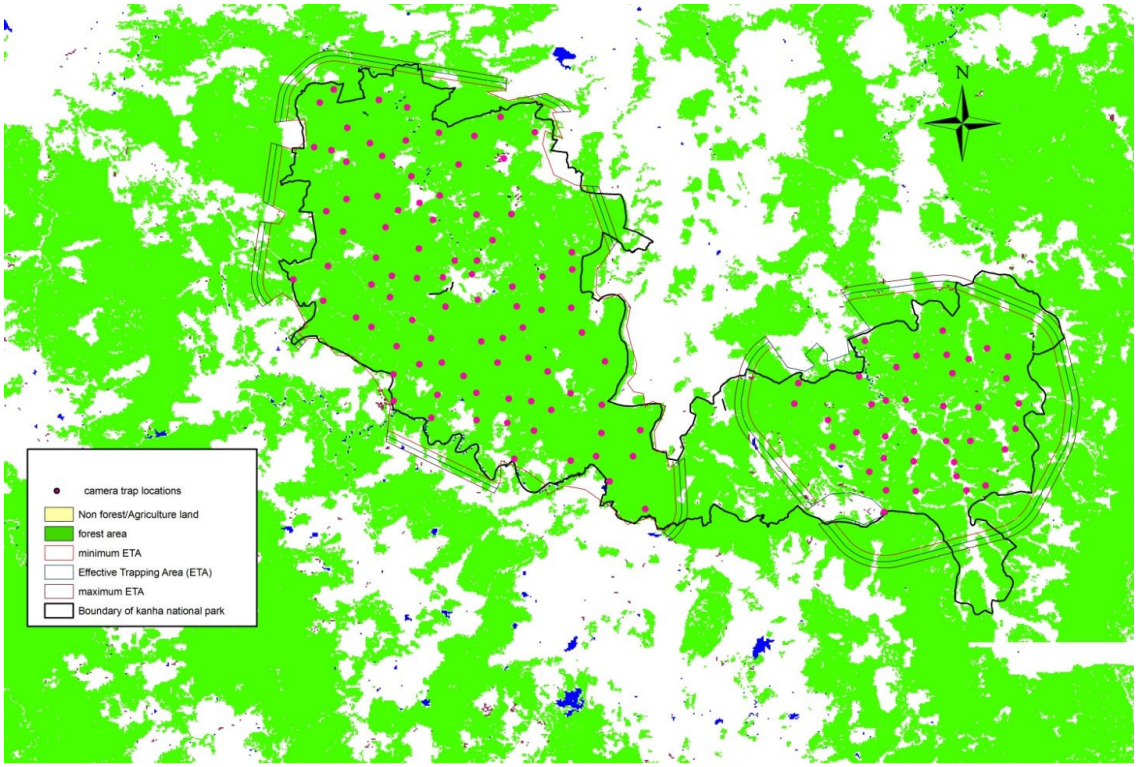

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Figure 1.1: Camera Trap location and Effectively Trapped Area within the two blocks of Kanha Tiger Reserve in 2012.

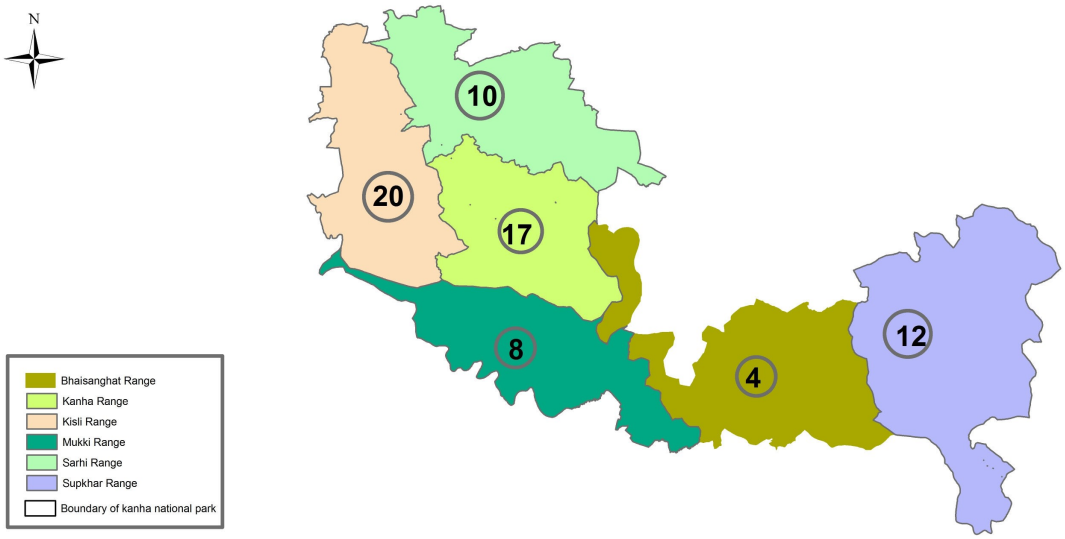

Figure 1.2: Number of Tigers operating in different Forest ranges of Kanha Tiger Reserve.

(**Note:** A Tiger may be operating in more than one range. See below for individual tiger details.

6.8 Prey Abundance Estimation:

6.8.1 **Introduction:** Distance sampling along systematically laid line transects is considered to be an appropriate method for estimation of herbivore abundance in tropical forests (Burnham et al 1980 and Buckland et. al. 1993). Several studies using DISTANCE based line transect sampling have been carried out in tropical forests of India (Karanth and Sunquist 1992, Varman and Sukumar, 1995; Khan et al., 1996; Karanth and Nichols, 1998; Biswas and Sankar, 2002; Jathanna et al., 2003). However, only few estimates of prey population using DISTANCE sampling are available from Kanha Tiger Reserve.

The key to distance sampling analyses is to fit a detection function, g(x), to the perpendicular distances from the transect line and use it to estimate the proportion of animals missed by the survey (Buckland et al., 2001), assuming that all animals on the

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line transect are detected (i.e. g (0) = 1). The assumptions of distance sampling have been discussed by Buckland et al., (2001) **(Appendix-67)**.

6.8.2 **Methodology:** Line transects were established within the Kanha Core Zone for prey density estimation using distance sampling. This methodology is the standard method for estimating tiger prey abundance in protected areas in the Indian subcontinent (Karanth &Nichols 2002). The area of 940 square km was systematically sampled by laying atleast one or two (2-3 km length) transects in each forest beat. A total of 150 line transects were laid covering all the habitat types of the study area **(Fig. 1).**

Each transects were walked for three times in summer season in morning (6:00hrs-9:00hrs) when animals are more active. Data based on direct sightings of herbivore species were recorded along transects in the survey areas. To estimate the densities of herbivore species, following parameters were recorded:

- Date and time of sighting,
- Species ID
- Group size
- Angular sighting distance
- Animal bearing and transect bearing

The beginning and end Global Positioning System (GPS) readings were recorded. Sighting distances were measured using Laser range finders and SUUNTO compass were used to measure the bearings. The bearing would subsequently used for obtaining sighting angles. The data were recorded for seven ungulate species viz., Chital (*Axis axis*), Sambar (*Rusa unicolor*), Gaur (*Bos gaurus*), and Wild pig (*Sus scrofa*), Barking deer (*Muntiacus muntjak*), Nilgai (*Boselaphus tragocamelus*) and chousingha (*Tetracerus quadricornisi*) in the Kanha Core Zone.

The computer Program DISTANCE Version 6.0 (Thomas et al., 2004) was used for further analyses to yield density estimates of the different tiger prey species. Distance is a Windows-based computer package that allows us to design and analyze distance sampling surveys of wildlife populations. It gives us best fit model to calculate cluster

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density (DS), population density (D), estimated population (N), Detection probability (*p*).

Overall densities of ungulates were estimated for the Kanha Core Zone and results are also reported for range wise abundance of ungulates in the Kanha Core Zone.

6.8.3 **Model Selection**: For DISTANCE analysis several models were used with varying group intervals and truncations to select a model that best fit the data. Detection function was fitted using half normal, hazard rate or uniform models as key functions with cosine and polynomial series expansion. Outliers from the data were truncated. Akaike Information Criteria (AIC) values (Burnham *et al.,* 1980; Buckland *et al.,* 1993), goodness of fit tests, visual inspection of the detection function and variances associated with the estimates obtained were used to select the most appropriate model for each prey category (Buckland et al. 2001).

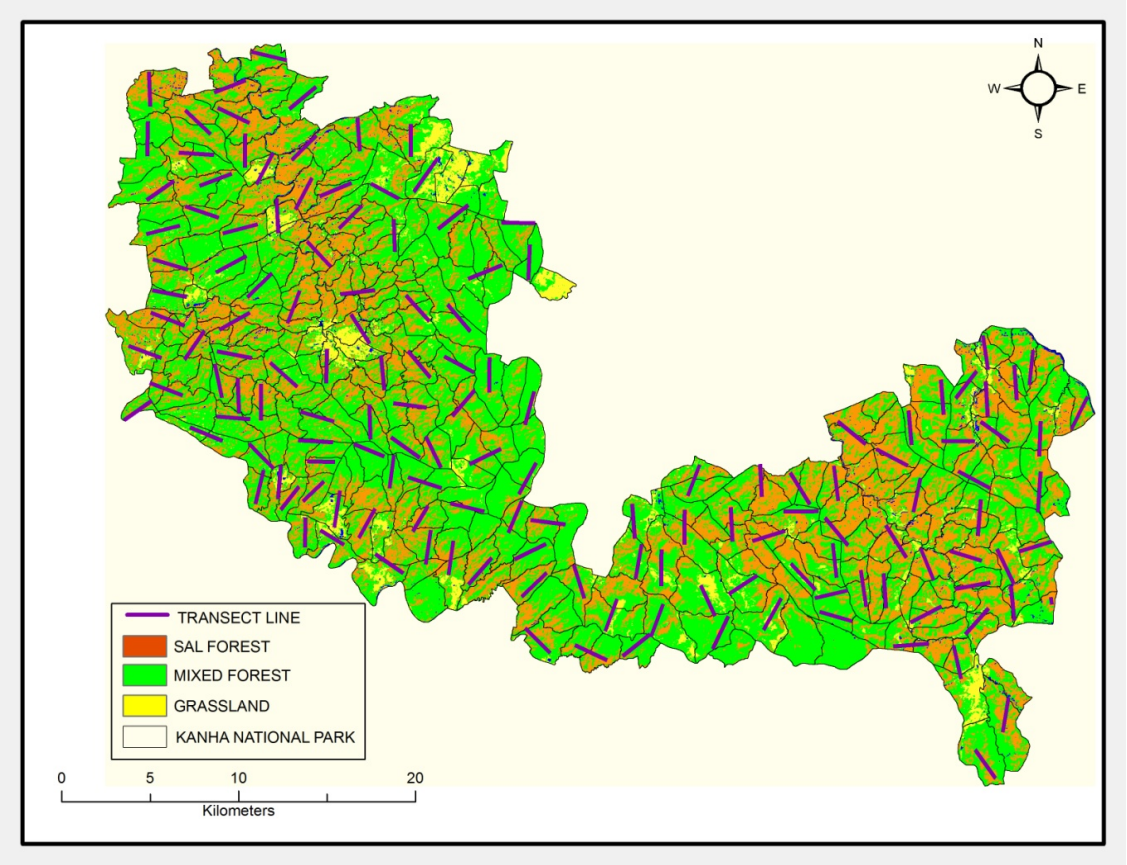

Fig. 2.1: Map showing Transect lines(n=150) laid in whole Kanha Core Zone (Area=940 sq. km.)

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6.9 Result:

Prey abundance in the Kanha Core Zone was estimated through systematic stratified distance sampling on line transects with an effort of 900 km walk. Ungulates were surveyed on foot along each of the 150 spatially replicated transects of 2 km. length with 450 temporal replicates covering the entire study area of 940 square km.

A total of 8 ungulate prey species were detected on transects, though density could not be estimated for Barasingha because of the behaviour of the species which are mainly clumped and restricted only in grassland. Half normal cosine, uniform cosine and hazard rate cosine adjustments were best fit model for all ungulates respectively.

Among ungulates, chital 33.0 with (SE 4.47) individuals / sq. km. was most abundant followed by sambar 8.51 (SE 1.11)/ sq. km., wild pig 5.48 (SE 0.96) /sq. km., gaur 4.11(SE 0.8) /sq. km. and barking deer 2.36 (SE 0.26) /sq. km. **(Tables 2.1 & Fig. 2.2).**

In results of Range wise estimation, Chital is the most abundant prey in Kisli, Kanha, Mukki and Sarhi range respectively while Wild pig is most abundant prey species in Supkhar and Bhaisanghat range **(Tables 2.2 & 2.3).** Nilgai and Chousingha have not been estimated due to very low observations in each range. Population estimates of ungulates given separately range wise cannot be compared with overall estimation of whole area of the park since animals can be shared between the ranges.

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Table 2.1: Results of Distance Sampling for Ungulate Abundance Estimates in Kanha National Park in 2012

Species	Population Estimates ($\hat{N}$)	SE ($\hat{N}$)	Density Estimates ($\hat{D}$)/ Sq. Km	SE ($\hat{D}$)	CV (%) ($\hat{D}$)	Group Size Density (DS)	SE (DS)	ER/ km.	SE (ER)	ESW (mts)	SE (ESW)	Detection Probability ($\hat{p}$)	SE ($\hat{p}$)
Chital	30926	4202	33.0	4.47	13.59	3.43	0.43	0.45	0.05	66.70	2.40	0.26	0.09
Sambar	7999	1043	8.51	1.11	13.04	2.63	0.32	0.28	0.02	54.30	4.67	0.33	0.02
Wild pig	5151	902	5.48	0.96	17.52	1.15	0.15	0.13	0.01	58.09	5.09	0.41	0.03
Gaur	3863	752	4.11	0.8	19.46	0.69	0.10	0.11	0.01	78.84	8.30	0.39	0.04
Barking Deer	2218	244	2.36	0.26	11.02	1.92	0.20	0.19	0.01	50.91	3.53	0.50	0.03
Nilgai	320	179	0.34	0.19	55.88	0.09	0.04	0.01	0.004	51.65	2.38	0.43	0.01
Chousingha	160	75	0.17	0.08	47.06	0.10	0.05	0.01	0.004	66.75	2.39	0.26	0.009

ER- Encounter Rate; ESW- Effective Strip Width; S.E. – Standard Error; CV= Coefficient of Variation

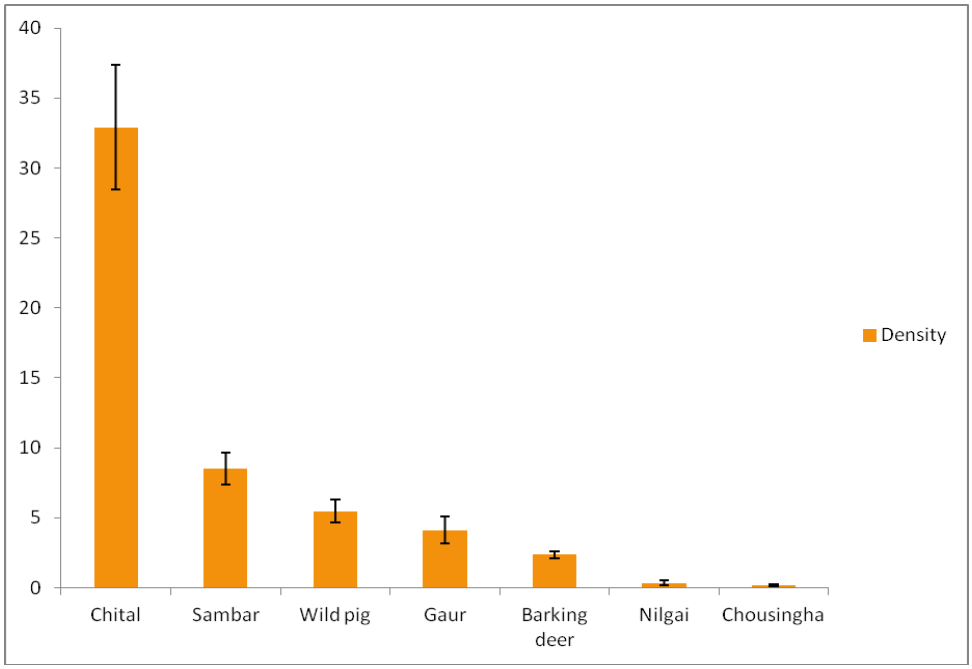

Fig. 2.2: Density (#/ sq. km.) of different ungulate species in Kanha National Park in 2012

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Table 2.2: Results of Distance sampling for Range wise ungulate abundance estimates in Kisli, Kanha and Sarhi Range.

	Kisli range (Area=139 sq. km.)				**Kanha range (Area=121 sq. km.)**				**Sarhi range (Area=145 sq. km.)**			
Species	**Population Estimates** ($\hat{N}$)	**SE** ($\hat{N}$)	**Density Estimates** ($\hat{D}$)/ **sq. km.**	**SE** ($\hat{D}$)	**Population Estimates** ($\hat{N}$)	**SE** ($\hat{N}$)	**Density Estimates** ($\hat{D}$)/ **sq. km.**	**SE** ($\hat{D}$)	**Population Estimates** ($\hat{N}$)	**SE** ($\hat{N}$)	**Density Estimates** ($\hat{D}$)/ **sq. km.**	**SE** ($\hat{D}$)
Chital	3725	860	26.8	6.19	5904	1803	48.8	14.9	7830	2436	54	16.8
Sambar	2218	297	15.96	2.14	1008	275	8.33	2.27	2291	449	15.8	3.1
Gaur	270	147	1.94	1.06	308	128	2.55	1.06	1633	445	11.26	3.07
Wild Pig	952	375	6.85	2.7	134	59	1.11	0.49	745	281	5.14	1.94
Barking Deer	164	46	1.18	0.33	226	76	1.87	0.63	565	114	3.9	0.79

S.E. – Standard Error.

Table 2.3: Results of Distance sampling for Range wise ungulate abundance estimates in Mukki, Bhaisanghat and Supkhar Range.

	Mukki Range (Area=133 sq. km.)				**Bhaisanghat Range (Area=173 sq. km.)**				**Supkhar Range (Area=229 sq. km.)**			
Species	**Population Estimates** ($\hat{N}$)	**SE** ($\hat{N}$)	**Density Estimates** ($\hat{D}$)/ **sq. km.**	**SE** ($\hat{D}$)	**Population Estimates** ($\hat{N}$)	**SE** ($\hat{N}$)	**Density Estimates** ($\hat{D}$)/ **sq. km.**	**SE** ($\hat{D}$)	**Population Estimates** ($\hat{N}$)	**SE** ($\hat{N}$)	**Density Estimates** ($\hat{D}$)/ **sq. km.**	**SE** ($\hat{D}$)
Chital	10440	2194	78.5	16.5	830	297	4.8	1.72	1555	517	6.79	2.26
Sambar	2274	497	17.1	3.74	517	194	2.99	1.12	233	71	1.02	0.31
Gaur	1043	299	7.84	2.25	410	192	2.37	1.11	267	124	1.17	0.54
Wild pig	1016	262	7.64	1.97	884	320	5.11	1.85	1658	751	7.24	3.28
Barking Deer	403	73	3.03	0.55	631	124	3.65	0.72	568	92	2.48	0.4

S.E. – Standard Error.

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Detection Functions of Distance Sampling

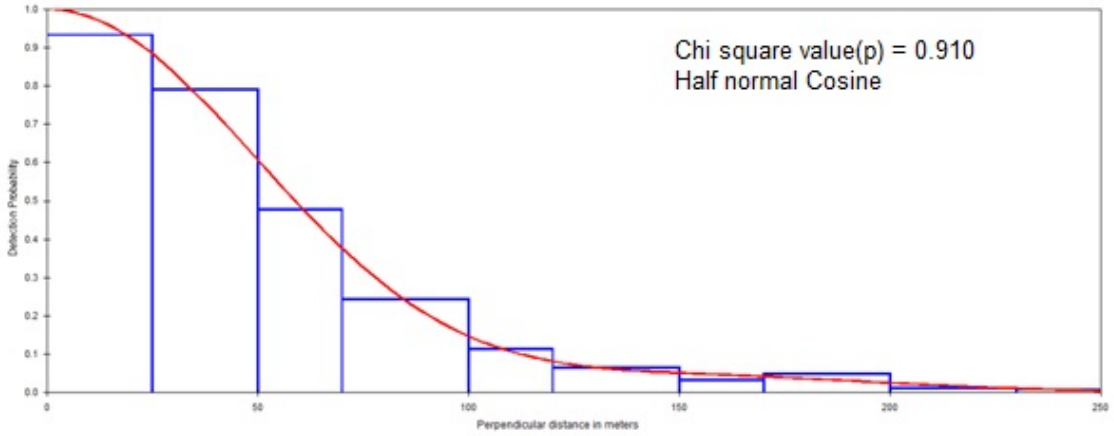

Fig. 1: Detection Function and sighting distances for chital in Kanha National Park in 2012

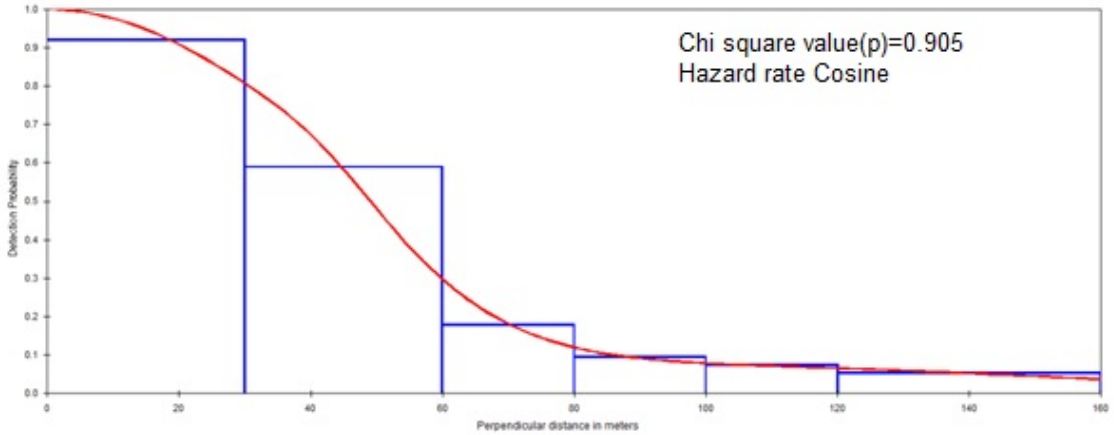

Fig. 2: Detection Function and sighting distances for Sambar in Kanha National Park in 2012

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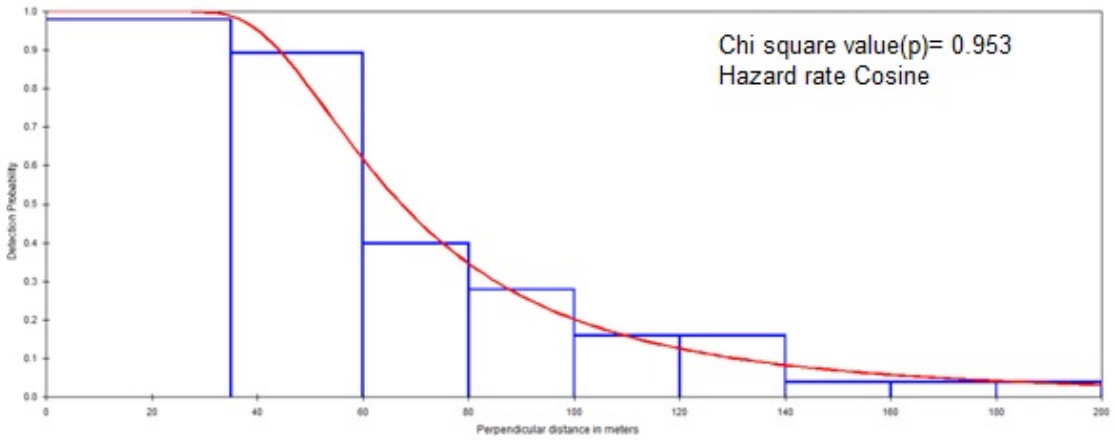

Fig. 3: Detection Function and sighting distances for Gaur in Kanha National Park in 2012

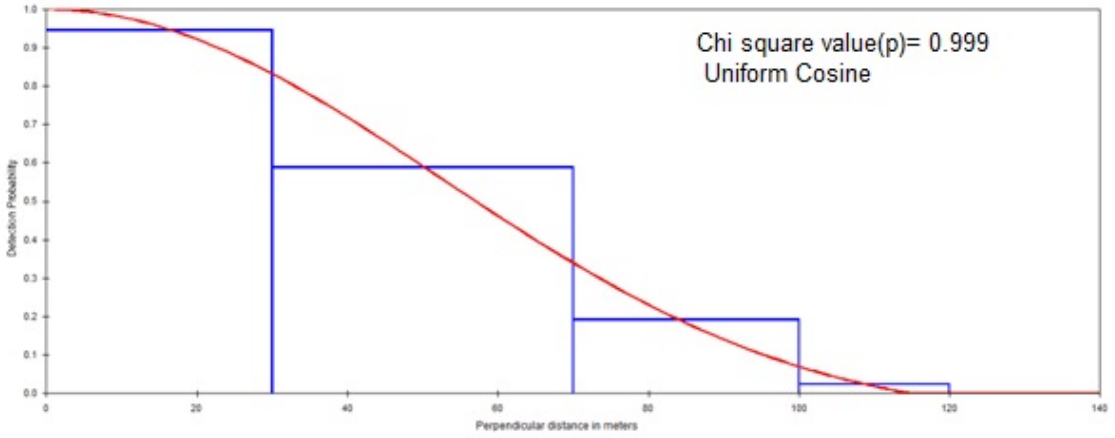

Fig. 4: Detection Function and sighting distances for Wild Pig in Kanha National Park in 2012

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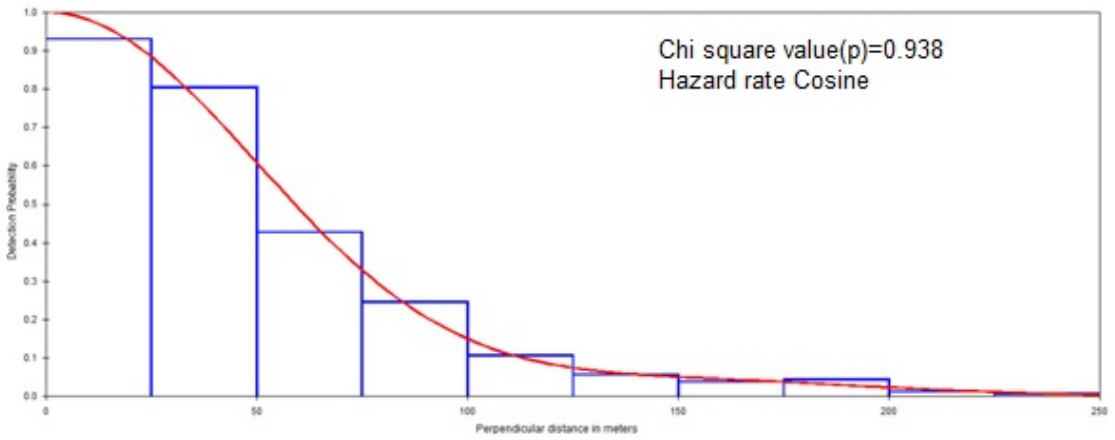

Fig. 5: Detection Function and sighting distances for barking Deer in Kanha national Park in 2012

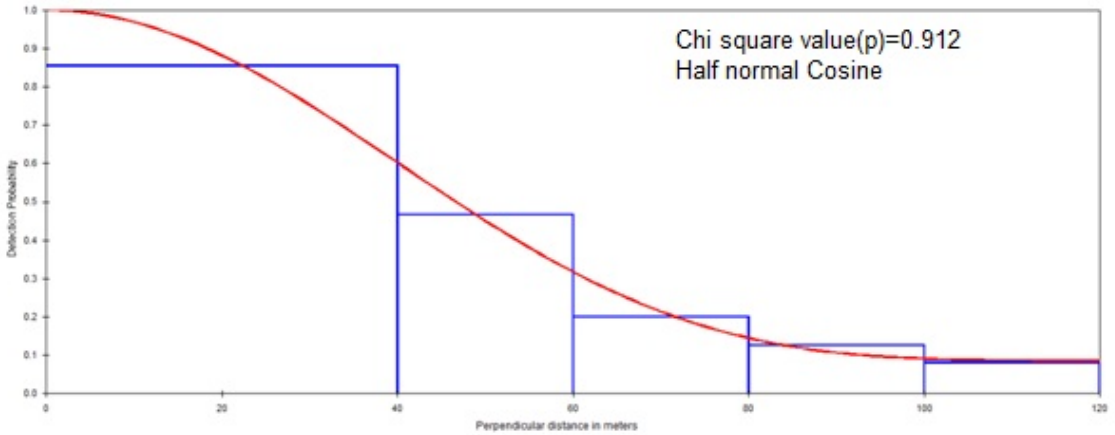

Fig. 6: Detection Function and sighting distances for Chousingha in Kanha National Park in 2012

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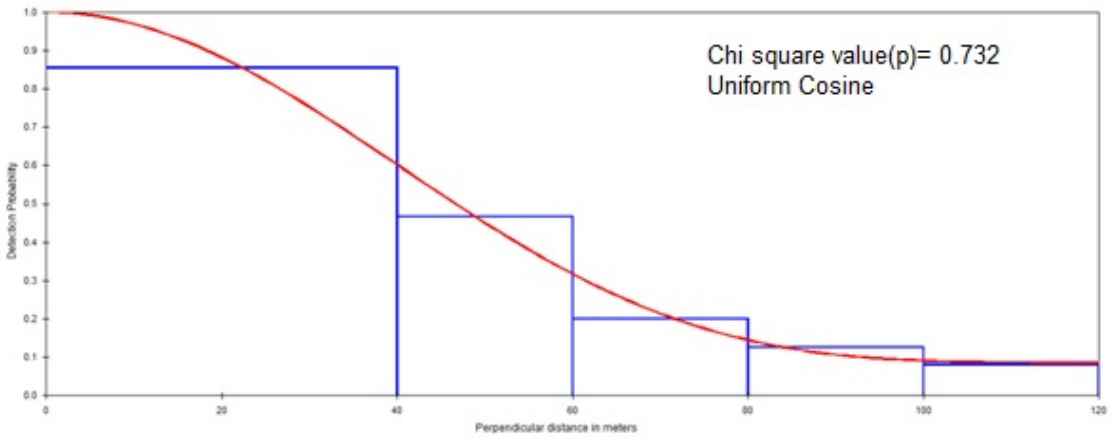

Fig. 7: Detection Function and sighting distances for Nilgai in Kanha National Park in 2012

6.10 Wildlife Sightings, Signs & Evidence:

Though various wildlife species are spread all over the Core Zone, prime habitats, geographical barriers and other beneficial factors also influence their distribution in the protected area. Generally, wildlife species in the Core Zone are sighted as under:

Wildlife Species	Probable Places of Sighting
Tiger	**Kanha Range:** Schaller hide, Chhoti Chuhri, Badi Chuhri, 7 No., 9 No., Bison Road, Kanha meadow **Sarhi Range:** Sonf, Ronda, Mahua dabri road, Jamun tola, Silpura meadow, Ramaghat **Kisli Range:** Khairwadi, Katankware, Bandrichhapar Talab, Siddiware, Bandh Pulia, Chunnurghati, Banjari, Jamun Talab, Kakaghat, Rajakachhar **Mukki Range:** Ghorella, Sondar, Andhkua, Bishanpura, Mukki Nawatola **Supkhar Range:** Kamkodadar, Jatadabra, Piperwada, Kusera, Supkhar **Bhaisanghat Range:** Ronda, Deoridadar, Katoldih, Gadaghat
Leopard	**Kanha Range:** Keraghat, Ghoorpani, Bijadadar, Naktighati, Koylabhatta, Badrinath, Kanha meadow **Sarhi Range:** Sonf, Ronda, Mahuakhol, Silpura **Kisli Range:** Banjari, Sandukkhol Talab, Digdola, Kanha Ghat, Naktighati Anicut, Bandrichhapar Talab **Mukki Range:** Bishanpura, Khapa, Algidadar, Mukki **Supkhar Range:** Chakarwah, Behind the FRH, Chhawarighat, Ladua **Bhaisanghat Range:** Pongapani, Katoldih, Adwar, Khamodidadar, Saraitola

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Wild Dog	**Kanha Range:** Kanha Ghat, Ghodachhapar, Benipat, Kanha meadow, Bhoindabara, Bamhnidadar **Sarhi Range:** Sonf, Ronda, Kariwah road **Kisli Range:** Kisli meadows, Bandrichhapar Talab, Silyari tank, Khudiakhero, Chuppe Meadows **Mukki Range:** Andhkua, Algidadar, Bishanpura, Babathenga, Sondar **Supkhar Range:** Piperwada, Kusera, Supkhar **Bhaisanghat Range:** Kauajhardadar, Garhidadar
Wolf	Supkhar meadow, Kisli and Bhaisanghat ranges
Jackal	Throughout the Core Zone
Hyena	Kisli and Supkhar Ranges
Sloth Bear	**Kanha Range:** Shravan tal, Bamhnidadar, Benipat, Chuhri, Circular road, 7 No., 9 No. **Sarhi Range:** Sonf, Ronda, Kariwah road, Mahuadabri, Garneridadar **Kisli Range:** Kopedabri, Naktighati **Mukki Range:** Andhkua, Sondar
Gaur	**Kanha Range:** Bamhnidadar, Chuhri, Dhawadadar, Kanha meadow, Bijadadar, Khamerpani, Ghangharmuda, Benipat, Kanha ghat **Sarhi Range:** Silpura meadow, Ramaghati, Ganeridadar, Jamuntola, Sonf **Kisli Range:** Chuppe Meadows, Banjari Near Saucer, Kisli Tank, Jamun Tank, Lendia Meadows, Rajakachhar, Sondar Meadows, Indri Meadows **Mukki Range:** Umarjhola, Bishanpura, Shringarpur, Ghorella, Khadari
Chital	**Kanha Range:** Kanhari meadows, Umarpani, Kanha meadow, Naktighati, Mundidadar, Kodaidadar, Bhapsabehra, Parsatola, Bhoindabra **Sarhi Range:** Sonf, Ronda, Jamuntola, Silpura meadow, Ganeridadar **Kisli Range:** Kisli meadows, Balaribehra, Chuppe meadows, Bhapsa anicut, Silyari tank, Chamarighati, Sandukkhol **Mukki Range:** Mukki, Sondar, Mavaikheda, Orai, Ghorella, Bisanpura **Supkhar Range:** Piperwada, Kusera, Supkhar **Bhaisanghat Range:** Adwar, Katoldih
Sambar	**Kanha Range:** Mundidadar, 9 No., Kanha meadow, 7 No., Bamhnidadar, Ghangharmuda, Parsatola, Kanha ghat **Sarhi Range:** Sonf, Ronda, Mediware, Ramaghati road, Jamuntola, Silpura meadow, Ganeridadar **Kisli Range:** Kisli tank, Bhapsa anicut, Sandukkhol tank, Bandrichhapar, Chamarighati, Jamun tank, Kopedabri, Banjari near saucer, Balaribehra, Silyari tank, Baneli tank **Mukki Range:** Bishanpura, Malkhedi, Sondar, Ghorella, Jodapulia, Muwala, Gaidhar
Barasingha	**Kanha Range:** Kanha meadow, Kanhari, Parsatola **Sarhi Range:** Sonf, Ronda, Urnakhero **Kisli Range:** Sondar, Indri **Mukki Range:** Bishanpura, Sondar, Oari **Bhaisanghat Range:** Ronda, Adwar, Dudhania, Lanjiabehra **Supkhar Range:** Jatadabra, Chakarwah, Ladua, Baspehra

Barking Deer	Kisli, Kanha, Sarhi, Mukki, Bhaisanghat and Supkhar ranges
Nilgai	**Sarhi Range:** Matigahan, Silpura
Chousingha	Kanha, Sarhi, Bhaisanghat and Supkhar Ranges

6.10.1 **Herd Formation & Dispersal:** While the size of the herds of ungulates vary from small to large, some specific observations are as under:

- The largest herd sizes of the barasingha are seen during the peak breeding season, in December and January.
- These herds split into smaller ones due to segregation after the breeding period is over.
- The herd sizes of chital are the largest in the rains.
- After October/ November the herd size starts decreasing.
- Water bodies play an important role in the movements of bison herds after January/ February.
- Average herd size of the bison is 15–25 animals.
- No seasonality is generally observed in the herd size of the sambar. The average herd size is 5–7 animals.
- Barking deer are generally found solitary or in pair.

6.10.2 **Monitoring of Signs/ Evidence:** As per the instructions and proforma guidelines received from the Principal Chief Conservator of Forests (Wildlife), Madhya Pradesh, the Park Management has been compiling and collating the data on the signs and evidences of various carnivore and herbivore species from patrolling camp registers to understand the trends of the growth of wildlife populations. The trends of the past five years are as under:

Year	Total Signs Seen		Directly Seen Adults		Directly Seen Cubs	
	Tiger	Leopard	Tiger	Leopard	Tiger	Leopard
2006	11460	3822	304	284	84	116
2007	12712	2918	452	303	74	38
2008	14885	3825	450	259	39	33
2009	23373	3095	621	276	55	2
2010	24442	2404	955	348	34	4

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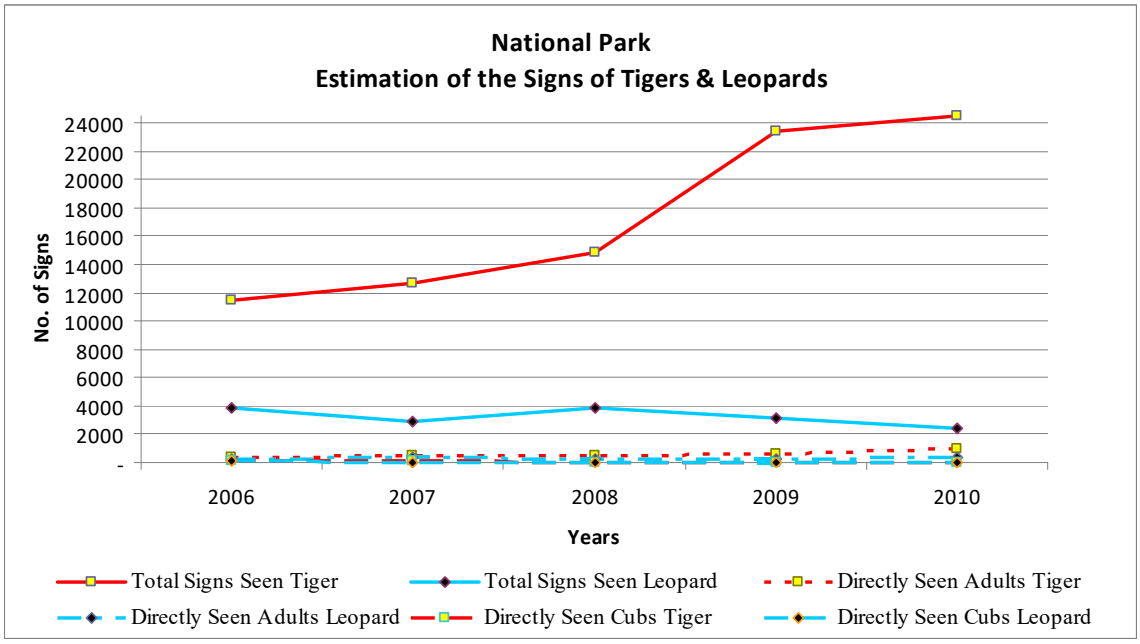

Year	Chital	Sambar	Barking Deer	Barasingha	Nilgai	Chinkara	Chousingha	Gaur	Wild Pig
2006	4048.639	737.058	1352.775	166.660	13.154	0.162	2.251	260.803	554.625
2007	4794.915	911.633	1364.113	263.409	11.666	0.078	4.671	271.365	526.699
2008	5392.712	961.965	1563.433	222.528	12.542	0.075	1.234	278.568	603.877
2009	4520.98	747.660	1349.890	175.360	12.810	0.190	1.910	291.300	611.740
2010	5383.99	1029.660	1377.150	225.920	40.500	0.150	4.360	263.720	588.600

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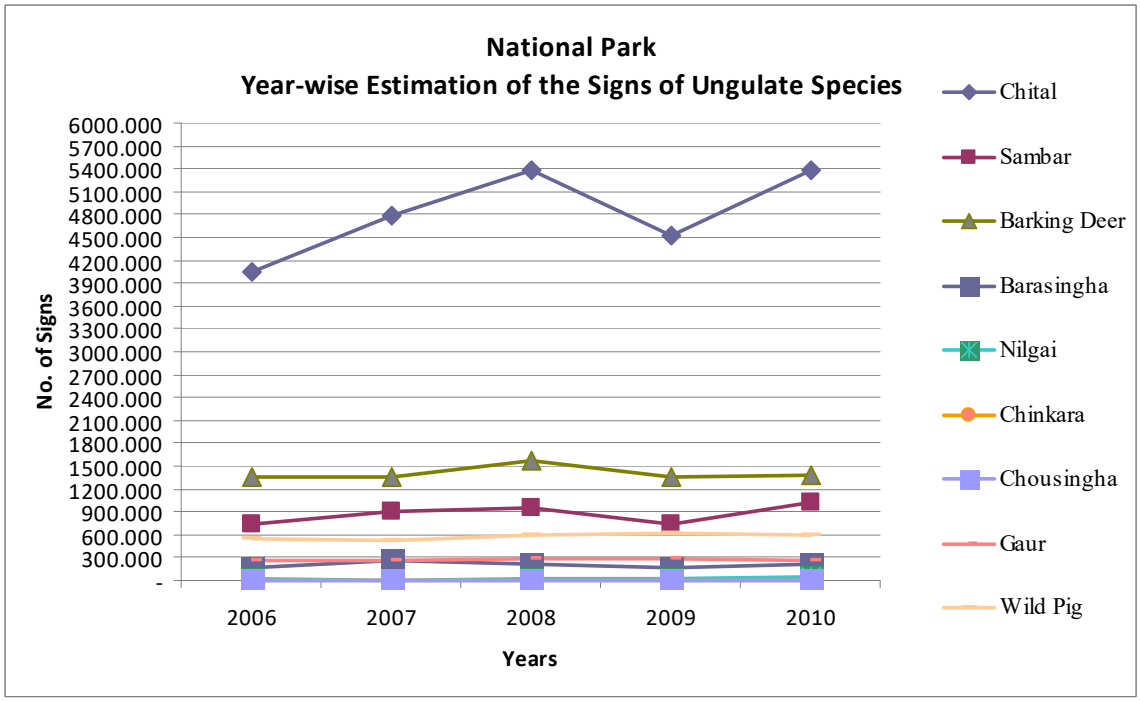

6.11 Prey-Predator Relationships:

Predator-prey relationship maintains the dynamics and health of the Kanha wildlife ecosystem, and any serious disturbance may cause either population explosions or crashes of any ungulate species, which is unnatural. The Kanha ecosystem supports the tiger as the main predator, and the leopard and wild dog as co-predators. These predators rank as such in the predation hierarchy, and have a distinct niche of their own.

Tigers, generally, prey upon large sized ungulates, and travel over a long distance in their home ranges, away from habitations. While tigers kill a wide range of ungulate species in the Core Zone, sometimes even an adult bison or a langur, or even a python with a freshly swallowed ungulate, the chital forms the most of its annual consumption. Besides, tigers also prey upon livestock on the peripheral areas of the Core Zone. They also frequently move into the Buffer Zone and kill cattle.

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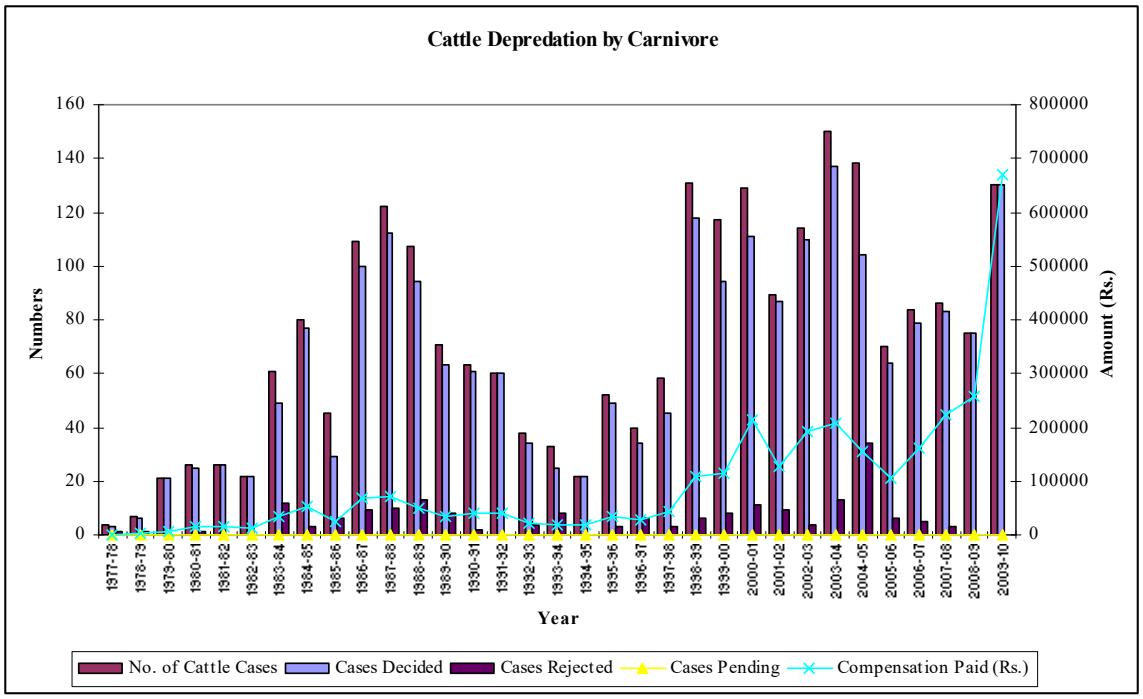

Leopards generally have smaller and almost stable home ranges close to habitations. There seems to be no competition between the tiger and leopard, and they follow the tactics of mutual avoidance. Leopards are, however, sometimes also known to operate close to the movements of tigers in the Core Zone. They generally kill small sized preys, including domestic dogs, goats and birds. The kills of leopards are also sometimes usurped by tigers in the Core Zone.

Wild dogs in the Core Zone are more transients, and travel frequently in packs over large distances. Though their home ranges overlap with those of tigers and leopards, their presence is so fleeting that they seldom come into conflict with the other two predators. The average pack size of the wild dog in the protected area is 5-10 animals. They also kill large preys.

The other lesser predators such as foxes and jackals prey upon small herbivores, rodents and birds.

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In this predator-prey relationship, the prey species also have their defense mechanism against the predators to avoid being killed. The defense may include alarm calls, large aggregations, and taking shelter in refuge covers etc.

6.12 Assessment of Prey-Predator Biomass:

The assessment of prey-predator biomass is very important to gauge the health of the wildlife ecosystem. The annual population estimates of the following animal species have been considered for assessing the animal biomass in the Core Zone:

Tiger & co-predators	**Prey animals**
Tiger	Chital
Leopard	Sambar
Wild Dog	Gaur
	Barasingha
	Nilgai
	Chousingha (4 horned antelope)
	Barking Deer
	Wild Boar
	Langur

For an appraisal of the available predator - prey biomass, the following average values were used:

Predator	**Average weight in Kg. for both the sexes**
Tiger	182.5
Leopard	59
Wild dog	17.5
Prey Animals	**(Assumed Body Weight for Computation in Kg.) (Panwar, 1990)**
Gaur	300
Sambar	150
Barking Deer	20
Barasingha	80
Chousingha	15
Chital	50
Langur	12.5
Wild pig	80
Nilgai	100

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To work out the prey biomass requirements of the predators per year, the calculations are based on the projection made by Panwar (1990) as under:

An adult (male or female) tiger requires 72 chital equivalents (72 x 50 = 3600 Kg.) per annum (1 chital equivalent = 50 kg., which is the assumed average body weight of a chital used in computation). The annual requirements for an average leopard and wild dog were also proportionately worked out by considering their body weights with respect to that of the tiger. Thus, the weight of an average adult leopard is almost 32.33% of the body weight of an average adult tiger, whereas for the wild dog this amounts to 9.59%. Based on the 2010 estimates, the following projections are made:

Predator Biomass (For the Core Zone)

Sl. No.	Animal Species	Average Weight (Kg.)	Estimate Number	Calculated Biomass (Kg.)	Biomass (Kg./ Sq. Km.)
1	Tiger	182.5	89	16242.5	17.2793
2	Leopard	59	78	4602	4.89574
3	Wild Dog	17.5	352	6160	6.55319
	Total:			**27004.5**	**28.73**

Prey Biomass (For the Core Zone)

Animal Species	Number	Assumed Body Weight (Panwar, 1990)	Biomass
Gaur	1654	300	496200
Sambar	3467	150	520050
Barking Deer	1124	20	22480
Barasingha	475	80	38000
Chousingha	146	15	2190
Chital	25885	50	1294250
Langur	5285	12.5	66062.5
Wild Pig	7740	80	619200
Nilgai	82	100	8200
Total:			**3066633**

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Prey Biomass (Range-wise)

Range: Kanha

Sl. No.	Species	Assumed Body Weight of Average Prey Size (Kg.)	Conversion Factor (As equivalent of average prey size) (Kg.)	Estimated Number	Total Biomass (Kg.)	Biomass (Kg./Sq. Km.)	Converted Spotted Deer Equivalent (chital units)
1	Chital	50	1	10184	509200	4185.16	10184
2	Sambar	150	3	655	98250	807.53	1965
3	Barking Deer	20	0.4	191	3820	31.40	76.4
4	Barasingha	80	1.6	118	9440	77.59	188.8
5	Nilgai	100	2	0	0	0.00	0
6	Chousingha	15	0.3	42	630	5.18	12.6
7	Gaur	300	6	332	99600	818.62	1992
8	Wild Pig	80	1.6	1788	143040	1175.66	2860.8
9	Langur	12.5	0.25	1299	16238	133.46	324.75
	Total:				**880218**	**7234.59**	**17604.35**

Prey Biomass (Range-wise)

Range: Sarhi

Sl. No.	Species	Assumed Body Weight of Average Prey Size (Kg.)	Conversion Factor (As equivalent of average prey size) (Kg.)	Estimated Number	Total Biomass (Kg.)	Biomass (Kg./Sq. Km.)	Converted Spotted Deer Equivalent (chital units)
1	Chital	50	1	4846	242300	1660.44	4846
2	Sambar	150	3	214	32100	219.98	642
3	Barking Deer	20	0.4	97	1940	13.29	38.8
4	Barasingha	80	1.6	163	13040	89.36	260.8
5	Nilgai	100	2	37	3700	25.36	74
6	Chousingha	15	0.3	14	210	1.44	4.2
7	Gaur	300	6	209	62700	429.67	1254
8	Wild Pig	80	1.6	610	48800	334.42	976
9	Langur	12.5	0.25	349	4362.5	29.90	87.25
	Total:				**409153**	**2803.85**	**8183.05**

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Prey Biomass (Range-wise)

Range: Kisli

Sl. No.	Species	Assumed Body Weight of Average Prey Size (Kg.)	Conversion Factor (As equivalent of average prey size) (Kg.)	Estimated Number	Total Biomass (Kg.)	Biomass (Kg./Sq. Km.)	Converted Spotted Deer Equivalent (chital units)
1	Chital	50	1	4264	213200	1496.39	4264
2	Sambar	150	3	832	124800	875.94	2496
3	Barking Deer	20	0.4	177	3540	24.85	70.8
4	Barasingha	80	1.6	3	240	1.68	4.8
5	Nilgai	100	2	43	4300	30.18	86
6	Chousingha	15	0.3	21	315	2.21	6.3
7	Gaur	300	6	498	149400	1048.60	2988
8	Wild Pig	80	1.6	1370	109600	769.25	2192
9	Langur	12.5	0.25	1143	14288	100.28	285.75
	Total:				**619683**	**4349.38**	**12393.65**

Prey Biomass (Range-wise)

Range: Mukki

Sl. No.	Species	Assumed Body Weight of Average Prey Size (Kg.)	Conversion Factor (As equivalent of average prey size) (Kg.)	Estimated Number	Total Biomass (Kg.)	Biomass (Kg./Sq. Km.)	Converted Spotted Deer Equivalent (chital units)
1	Chital	50	1	4820	241000	1798.49	4820
2	Sambar	150	3	461	69150	516.04	1383
3	Barking Deer	20	0.4	201	4020	30.00	80.4
4	Barasingha	80	1.6	148	11840	88.36	236.8
5	Nilgai	100	2	0	0	0.00	0
6	Chousingha	15	0.3	9	135	1.01	2.7
7	Gaur	300	6	221	66300	494.77	1326
8	Wild Pig	80	1.6	1281	102480	764.77	2049.6
9	Langur	12.5	0.25	706	8825	65.86	176.5
	Total:				**503750**	**3759.30**	**10075**

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Prey Biomass (Range-wise)

Range: Bhaisanghat

Sl. No.	Species	Assumed Body Weight of Average Prey Size (Kg.)	Conversion Factor (As equivalent of average prey size) (Kg.)	Estimated Number	Total Biomass (Kg.)	Biomass (Kg./Sq. Km.)	Converted Spotted Deer Equivalent (chital units)
1	Chital	50	1	257	12850	75.70	257
2	Sambar	150	3	472	70800	417.06	1416
3	Barking Deer	20	0.4	247	4940	29.10	98.8
4	Barasingha	80	1.6	12	960	5.66	19.2
5	Nilgai	100	2	2	200	1.18	4
6	Chousingha	15	0.3	21	315	1.86	6.3
7	Gaur	300	6	135	40500	238.57	810
8	Wild Pig	80	1.6	1334	106720	628.66	2134.4
9	Langur	12.5	0.25	519	6487.5	38.22	129.75
	Total:				**243773**	**1435.99**	**4875.45**

Prey Biomass (Range-wise)

Range: Supkhar

Sl. No.	Species	Assumed Body Weight of Average Prey Size (Kg.)	Conversion Factor (As equivalent of average prey size) (Kg.)	Estimated Number	Total Biomass (Kg.)	Biomass (Kg./Sq. Km.)	Converted Spotted Deer Equivalent (chital units)
1	Chital	50	1	1514	75700	330.39	1514
2	Sambar	150	3	833	124950	545.34	2499
3	Barking Deer	20	0.4	211	4220	18.42	84.4
4	Barasingha	80	1.6	31	2480	10.82	49.6
5	Nilgai	100	2	0	0	0.00	0
6	Chousingha	15	0.3	39	585	2.55	11.7
7	Gaur	300	6	259	77700	339.12	1554
8	Wild Pig	80	1.6	1357	108560	473.80	2171.2
9	Langur	12.5	0.25	1269	15863	69.23	317.25
	Total:				**410058**	**1789.67**	**8201.15**

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Prey Biomass Requirement for the Predators/ Annum (For the Core Zone)

Predator	Average Body Weight	Average Requirement For a Year (Kg.) For a Single Animal	Average Requirement for the Predator Animal Population/ Annum
Tiger	182.5	3600	414000
Leopard	59	1163.88	82635.48
Wild dog	17.5	345.24	129119.76

Predator–Prey Biomass Assessment in the Kanha Core Zone

Area (Sq. Km.)	PREDATOR NUMBERS			Prey Requ. (Kg./ Yr.)	Prey Biomass (Kg.)	Prey Avail. (Kg./ Yr.)	Prey Avail. Requir. (%)	Prey (Kg./ Sq. Km.)	PREDATOR BIOMASS (Kg./ Sq. Km.)			Total (Kg.)	Predator- Prey Biomass Ratio	Prey Biomass Requir. (Kg./ Sq. Km.)	Compensation (2007-08 to 2009-10) (Rs.)
	Tiger	Leopard	Wild dog						Tiger	Leopard	Wild dog				
940	89	78	352	532707	3066635	613327	86.86	3262	17.28	4.90	6.55	28.73	113.56	2833.55	1152050.00

- ***The value of annual growth of prey animals is around 20%***
- ***Almost 20% of the prey biomass in the habitat is available to the predators in a year***

It is evident from the above animal biomass assessment that the predators derive 86.86% of their food from the prey biomass available in the habitat. The balance requirement of prey biomass in these ranges is compensated by the livestock in the peripheral villages,

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which form part of the prey base for tigers and co-predators in any protected area system (Rodgers, 1991).

Therefore, the population estimation of tigers in the Core Zone is validated adequately by prey- predator biomass calculation also, as the prey base prevailing in the habitat is enough to support the predators on a sustained basis.

However, it should be remembered that the prey biomass estimates are not necessarily correlated to the number of tigers available in a habitat. The interspersion and juxtapositioning of welfare factors in the Core Zone also affect the predation, and accordingly the prey animals adapt themselves by eliciting various anti-predator strategies. Thus, the prey availability is governed by various attributes prevailing in the habitat in a combined manner. Therefore, the unique topographical and vegetal components prevailing in the Core Zone habitat also foster tiger abundance.

6.13 Ungulate Density & Biomass:

On the basis of ungulate estimates calculated by the Wildlife Institute of India, Dehradun the density and biomass of ungulates in the different habitat types of the Core Zone is computed as under:

GRASSLAND (Area=51.76 Sq. Km.)

Species	Density	Weight (Kg.)	Biomass
Chital	136.26	80	10900.8
Sambar	5.94	140	831.6
Gaur	7.95	650	5167.5
Wild pig	3.32	60	199.2
Barking deer	2.08	20	41.6
Barasingha	31.44	170	5344.8
Total:	**186.99 (Ungulates/ Sq. Km.)**	**1120**	**22485.5 (Ungulate Biomass/ Sq. Km.)**

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SAL (Area=273.18 Sq. Km.)

Species	Density	Weight (Kg.)	Biomass
Chital	56.3	80	4504
Sambar	7.6	140	1064
Gaur	6.18	650	4017
Wild pig	10.44	60	626.4
Barking deer	2	20	40
Total	**82.52 (Ungulates/ Sq. Km.)**	**950**	**10251.4 (Ungulate Biomass/ Sq. Km.)**

MIXED (Area=595.73 sq. km.)

Species	Density	Weight (Kg.)	Biomass
Chital	26.7	80	2136
Sambar	10.53	140	1474.2
Gaur	4.97	650	3230.5
Wild pig	6.99	60	419.4
Barking deer	2.57	20	51.4
Total	**51.76 (Ungulates/ Sq. Km.)**	**950**	**7311.5 (Ungulate Biomass/ Sq. Km.)**

6.14 Carrying Capacity Computation for the Core Zone:

There are several predictive equations developed to compute carrying capacity (Karant et al 2004, Carbone et al 2002, Hayward et al 2007) as well as formulations that consider an ideal predator density that does not induce trends in the prey populations (Fuller 1989). The other approach is to use a 10% cropping rate by large predators and compute the potential numbers (density) that the ungulates can support. Dr. YV Jhala of the Wildlife Institute of India suggests that Hayward's carrying capacity equation developed for lions based on preferred prey biomass is more applicable for tigers especially in a ecosystem with a diverse carnivore community. This equation is used to compute the carrying capacity of Kanha Tiger Reserve considering the preferred prey of tigers to be Chital, Sambar, Wild pig and Gaur. The following computations show that currently the tiger population is below prey dictated carrying capacity as based on this equation a density of about 12 tigers per 100 sq. km. can be supported in Kanha TR i.e. about a 100 tigers. Therefore, there is no need to manipulate any habitat to improve prey populations till this

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density is reached. This conclusion is also reached using the 10% cropping rate of preferred prey:

y = -1.363+0.152x

y = log10 of maximum carrying capacity of predator density for the available prey

x = Log10 of prey biomass per unit area/sq. km.

For the Kanha Core Zone:

Species	**Density**	**Average Weight**	**Biomass**
Chital	33.25	60	1995
Sambar	9.4	120	1128
Gaur	4.6	350	1610
Wild pig	5.9	40	236
Avg. Biomass/ sq. km.			**1242**

Log10 of prey biomass: 3.094121596
Regression equation: y = a+bx

Here:

a	**b**	**x**	**Bx**
-1.363	0.152	3.094122	0.470307

So carrying predator density (Y) will be

a	**b**	**x**	**bx**
y= -1.363+0.152*x*	y=a+bx	-0.892693456	0.128028

Tiger density will be: 12/100 sq. km.

6.15 Assessment of Threats:

Over the years, the Park Management has been able to make a very reliable assessment of threats to the wildlife of the protected area. While so far no instances of commercial or organized wildlife crime has been detected, sporadic poaching of wildlife does occur in

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the peripheral areas of the Core Zone and near the habitations. The threats to wildlife are as under:

- Electrocution of tigers and other wild animals through high voltage electric lines running across the Core Zone.
- Poisoning of cattle kills by aggrieved and distressed villagers.
- Poisoning of waterholes, specially in the pinch period.
- Gin-trapping of tigers by experienced offenders.
- Snaring of wild animals.
- Killing by bows and poisoned arrows.
- Illicit grazing by village cattle on the periphery.

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CHAPTER – 7

STOCK MAPPING

7.1 Introduction:

This is probably for the first time that the stock maps of the Kanha Core Zone have been prepared. Essentially, the importance of stock maps consists in describing the compositions and structures of forest crops in the plan area under different parameters and classifications. The Chief Wildlife Warden, Madhya Pradesh (2009) has also issued instructions to prepare stock maps of the wildlife protected areas for the Management Plans.

7.2 Stock Mapping:

The mapping of the forest stocks of all the compartments in the Core Zone was done on maps of 1: 15,000 scale. All the instructions contained in the MP Working Plan Manual, 1996 for the preparations of stock maps have been followed, including the use of prescribed conventional symbols, signs, classifications and other parameters. The prepared stock maps are in place, and the detailed statistics of stock maps are appended **(Appendix-27)**.

As per the statistics of the stocked, under-stocked and grassland areas in the Core Zone, the Supkhar range harbours the maximum percentage (12.40%) of sal followed by the Mukki range (7.66%) and the Kanha range (4.71%). The Sarhi range supports the maximum percentage (10.71%) of miscellaneous crop, followed very closely by the Bhaisanghat range with 10.34%. Of the total area of the Core Zone, grassland/ open areas constitute around 8.0%, and the Bhaisanghat range holds the maximum percentage (2.39%) of the total grassland followed by the Sarhi range with 1.70%. The relevant information is as under:

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Stocked Area (Ha.)

Range	Stocked Area			Total	Under Stocked	Grassland	River Bed	FV	Total	%
	Teak	Sal	Miscellaneous							
Bhaisanghat	32.52	3213.87	9762.94	13009.3	77.46	2255.14	0.00	1741.35	**17083.25**	**18.09**
Kanha	4.05	4446.86	6977.48	11428.4	123.47	921.45	27.95	0.00	**12501.27**	**13.24**
Kisli	0.00	3559.02	8912.9	12471.9	789.64	412.3	94.05	0.00	**13767.89**	**14.58**
Mukki	0.00	7233.92	5004.76	12238.7	121.37	885.25	67.85	278.72	**13591.89**	**14.40**
Sarhi	13.05	1948.75	10115.68	12077.5	36.69	1605.11	145.59	761.64	**14626.53**	**15.49**
Supkhar	6.87	11703.16	7700.98	19411	261.38	1507.39	18.27	1646.05	**22844.09**	**24.20**
Total	**56.49**	**32105.6**	**48474.74**	**80637**	**1410.01**	**7586.65**	**353.71**	**4427.8**	**94414.93**	**100**
Percentage	**0.06**	**34.00**	**51.34**	**85.41**	**1.49**	**8.04**	**0.37**	**4.69**	**100**	

The topographical data of the Core Zone suggests that the area is almost flat with 88.31% under the 0-10 degree class. Over 25 degree slopes form only 0.01% of the total four slope classes. The information relating to the slope classes is as under:

Slope Area (Ha.)

Range	0 - 10	10 - 15	15 - 25	> 25	Total	Percentage
Bhaisanghat	15303.77	1526.54	253.01	0.00	17083.31	**18.09**
Kanha	10615.25	1515.12	370.87	0.00	12501.23	**13.24**
Kisli	12642.13	904.92	219.15	1.58	13767.78	**14.58**
Mukki	11786.44	1308.24	494.02	3.17	13591.87	**14.40**
Sarhi	13223.34	1007.20	395.96	0.00	14626.51	**15.49**
Supkhar	19810.21	2761.77	272.11	0.00	22844.09	**24.20**
Total	**83381.13**	**9023.79**	**2005.12**	**4.75**	**94414.79**	**100.00**
Percentage	**88.31**	**9.56**	**2.12**	**0.01**	**100**	

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The data of different vegetation and age class-wise areas suggest that the middle aged miscellaneous crops form the maximum percentage (55.8%) in the Core Zone, followed by middle aged sal with 38.20%. While the mature crops form 4.30% of all three age classes under three forest types, the young age crop forms only 1.60%.

Age Class-wise Area (Ha.)

Range	Teak		Total	Sal			Total	Miscellaneous			Total	Grand Total
	Young	Middle		Young	Middle	Mature		Young	Middle	Mature		
Bhaisanghat	0.0	32.5	32.5	46.4	3163.0	4.5	3213.9	0.0	9732.1	30.9	9762.9	13009.3
Kanha	4.1	0.0	4.1	62.7	4298.3	85.9	4446.9	0.0	6251.2	726.3	6977.5	11428.4
Kisli	0.0	0.0	0.0	134.8	3066.6	357.6	3559.0	828.4	7995.3	89.2	8912.9	12471.9
Mukki	0.0	0.0	0.0	139.0	7046.1	48.9	7233.9	22.3	4982.4	0.0	5004.8	12238.7
Sarhi	11.6	1.5	13.1	0.0	1948.8	0.0	1948.8	0.0	9155.9	959.8	10115.7	12077.5
Supkhar	0.0	6.9	6.9	57.1	11307.5	338.6	11703.2	0.0	6853.2	847.8	7701.0	19411.0
Total	**15.6**	**40.9**	**56.5**	**440.0**	**30830.1**	**835.5**	**32105.6**	**850.7**	**44970.0**	**2654.0**	**48474.7**	**80636.8**
Percentage	**0.0**	**0.1**	**0.1**	**0.5**	**38.2**	**1.0**	**39.8**	**1.1**	**55.8**	**3.3**	**60.1**	**100.0**

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CHAPTER – 8

VILLAGE RELOCATION

8.1 Background:

The present Kanha Core Zone used to be a typical Indian forest landscape dotted with a large number of villages/ settlements with their inhabitants and cattle populations. The village life had a touch of aboriginality as the majority of populations in these villages belonged to the Scheduled Tribes, mainly the Gonds and the Baigas. As already stated in an earlier chapter, these villages enjoyed considerable access to the nearby forests for their needs and demands of grass, fuel wood, timber and a wide range of miner forest produces. The hunting of wild animals in the tract by a host of methods was only a way of life. Laxity in the enforcement of the existing Acts/ Rules relating to wildlife conservation added further to the plunder of natural resources. This automatically resulted in a perceptible biotic pressure on the forests and wildlife of the vicinity of these forest villages **(Appendix-68)**.

The hard ground barasingha was the species that suffered most in this background and its population declined sharply in its habitats. The forest department was much concerned about the dwindling population of this handsome cervid, and took urgent initiatives to stabilize and reverse this situation. In the backdrop of the "save the barasingha" programme in 1969, the relocation of Sonf village was initiated to reclaim around 1000 ha. of additional land for the barasingha. Very shortly, this village relocation proved to be a most crucial measure, and was the turning point in the conservation history of barasingha in this protected area.

The National Park was included in Project Tiger in 1973-74, and the philosophy of this ambitious conservation project required that the National Park must remain a zone of tranquility for the protection and propagation of wildlife. Acting upon this guideline, the Park Management, which had already reaped the benefits of the released habitat of the erstwhile Sonf village, started making sincere efforts to relocate some more forest

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villages. This proved to be a very arduous and cumbersome task, requiring, on the one hand, a lot of patience and sympathy towards the target villages, and on the other, sheer tactfulness, persuasion, and many confidence building measures. The Park Management has successfully relocated as many as 28 (including Jami in 2010) forest villages outside the National Park between 1969 and 2010. The relocation has helped the Park Management reclaim 5794.272 ha. of wildlife habitat. Though the relocated deserve full sympathy and utmost care, it is difficult to visualize the present Core Zone with all these villages still inside and steadily undergoing the typical dynamics of Indian demography and animal husbandry. The old village sites are undoubtedly the finest habitats of herbivores - the main prey base of tigers and co-predators in the protected area.

While there was no attractive and concrete government policy as such, the relocation of all these villages was carried out in different years and in a phased manner, with desired/ appropriate inputs, such as site clearance, house construction, ploughing of fields, approach roads and drinking water facilities etc. provided at the new sites of resettlement **(Appendices-28A & 28B)**.

These relocated forest villages were resettled outside the Kanha Core Zone. The current status of the resettlement of these villages is as under:

Sl. No.	Name of Relocated Forest Village	New Habitation Site	Under Forest Division
1	Sonf	1. Bhanpurkheda	East Mandla (T)
2	Ronda	1. Premnagar	Kanha National Park
		2. Vijaynagar	Kanha National Park
		3. Kariwah	Kanha National Park
3	Silpura	1. Ajaynagar	Kanha National Park
		2. Raniganj	Kanha National Park
4	Matigahan	1. Indra	Buffer Zone Division
5	Bamhnidadar	1. Hirapur (Balgaon)	Buffer Zone Division
6	Sondar (K)	1. Kapotbehra	West Mandla (T)
7	Kisli		
8	Indri		
9	Bisanpura	1. Tatighat	North Balaghat (T)
		2. Jamjhiria	North Balaghat (T)
10	Sondar (M)	1. Mukki	Kanha National Park

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11	Ghorella	1. Mukki	Kanha National Park
		2. Dhaniajhor	Kanha National Park
12	Oarie	1. Mukki	Kanha National Park
13	Parsakheda (Parsatola)	1. Mukki	Kanha National Park
14	Adwar	1. Bandhankhero	Buffer Zone Division
		2. Semarkhero	Buffer Zone Division
		3. Juwaritola	Buffer Zone Division
		4. Ghorsibehra	Buffer Zone Division
15	Deoridadar	1. Naunadar	East Mandla (T)
16	Chilpura	1. Tatma	East Mandla (T)
17	Baspahra	1. Chhatarpur	Kanha National Park
18	Jatadabra	1. Ghorsibehra	Buffer Zone Division
19	Chakarwah	1. Khaksatand	Buffer Zone Division
20	Dudhania	1. Bandhankhero	Buffer Zone Division
		2. Murenda	Buffer Zone Division
21	Katoldih	1. Hirapur	Buffer Zone Division
22	Ladwa	1. Navalpur	Buffer Zone Division
		2. Chhatarpur	Kanha National Park
23	Gaydhar	1. Chhatarpur	Kanha National Park
		2. Navalpur	Buffer Zone Division
		3. Khaksatand	Buffer Zone Division
24	Kawajhar	1. Navalpur	Buffer Zone Division
		2. Navnadar	Buffer Zone Division
25	Piperwara	1. Chimaghundi	East Mandla (T)
26	Supkhar	1. Bajghundi	Buffer Zone Division
27	Kanha	1. Manegaon	Kanha National Park
28	Jami	1. Mandla	East Mandla (T)
		2. Balaghat	North Balaghat (T)
		3. Kabirdham (CG)	Kabirdham (T)

The Kanha Management regards the relocation of the first 27 villages as a great sacrifice of the villagers for wildlife conservation, and makes the utmost efforts to ensure that the relocated communities are still cared for satisfactorily. All these villages are covered by respective Ecodevelopment Committees (EDC), and are also prioritized by the Kanha Management for their upliftment/ development. Regular allocations received from the State government as well as from the National Tiger Conservation Authority, New Delhi are spent on these villages. Besides, funds are also diverted specially to the relocated villages from the *Kanha Vikas Nidhi* every financial year **(Appendix-29)**.

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8.2 Biotic Pressure of Forest Villages:

Forest villages located inside the Core Zone do exert biotic pressure around their peripheries ultimately impacting the Core Zone. The cases of intrusion, illicit MFP collection, illicit grazing, illicit felling, several forms of poaching, and quarrels with park personnel are very common. Needless to say, the human population of these villages is showing a typical Indian decadal demographic growth. The same is also true of the cattle population with most defective animal husbandry practices and their consequent dependence on the bio-resources of the Core Zone. Besides, the Park Management also appreciates the problems these villages have to face in the light of various Acts and Rules for enforcing forest and wildlife conservation that may threaten their tendencies to depend on bio-resources. Conservation Acts and Rules may also discourage any development activities that would otherwise be very important for the upliftment of these villagers. In this way, such villages in the Kanha Core Zone are doomed to become islands, unfortunately, far away from the rapid development of other villages located near the mainstream of progress. Similarly, the existing park – people setup in Kanha actually drags rather uncomfortably at the cost of each other, which is bothersome to both.

8.3 Background of New Relocation Policy:

The relocation of 27 forest villages from the Kanha National Park, till the writing of the Tiger Task Force Report in 2005 (constituted by the govt. of India), was a tremendous feat as far as wildlife conservation in the country is concerned. Till then, of the 80 forest villages so relocated from the different National Parks of the country, 27 were from the Kanha National Park itself. This shows the commitment of the then Park Management to wildlife conservation in the National Park. It was, however, clear that unless there was a special and attractive policy for relocation, the people living inside protected area were bound to oppose it vehemently.

There is no doubt that such relocation requires funds, facilities, administrative expertise and commitment from the respective Park Managements. It is very important to note that

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if relocation is not carried out to the satisfaction of the relocated, it leads to antagonism and alienation of the local communities. Besides, the next efforts for relocation become all the more difficult as the people of target villages already become well aware of the bitter experiences of the past.

In view of the above and on the recommendations of the report of the Tiger Task Force, 2005, the National Tiger Conservation Authority, New Delhi, a statutory body under the Govt. of India laid down a new relocation policy. The salient features of this policy are as under:

- The Wildlife (Protection) Act, 1972 (amended subsequently), as well as the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, require that rights of people (Scheduled Tribes and other traditional forest dwellers) recognized in forest areas within core/critical tiger/wildlife habitats of tiger reserves/protected areas may be modified and resettled for providing inviolate spaces to tiger/wild animals. This requires payment of compensation (rights of settlement in addition to the relocation package offered under the Central Sponsored Scheme at present). Chapter IV of the Wildlife (Protection) Act, 1972 (Section 24) provides for acquisition of rights in or over the land declared by the State Government under Section 18 (for constituting a Sanctuary) or Section 35 (for constituting a National Park). Sub-section 2 of Section 24 of the Wildlife (Protection) Act, authorizes the Collector to acquire such land or rights. Therefore, payment of compensation for the immovable property of people forms part of modifying/ settling their rights which is a statutory requirement.

- The ongoing study and the analysis of the available research data on tiger ecology indicate that the minimum population of tigresses in breeding age, which are needed to maintain a viable population of 80-100 tigers (in and around core) require an inviolate space of 800-1000 sq. km. Tiger being an “umbrella species”, this will also ensure viable populations of other wild animals (co-predators, prey) and forest, thereby ensuring the ecological viability of the entire area / habitat. Thus, it becomes

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an ecological imperative to keep the core areas of tiger reserves inviolate for the survival of source populations of tiger and other wild animals.

Based on the recommendations of a professional agency, a new package for village relocation/rehabilitation has been proposed, with the following options / norms, which adequately covers the "National Rehabilitation & Resettlement Policy, 2007", while taking into consideration the difficulties/ imperatives involved in relocating people living in forest areas:

The proposed package has two options:

8.3.1 **Option I** – Payment of the entire package amount (Rs. 10 lakh per family) to the family in case the family opts so, without involving any rehabilitation / relocation process by the Forest Department.

8.3.2 **Option II** – Carrying out relocation / rehabilitation of village from protected area/ tiger reserve by the Forest Department.

In case of option I, a monitoring process involving the District Magistrate of the concerned district(s) would be ensured so that the villagers rehabilitate themselves with the package money provided to them. In this regard, a mechanism involving handholding, preferably by external agencies, should also be ensured while depositing a considerable portion of the amount in the name of the beneficiary in a nationalized bank for obtaining income through interest generated.

In case of option II, the following package (per family) is proposed, at the rate of Rs. 10 lakh per family:

(a)	Agriculture land procurement (2 hectare) and development	:	35% of the total package
(b)	Settlement of rights	:	30% of the total package

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(c)	Homestead land and house construction	:	20% of the total package
(d)	Incentive	:	5% of the total package
(e)	Community facilities commuted by the family (access road, irrigation, drinking water, sanitation, electricity, tele-communication, community center, religious places of worship, burial/cremation ground)	:	10% of the total package

8.4 Relocation of Jami Village:

Jami forest village, established in 1930, was one of the eight forest villages that fell within the Core Zone of the Tiger Reserve. The village, surrounded on three sides by hillocks, occupied a very significant wildlife habitat of the Supkhar forest range.

The total area of the village was 105.210 ha. It was located in the north-eastern part of the Core Zone, and was one of the nine forest villages of the Supkhar range. The total population of the village was 412 belonging to 64 families. As per the definition of a "family" envisaged in the new relocation policy of the NTCA, New Delhi, as well as that of the MP State Govt., the 66 families were further divided into and identified as 153 families for the purpose of bank accounts, compensations and monitory benefits etc. relating to the relocation. Of the 153 families, 105 belonged to the Gonds, 33 to the Baigas, and 15 to the Other Backward Castes.

Jami was one of the four forest villages that chose to be relocated under Option-I as prescribed in the new Relocation Policy. As all the four villages fell within the Balaghat district, the empowered district administration was automatically involved to oversee and finalize the relevant issues, through a sub-divisional and a village level committee for the identification of families, payment of compensation through bank accounts and extinguishment of rights etc. These committees also facilitated the target families in the selection, purchase and registry of new lands, the operation of their bank accounts and resettlement at new sites.

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The Kanha Management wanted to make this resettlement a model undertaking under the new relocation policy, and to ensure fully transparent, hassle-free, and people-friendly relocation so that the remaining forest villages may also be inspired to move out of the Core Zone and join the mainstream of development in the state. Besides the regular staff of the concerned range and officers, the Park Management also involved two retired forest officers who had spent their entire service span in the Core Zone, and were well-known to these villagers. It proved to be a tremendous morale booster for the villagers who could now freely talk to them about their doubts, confusions, and problems. Besides, as per the relocation guidelines of the NTCA, an external agency was also to be involved for handholding support in the relocation of forest villages. The Park Management requested World Wildlife Fund for Nature-India, a wildlife organization of world repute, to extend its support to this ambitious relocation programme. WWF asked its Mandla branch of the Satpura-Maikal Landscape Project to consult and coordinate with the Park Management and play its role sincerely in this relocation programme. The field personnel of this project established their headquarters near Jami and, in close coordination with the regular staff/ officers of the park, facilitated these families throughout the relocation.

As the Park Management received financial allocation from the NTCA for only Jami village in the 2009-10 financial year, the other three forest villages could not be relocated.

8.4.1 **Salient Points of the Jami Relocation:** The salient points of the relocation process of Jami village are as under:

- Decisions on the time schedules of publication of survey lists of the 4 villages, and invitation and disposal of objections were taken at the meeting dated 26-06-2008 held by Collector, Balaghat. Regarding the calculation of 18 years of age, date 01-01-2008 was adopted as final.

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- The preliminary surveys of 822 families belonging to Jami, Sukdi, Ajanpur and Jholar forest villages were completed, and the survey lists were sent to Collector, Balaghat vide letter No. 2005 dated 13-07-2008.
- The survey lists were published in the villages through the Gram Panchayats on 26-08-2008, and the objections received were disposed of on 11-09-2008 by SDM, Baihar.
- The Collector of Balaghat reviewed the progress of relocation work on 29-01-2009. As the non-receipt of budget delayed the relocation process, the calculation of 18 years of age was extended upto 01-01-2009, and the Chief Medical & Health Officer (CMHO) of Balaghat was informed to have the remaining certificates pertaining to the disability prepared.
- The Collector of Balaghat took the following decisions at the review meeting of relocation work on 23-05-2009:
    - Completion of the selection process of the beneficiaries of the Sukdi, Ajanpur, Jholar and Jami forest villages.
    - An amount of Rs. 1390.00 lakh, received from the Govt. of India, has been deposited into Collector (Land Acquisition), Balaghat PD account.
    - Two bank accounts of each selected beneficiaries be opened at the State Bank of India, Branch Baihar. The Corporate Liquid Term Deposit (CLTD) account would be a joint account of the Collector and the beneficiary, while the second account would be of the beneficiary from which he would be able to withdraw money.
    - Under Phase-I, out of the money received for the Jami forest village, Rs. 1.00 lakh be deposited into the personal savings account of each family, and the remaining amount of Rs. 9.00 lakh be deposited into the respective beneficiaries' CLTD accounts and the interest would be transferred into their savings account.
    - In order to release money from the beneficiaries' joint accounts, as per their demands from time to time, the validity/ justification of the same would be verified by the Gram Panchayat, Patwari, Forest Guard and NGO of the

respective areas to start the proceeding of releasing the money from the joint account.

- On 27-06-2009, the widows, divorcees and the orphans registered in the list of the relocated of Jami forest village were verified by a joint team of the revenue and forest department in presence of the Sarpanch, Rol Gram Panchayat and villagers, and the underage (non-adults) heads of families were excluded after the comparison of date of births. As per the revised list, 153 families were found eligible for relocation as under:
  - The list of families for relocation as published on 28-08-2008, 139 families as on 01-01-2008.
  - The number of the eligible and non-eligible families after verification by the sub-divisional level committee and revenue team as on 01-01-2009:
    - Number of families included in the list: 30
    - Number of families excluded from the list: 18
  - Total number of families for relocation: 153
  - After the last announcement of the list of 153 eligible families of Jami forest village by Collector, Balaghat, money will be deposited into the joint accounts of relocated families.

Sl. No.	Particulars	No. of Families
1.	Adult men	112
2.	a. Unmarried women b. Married women	5 5
3.	a. Widow b. Estranged	17 3
4.	Orphan	3
5.	Handicapped	8
	Total:	**153**

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- The Collector of Balaghat vide his letter No. 11001 dated 11-09-2009 asked an additional budget of Rs. 140.00 lakh so that Rs. 10.00 lakh per family may be deposited into the accounts of all the 153 families, and they may be relocated outside the Core Zone after harvesting the *Kharif* crop and before harvesting the second crop.
- The list of 153 eligible families was published and the SBI, Baihar branch was instructed to open the accounts of beneficiaries vide Collector (Land Acquisition), Balaghat order No. 14083/Land Acquisition/2009 dated 26-09-2009. Accordingly, the officers of the SBI, Baihar branch camped at the Jami village and started opening the accounts.
- Information on the savings accounts of 153 families was received vide SDM, Baihar letter No. 2414/Adm.1/09 dated 19-11-2009.
- The Collector of Balaghat was requested by this office letter No./DM/3207 dated 23-11-2009 to deposit Rs. 10.00 lakh per family into the savings and CLTD accounts of 139 families. As the remaining 14 families were included after the disposal of objections, the money into their accounts will be deposited after the receipt of budget.
- The Collector of Balaghat (Land Acquisition) vide letter No. 18402/ Land Acquisition/2009 dated 02-12-2009 sent the bank draft No. 617671 dated 02-12-2009 for Rs. 1390.00 lakh to the SBI, Baihar branch and instructed them to deposit Rs. 1.00 lakh into the personal savings account and Rs. 9.00 lakh into the joint account (head of family and Collector, Balaghat) of each family.
- This office sent letter No./DM/ 94 dated 11-01-2010 to the National Tiger Conservation Authority, New Delhi to release Rs. 140.00 lakh for the remaining 14 families.
- Rs. 1.00 lakh was transferred to the accounts of 139 beneficiaries, and the CLTD certificates of Rs. 9.00 lakh were prepared by the SBI, Baihar branch.
- As per the instructions of the Collector of Balaghat at the meeting dated 28-07-2009, the SDM, Baihar vide letter No. 203 dated 08-02-2010, constituted a village level committee, including the Sarpanch, Patwari, Range Assistant/ Forest Guard and a member from WWF-India.

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- This committee examined the documents of immovable properity, house, agricultural land etc. being bought by the relocated, to recommend to the sub-divisional level committee for the release of the money from the CLTD account.
- The families started moving out gradually and by 03-06-2010 the old Jami village was abandoned completely. As the Park Management did not receive budget from the NTCA, New Delhi for 14 families, each family was allocated Rs. 1.00 lakh from the *Kanha Vikas Nidhi* in the anticipation of allocations to be received in future from the NTCA, New Delhi. Ultimately, the required allocation was made by the NTCA, New Delhi.

All the 153 relocated families have settled down outside the Core Zone in difference places. The current status is as under:

District	Tehsil	Police Station	Name of Village	No. of Relocated Families
Balaghat (MP)	Bihar	Garhi	Koylikhapa	9
			Hirapur	6
			Pondi (Garhi)	1
			Rol	8
		Birsa	Charchandi	4
		Baihar	Baihar	4
			Total:	**33**
Mandla (MP)	Bichiya	Motinala	Chandgaon	8
			Murkuta (Indri)	7
			Margaon	2
			Kaluakhera	5
			Indri	2
			Indri (Murkuta)	5
			Indri (Karondatola)	29
		Bichiya	Sijhora	3

	Mavai	Motinala	Bhimdongri	8
			Khalondi	6
			Bhalapuri	6
			Total:	**81**
Kabirdham (CG)	Bodla	Daria	Lahbar	5
			Ajna Lahbar	2
			Chhapla	3
			Daria	3
			Samnapur (Daria)	4
			Kharia	5
		Chilpi	Rajadar	14
			Bahnakhodra	1
		Bodla	Kerajhola	2
			Total:	**39**
			Grand Total:	**153**

In this way, the relocation of Jami forest village from the Core Zone under Option-I was peaceful, fully transparent and hassle-free. There was no confusion or any altercation throughout this relocation programme. There was no complaint of any sort received by this office till the writing of this Tiger Conservation Plan. Several officers, journalists and NGIs also visited the area during the relocation and talked to the villagers about their inconveniences and problems, and found that they were all happy, satisfied, and were moving out willingly.

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CHAPTER – 9

WILDLIFE HEALTH & ELEPHANT MANAGEMENT

9.1 Wildlife Health:

The surveillance and monitoring of wildlife diseases under comprehensive wildlife health management have acquired great significance in good wildlife protected areas all over the world. Wildlife diseases have proved to be one of the many decimating factors causing high mortality among wild animals in some of well established wildlife protected areas. Besides, it is now generally recognized that countries that carry out disease surveillance of their wild animal populations are likely to understand the epizootiology of specific infectious disease and zoonotic infections, and are therefore better prepared to protect wildlife, cattle and human population.

Wildlife diseases may occur in many different forms in a wide range of wildlife species and populations. Diseases, when expressed in free-ranging animals, may also have a significant effect on wildlife ecologies. While some diseases exist as asymptomatic, sub-clinical infections, without any apparent ecological impact and of no consequence they may also results in dramatic epizootic outbreaks characterized by high morbidity and mortality.

Experts also suggest that in future climate change will have significant effects on wildlife, domestic animal, and human diseases. Rapidly growing human populations could aggravate already limited water availability and increase habitat destruction, providing yet more opportunities for infectious diseases to cross from one species to another. Scientists have also listed out some diseases which might play havoc with wild animal populations.

The above background apart, the Park Management's immediate concern is the prevention of the outbreak of any endemic disease. The protected area after all harbours two major endangered wildlife species – the tiger and barasingha. While there has been

no instance of any major epidemic in the Core Zone, the Management is always alert and cautious as far as wildlife health management is concerned.

9.1.1 **Veterinary Setup:** A wildlife veterinarian, trained in wildlife management, has been posted to the Tiger Reserve since 2001. Presently, there is a modest setup for wildlife health management within the Tiger Reserve. The wildlife veterinarian is responsible for dealing with the health aspects of wildlife both in the Core and Buffer divisions. Wildlife health management in the Kanha Core Zone consists in the understanding and prevention of infectious diseases from village cattle, their timely vaccination, drawing inferences of diseases/ infections from postmortems, treatment of sick and injured animals and monitoring physical health of wild ungulates. The veterinary setup includes exclusive space in the research laboratory of Kanha, postmortem kit, emergency medicines, tranquilizing guns with medicines, and some field instruments etc. The availability of veterinary equipment/ medicines is appended **(Appendix-30).**

9.1.2 **Wildlife Diseases:** While there has been no serious instance of epidemic in the Core Zone for many years, the Park Management is always alert and cautious about the outbreak of any such pestilence. The livestock of the villages still living inside and that of the villages located very close to the park boundary is regarded as a reservoir of diseases for wildlife.

Most wildlife protected areas, including the Kanha Core Zone, in India have, more or less, become islands in a vast sea of human population. The protected area also has a pastoral history, and the already relocated 28 forest villages from the Core Zone also had a huge livestock. The interface of wildlife and domestic ungulates had continued for many years in the present wildlife habitats till the relocation of these villages from the Core Zone. Some of the causative factors of pastoral diseases are known to remain dormant for many years before recurring again. Besides, owing to the deciduous nature of the valley forests, the sylvatic

cycle of the landscape may also foster disease transmission through vectors, by blending with the pastoral cycle.

Further, the Core Zone is surrounded by a large number of forest and revenue villages. Even inside the erstwhile National Park, most of which is now the Core Zone, there are still 17 forest villages. All these villages typically domesticate a huge number of cattle. While most cattle may not be productive, and the practice is rather defective as far as animal husbandry is concerned, villages are emotionally very much attached to the present way of life. While the Park Management tries its best to control illicit grazing in the Core Zone, there is still every possibility of interactions/ intermingles between wild animals and village cattle through common use of waterholes close to the park boundaries, crop depredation and illicit grazing in the peripheral areas of the Core Zone. These interactions/ intermingles are actually sure source of the transmission of diseases.

9.2 Types of Diseases:

Past management of wildlife health and general epidemiology of the cattle of the surrounding villages suggests the occurrence of the following types of diseases in the Core Zone:

<u>Bacterial Disease</u>:

Name of the Disease	Etiological Agents	Species Affected	Diagnosis	Prophylaxis	Treatment
Anthrax	Bacillus anthracis	Leopard, elephant, primates, Gaur, chital, barking deer, sambar, barasingha, wild boar	Blood smear. Biological test. Cultural tests. Ascoli's test	Attenuated spore vaccine cattle 1 c.c. S/C. sheep and goats 0.3-0.5 c.c.	Penicillin in massive doses, till recovery. Streptomycin 8-10 gm. daily in 2 doses I/M Antiserum I/V in 100/ 200 ml. with antibiotics.

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Black quarter	Clostridium Chauvoei	Leopard, elephant, primates, Gaur, chital, barking deer, sambar, barasingha, wild boar	Clinical sings, postmortem examination, immunological & biological test	Formalized Vaccine cattle 5 c.c. S/C. sheep and goat 2 c.c.	Penicillin 5000 units per lb. b.wt.
Pasturellosis	Pasteurella septica	Tiger, Elephant, primates, Gaur, chital, barking deer, sambar, barasingha, wild boar	Blood smear exam. Biological tests. Cultural tests.	Adjuvant vaccine upto 300 lb, 2 ml. above 300 lb, 3 ml.	Streptomycin 5-10 mg. per lb. b.wt. Sulphameathine 33 1/3% S/C. or I/V gives good results.
Brucellosis	Brucella abortus	Barasingha herd, Gaur, chital, barking deer, sambar, cattle, sheep, goat, pig	Serum agglutination test, Tube method and Quick method. Biological test.	Cotton 19 female calf hood Vaccination 5 ml. S/C	Treatment not undertaken. Streptomycin and Auromycine used in the human beings.
Tuberculosis	Mycobacterium tuberculosis var. bovine.	Carnivores, primates, artiodactylids & proboscida	Pus smear from the affected parts stained with Z-N method. Acid fast organisms are seen. Biological test in G. pigs. Tuberculin test.	B.C.G. Vaccination 50-100 ml., S/C, calves are vaccinated as soon as birth, not much used because animals remain as reactors.	Not much used.
Johne's disease	Mycobacterium paratuberculosis	Artiodactylids	Rectal mucus membrane smears examination. Biological test. Johnin test.	Rinjard and Valle Vaccine. Living animal react to tuberculin test.	Not much used. Streptomycin 25 mg. per lb. b.wt. daily gives transient improvement.

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Glanders disease	Malleomyces	Equidae & felidae	Pus smear Exam, Biological test. Strau's reaction in G. pigs, Mullein test.	No vaccine	Sodium sulphadiazine is effective and is tried in hamsters.
Contagious Caprine Pleuropneumonia	P.P.L.O.	Goats	Symptoms cultivation and isolation of the agent. Goats experimentally infected.	Attenuated vaccine 2 ml. S/C	Terraymycine has been found to be effective.
Mastitis	Streptococcus staphylococcus	Artiodactylids	Milk sediment smear exam. Strip cup method. Whiteside test. Cultural exam.	No vaccine, Toxoid against Staphylococcus tried but not much useful.	Penicillin intramammary is very useful in early stage. Dihydro Streptomycin is also effective. Use antibiotic after A.S. test.
Fowl Cholera	Pasteurella septica	Birds	Blood smear exam. Isolation and identification of the organism	Killed broth culture is used. Not much useful	Sulphamezathine and Sulphadimidine orally by injection are useful.
Leptopirosis	Leptospira pomona and canicula	Carnivores, primates, artiodactylids & proboscida	Demonstrate the organism in the urine under the dark ground illumination. Cultivation of the agent in the chicks.	Kill bacteria	Vaccine is still doubtful.

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Viral Disease:

Name of the Disease	Etiological Agents	Species Affected	Diagnosis	Prophylaxis	Treatment
Foot & Mouth	Virus O.A.C. types. SAT-1, SAT-2, SAT-3, ASIA-1	All ruminants	Symptoms and the nature of the epidemic. Isolation of the virus in the G. Pigs and calves.	Crystal violet vaccine, not much used. It is costly to prepare.	Symptomatic Treatment
Pox	Virus	Primates, & proboscida	Symptoms-Isolation of the virus in the eggs.	Low virulent Pigeon Pox vaccine is available and it is rubbed on the legs with brushes.	Symptomatic treatment.
Rinderpest	Virus	All bovids & antelopes	Symptoms and the history of the epidemic, biological test. Serum neutralization test.	Goat adopted tissue vaccine is used. TCRPV.	Hyperimmune serum. Disease has been eradicated from India
Hog Cholera	Virus	Wild boar	Symptoms serum neutralization test.	Modified, live vaccine and crystal violet vaccine. Not yet prepared in our State.	Hyperimmune serum is the only available treatment.
Canine distemper	Virus	Canids	Symptoms Biological in Ferrets	Distemper virus vaccine S/C, dose from 6-9 weeks age are protective.	Symptomatic treatment.

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Ranikhet Disease	Virus	Birds	Symptoms and history of the epidemic. Isolation of the virus int eh egg. H.I. test.	Attenuated Vaccine 0.5 ml. S/C	Symptomatic treatment.
S.A.H.S.	Virus	Equides	Symptoms and history of the epidemic. Isolation of the virus in suckling mice. Serum Neutralization test.	Attenuated live vaccine	Symptomatic treatment.
Contagious respiratory (C.R.D.) disease	Bacteria & P.P.L.O.	Birds	Symptoms, quick agg. test. Isolation of the causal agents.	No effective vaccine	Symptomatic treatment.
Rabies	Virus	Carnivores, primates, artiodactylids & proboscida	Symptoms Fluorescence antibody coating test. Biological test mice.	Attenuated Flury strain (L.E.P.) killed vaccine.	No treatment.

Parasitic Disease:

Name of the Disease	Etiological Agents	Species Affected	Diagnosis	Prophylaxis	Treatment
Fasciola hepatica	Trematode	Primates, artiodactylids & proboscida	Clinical symptoms		Avlothane, I, C.I. Hexachlorethane.
Schistosomiasis	S. nasalis	Ruminants & proboscida	Clinical symptoms		Control of snails by ducks and geese and $CuSo_4$. Treatment of water tanks. Antimony preparations.

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Surra	T. evansi	Carnivores, ruminants & proboscida	Symptoms, Blood smear examination, M.B. 693 test.		Naganol Bayers 205 Antripol Antricide, Diaminazine aceturate
Babesiosis	B. canis, B.bigemina	Carnivores, ruminants & proboscida	Symptoms, Blood smear examination.		Acapirin Babosan, Diaminazine aceturate
Anaplasmosis	A. marginale	Ruminants & birds	Symptoms, Blood smear examination C.F. test.		Tetracyline 3-5 mg. per lb. b.wt. one injection.
Coccidiosis	Emieria	Ruminants & birds	Symptoms and faecal matter examination		Sulpha drugs-Sulphonamide Nitrofurazone 1%, and in food Atebrine.

Fungal Disease:

Name of the Disease	Etiological Agents	Species Affected	Diagnosis	Prophylaxis	Treatment
Aspergillosis	A. fumigatus	Birds	Symptoms Isolation of the fungus, and identification.		
Epizoatic lymphangitis	Cryptococcus farciminosis	Equidae	Pus smear examination.		
Ringworm	Fungus	Carnivores, ruminants & proboscida	Lesion on the affected part, Wood's light, scrapings examination.		Salicylic ointment, Resorcine, Griesofulvin.

Some of the common diseases that occur in the villages around the Kanha Core Zone are as under:

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VIRAL DISEASES	MYCOTIC DISEASES
1. Rabies	1. Dermatomycosis
2. Louping ill.	2. Histoplasmosis
3. Infectious Hepatitis	3. Cryptoccosis
4. Vesicular Stomatitis	**HELMINTH DISEASES**
5. Encephalomylitis	1. Fasciolopsiosis
BACTERIAL DISEASES	2. Amphistomiasis
1. Paratuberculosis	3. Schistosomiasis
2. Salmonellosis	4. Echino coccosis
3. Leptospirosis	5. Trichinosis
4. Pasturellosis	6. Anchylostomiasis
5. Brucellosis	7. Ascariasis
6. Anthrax	8. Strengyloidosis
7. Actino bacillosis	9. Taeniasis
8. Black disease	**ECTOPARASITIC**
9. Campylobacteriosis	1. Acariasis
PROTOZOAN DISEASES	2. Myiasis
1. Trypanosomiasis	
2. Toxoplasmosis	
3. Babesiosis	
4. Sarcosproridiosis	
5. Anaplasmosis	

Wild animals may contract the following zoonotic diseases which normally affect the livestock:

VIRAL DISEASES	MYCOTIC DISEASES
1. Rabies	1. Dermatomycosis
2. Encephalomyelitis	2. Histoplasmosis
3. Herpes B. Virus	3. Cryptoccosis

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4. Vesicular Stomatitis
5. Psittacosis
6. Influenza
7. Louping ill.
8. Lassa fever
9. Infectious Hepatitis A.
10. Lymphocytic choriomeningitis

RIKETTSIAL DISEASES

1. Q. Fever

BACTERIAL DISEASES

1. Tuberculosis
2. Salmonellosis
3. Anthrax
4. Leptospirosis
5. Listeriosis
6. Pasturollosis
7. Tularaemia
8. Brucellosis
9. Melioidosis
10. Campylobacteriosis

ECTOPARASITIC

1. Acariasis
2. Myiasis

PROTOZOAN DISEASES

1. Trypanosomiasis
2. Toxoplasmosis
3. Leishmaniasis
4. Amaebiasis
5. Malaria
6. Sarcosporidiosis

HELMINTH DISEASES

1. Fasciolopsiosis
2. Paragonimiasis
3. Amphistomiasis
4. Schistomiasis
5. Echinococcosis
6. Hymenolepiasis
7. Cysticercosis
8. Trichinosis
9. Filariasis
10. Anchylostomiasis
11. Angiostrongyliasis

9.3 Vaccination:

As per Section-33 A (1) of the Wildlife (Protection) Act, 1972 (as amended upto 2006) and the Supreme Court's directive the Park Management ensures that the livestock of the villages falling within 5 km. of periphery of the Core Zone is vaccinated for infectious diseases so that the same may not be transmitted to the wildlife population of the Core Zone. The National Tiger Conservation Authority, New Delhi has also issued its

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guidelines for the proper prophylaxis of diseases contracted by wild animals. The Veterinary Departments of the Mandla and Balaghat districts have also been instructed by the State Government to lend their full technical support to the Park Management for vaccinating village cattle. The livestock is generally vaccinated for Hemorrhagic Septicemia (HS), Black Quarter (BQ), Anthrax, and Foot & Mouth Diseases (FMD). The wildlife veterinarian, assisted by *gau sewaks* (cow attendants) and concerning field staff, ensures timely and proper vaccination programme before the advent of monsoon. Instances of villagers opposing vaccination have also come to the notice of the Park Management. The opposition in some villages is due mainly to illiteracy and backwardness, and people think that the vaccination may harm their cattle in several ways. These fears and distrusts are, however, gradually getting allayed through gentle persuasion of the Park Management. The information on past years' vaccination is as under:

Year	Name of Vaccination	Total No. of Cattle Vaccinated
2005-06	Raksha Trivac/ Anthrax	2814
2006-07	Raksha Trivac/ Anthrax	3130
2007-08	Raksha Trivac/ Anthrax	3114
2008-09	Raksha Trivac/ FMD	2978
2009-10	Raksha Trivac/ FMD	1823

Animal	Diseases	Vaccine	Dose/ Route	Immunity
Cattle & Buffaloes	Rinderpest (This vaccination is abandoned due to successful eradication of disease)	• F.D.G.T.V. (for Indian breeds) • Tissue culture R.P. Vaccine (TCRP) (for exotic, crossbred cattle, sheep and goats)	1 ml. s/c 1 ml. s/c (can be used in very young calves also)	• 14 yrs. • 2 yrs. (even more as recently reported)

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Cattle & Buffaloes	F.M.D.	• Tetravalent (including A-22 Strain) IVRI. Bangalore, BAIF and Intervet Vaccines - Intervet (Concentrated) - Raksha (Ind Immunol) - Raksha OVAC (Ind Immunol)	- 10 ml. subcut. - 5 ml. subcut. - 3 ml. i.m. Cattle – 2 ml. i.m. Sheep/ goat – 1 ml. i.m.	• First vaccination at 3 months age (even earlier) • Booster: after 3 months • Afterwards: at 6 monthly intervals
Cattle & Buffaloes	H.S.	• Alum – precipitated • Oil adjuvant (IVBP) Pune	5 ml. s/c 2.5 to 3 ml. i.m.	• 6 months • 1 month
Cattle & Buffaloes	B.Q.	• Alum – precipitated Combined H.S., B.Q. vaccine also available with BAIF	5 ml. s/c	• 6 months
Cattle & Buffaloes	Anthrax	• Spore Vaccine (IVBP Pune & BAIF)	1 ml. s/c	• 1 year
Cattle & Buffaloes	Brucellosis	• Cotton-19" strain. Handle the vaccine with care (IVBP Pune)	10 ml. s/c Vaccination of calves be done at 4-8 month of age only if incidence of disease is more than 25% in the herd	
Cattle & Buffaloes	Theileriosis	NDDB-Raksha-T (Ind. Immunol.) Animals in adv. Pregnancy not vaccinated.	3 ml. s/c	• 1 year

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		Vaccine stored in liquid nitrogen		
Sheep	Enterotoxaemia	• Multi-component clostridial vaccine (IVRI & IVBP)	5 ml. s/c (2 doses. 3 weeks apart)	• 1 year
Sheep	Sheep Pox	• Tissue culture vaccine (BAIF, IVRI, IVBP)	0.5 ml. s/c (inside ear)	• 1 year
Goats	C.C.C.P.	• IVRI Vaccine	0.2 ml. (at ear tip)	• 1 year
Goats	P.P.R.	• TCRP vaccine	1.0 ml. s/c	• 1 year
Pigs	Swine Fever	• Freeze dried Tissue culture vaccine (IVBP Pune & BAIF)	1 ml. s/c (inside thigh)	• 1 year

9.4 Postmortems:

The Park Management ensures that each death of wild animals, including tigers, in the Core Zone is meticulously examined through a thorough postmortem. The main objectives of postmortems are to know the cause of death, to fulfill veterolegal and forensic obligations and the scientific study of diseases. Bio-sampling is ensured in each postmortem, and the samples are sent to the State Forensic Laboratory, Sagar for toxicological examination and their report/ findings. Bio-samples are also sent to the Wildlife Disease Diagnostic & Research Centre, Jabalpur for pathological, parasitological and other relevant examinations. In view of several cases of deaths by poisoning in the past, the Park Management ensures to obtain an authoritative/ expert opinion from the State Forensic Laboratory.

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9.5 Immobilization:

The immobilization of sick, distressed and problematic wild animals is another important activity carried out under veterinary care and expertise in the protected area. Instances of sickness and distress in wild animals are sometimes seen in the Core Zone. An ungulate may sustain serious injuries in infighting/ combats, slam into fences/ obstacles/ structures, or may simply be indisposed. Whenever a sick or distressed wild animal is reported by the staff of the Core Zone, the wildlife veterinarian immobilizes the animal and treats it with adequate medicine, and later revives it by giving an antidote. Sometimes, if it is not possible to immobilize an animal, the treatment is administered with the help of medicines darted by tranquilizing guns. Similarly, problematic animals have also to be tackled and captured carefully. Tigers and panthers are also known to create serious nuisance for villagers. They have also injured and killed a few persons in several villages in the past. These problematic animals have to be carefully identified, captured, sedated for safe transportation and released into the wild, far away from the villages where they were earlier operating. Besides, in case of repeated nuisance of any animal, the same is sent to the Van Vihar National Park, Bhopal.

9.6 Wildlife Rescue Squad:

Acting upon the guidelines issued by the Principal Chief Conservator of Forests (Wildlife), MP, Bhopal, the Park Management has also constituted a well-equipped Wildlife Rescue Squad to handle the aforementioned eventualities. The chief objective of the constitution of Wildlife Rescue Squad is proper handling of distressed and problematic animals. A total of 9 such Wildlife Rescue Squads have been constituted in the State. The structure of the Kanha Wildlife Rescue Squad is as under:

Sl. No.	Designation	Duties
1.	Assistant Director	Head of the Rescue Squad
2.	Wildlife Veterinarian	Leader of the technical work
3.	Range Officer	For providing necessary support/ assistance to the Rescue Squad team

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4.	Dy. Ranger	Coordinating members of the Rescue Squad & field work
5.	Forester	Assisting the Rescue Squad, & field work
6.	Forest Guards	Assisting the Rescue Squad, & field work
7.	Labourers	Providing manpower/ physical support during Rescue operations

The jurisdiction of the Rescue Squad of the Kanha Tiger Reserve will cover the Mandla, Balaghat and Dindori districts of the Madhya Pradesh. The activities performed by this Wildlife Rescue Squad have to be submitted in a prescribed format **(Appendix-31)**.

9.7 Expert Opinions in Court Cases:

The wildlife veterinarian is also responsible for giving expert opinions on the seized wildlife products/ materials in cases of wildlife offence investigated by the forest and police departments. The Kanha laboratory has known/ standard samples of the various appendages of wildlife such as skin, antlers, hair, hooves, nails, teeth and bones etc. On the basis of these known samples and personal technical knowledge, the wildlife veterinarian gives expert opinions. These expert opinions carry considerable value as far as the trials of wildlife offences are concerned. In case secondary opinions are also required for the samples of blood, meat, and some bones, the prosecuting agency is also advised to approach the Central for Cellular & Molecular Biology, Hyderabad and Wildlife Institute of India, Dehradun.

9.8 **Management of Departmental Elephant:**

9.8.1 **Background:** The Indian elephant is actually a wild species that has been tamed by man over the past hundreds of years. History is replete with references to the use of these elephants for wars, transportation and heavy works throughout the world. As far as our country is concerned, the elephant commands considerable religious, cultural, mythical and historical significance. There is ample evidence to suggest that a large number of tamed elephants were in the service of mankind

even as far back as in the Indus valley civilization (2500-1500 BC) and during the times of the Aryans (around 1500 BC). Our Vedic literature also mentions presence of such elephants, and their capture and training used to be regarded as an art.

9.8.2 **Tamed Elephants in MP:** Tamed elephants were also being used typically in Madhya Pradesh and Central India. Before Independence, these elephants were used by the representatives and administrative/ army officers of the British Empire for hunting wild animals and touring in difficult terrains. In the forest tracts of the Satupra-Maikal ranges, these elephants were used by the MP Forest Department to lift and carry heavy logs in difficult topographical areas and load them onto trucks, and fell trees from time to time. The passage of time witnessed the forest department turning mechanical gradually, and with the construction of good roads, availability of heavy vehicles and machinery, the services of these elephants for forestry operations were gradually dispensed with.

9.8.3 **Tamed Elephants in Kanha:** In the Madhya Pradesh of the 1950s, there were only several forest divisions that still had a few tamed elephants. In those days, the Kanha area was under the South Mandla (T) Division. Elephants available at that time were used to carry local officers and senior officers on tour for the inspection of forestry operations in the forest areas of problematic terrains inaccessible by other modes of transportation. When the Kanha National Park was established in 1955, the pressure of tourism was very low, and only important persons/ tourists visiting the park used to be carried on elephant backs for joy rides. As there was no ban on the baiting of tigers, these visitors were also sometimes allowed to see tigers at kills in the early 1960s. Gradually, the viewing of tigers at kills from elephant tops, also known as “tiger shows” became popular, and the Park Management also started charging fee for this programme.

George B Schaller came to Kanha in 1963 and stayed here for about 14 months to conduct a scientific study on the wildlife of the National Park. Schaller made

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excellent use of the available elephants to study animal behaviour closely. By that time, resident ungulates had started tolerating the close presence of these elephants. Schaller also used to tie baits for the behavioural study of tigers. During this time, wherever possible, tigers at kills were shown to tourists. Visitors were also used to be taken for joy rides in the evening. As per old records, in 1969, two elephants, a male named Jaitra and a female named Pawan Mala, brought from Khairagarh (CG), were available in the National Park. After the inclusion of the National Park into Project Tiger, baiting was restricted for only very important domestic and foreign tourists, however, it continued till 1980. By this time, tiger shows had become immensely popular in the National Park, and to make them more effective and enjoyable, the Park Management also started acquiring some more elephants. Elephants were brought from Sonpur (Bihar), Assam, Karnataka and Coimbatore (TN). Besides, some wild elephants that had crossed the Bihar-Madhya Pradesh border and entered the Sarguja forests were also captured, brought to Kanha and trained. In this way, the number of elephants in the National Park went on increasing, some also died, and now there are 16 elephants **(Appendix-32)**. Besides tiger shows, these elephants are also used for special patrolls in the Core Zone. Their role is specially important during the monsoon and they are used by the park staff to reach difficult and inaccessible parts of the protected area.

9.8.4 **Elephant Housing:** Except during the monsoon when the elephants are specially deployed in different forest ranges for patrolling, for the rest of the year the elephants are picketed/ kept at Kanha, Kisli and Mukki. The Park Management ensures that the granaries/ storehouses for the elephants are well-kept, and the kitchens where the elephants' meals/ food are prepared are always clean. Suitable structures of wooden logs have also been erected where the elephants are given their daily meals/ diets. The Park Management has also constructed sheds that are used during the treatment of sick and indisposed elephants.

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9.8.5 **Elephant Health:** The health of the park elephants is of utmost importance to the Park Management. The wildlife veterinarian is responsible for the periodic check-up, timely vaccination against common diseases, and treatment of sick elephants. He also ensures the quality of grains/ foodstuffs given to the elephants. It is also made sure that the elephants are not overworked/ exhausted by the staff during tiger shows and patrolling. Indisposed/ sick elephants are immediately taken off work until they improve completely. The Park Management has also started arranging a very special "elephant rejuvenation" camp in the rainy season for treating these elephants to special diets, cleanliness, grooming and complete relaxation etc.

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