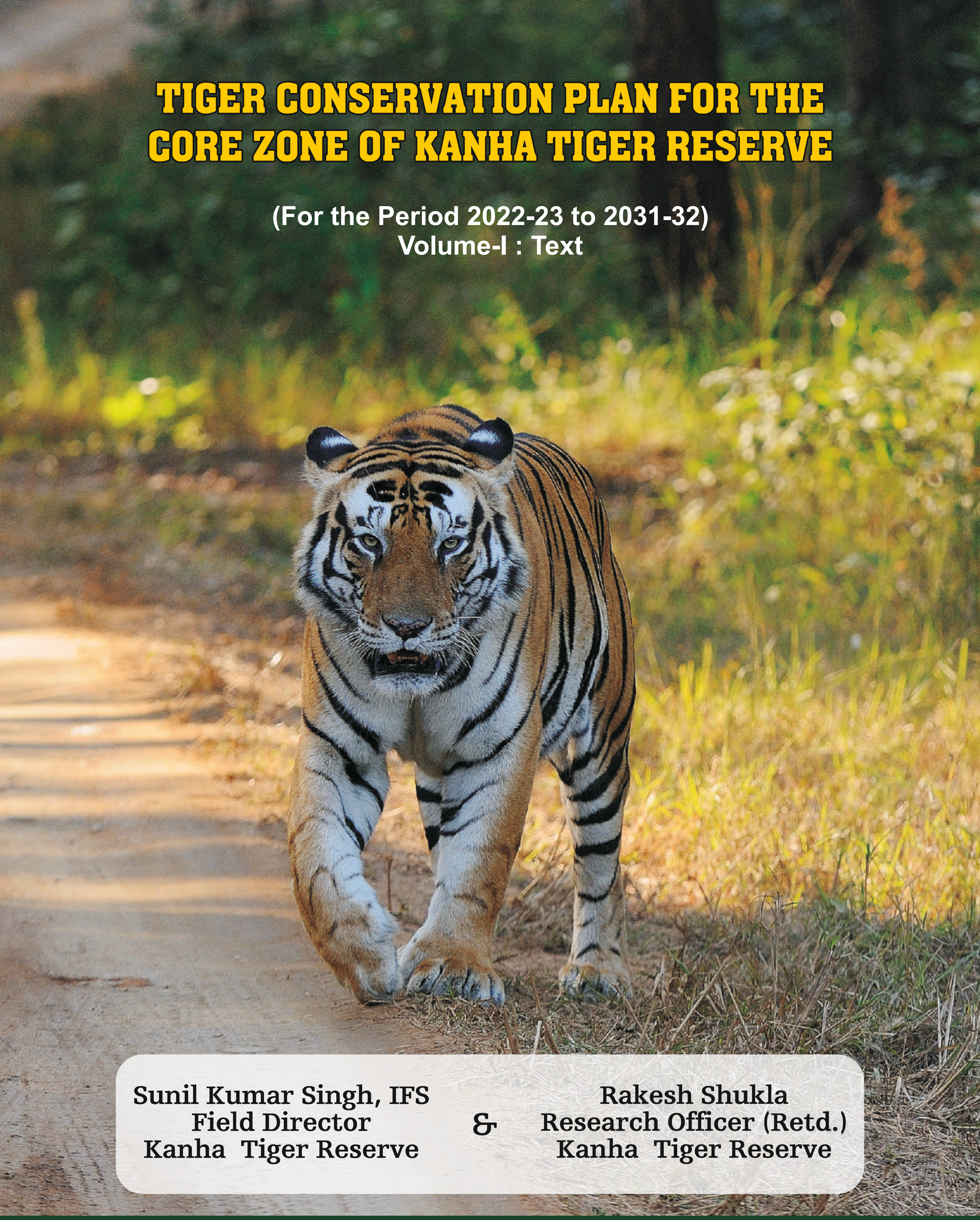

TIGER CONSERVATION PLAN FOR THE CORE ZONE OF KANHA TIGER RESERVE

(For the Period 2022-23 to 2031-32)
Volume-I : Text

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EXECUTIVE SUMMARY

TIGER CONSERVATION PLAN FOR THE CORE ZONE OF KANHA TIGER RESERVE

General Introduction

This tiger conservation plan for the core zone is comprised of two volumes. While Volume-I deals basically with the text part of the planning, including relevant maps, Volume-II contains appendices and referrals, etc. of Volume-I.

- **Volume-I** (Part-I: The Existing Situation and Part-II: The Proposed Management)
- **Volume-II** (Appendix)

Among the first nine tiger reserves in India, Kanha is now regarded as one of the best-managed protected areas not only in the country but also in south-east Asia. The tiger reserve forms part of an eco-region once renowned internationally for its rich floral and faunal attributes. Located administratively in the Mandla and Balaghat districts of Madhya Pradesh, the tiger reserve lies on the northern slopes of the Maikal Hills of the Satpuras in central Indian highlands. Immortalized by several renowned naturalists of the past such as Capt. James Forsyth, Mr. AA Dunbar Brander, and later by Mr. EP Gee, Juan J Spillet, and Dr. Salim Ali, this remnant of the central Indian highlands has become the “sanctum sanctorum” of many endangered and threatened species. Restorative efforts during the formative years followed by intensive scientific management have so far succeeded in restoring biodiversity, apart from conserving the flagship species – the tiger, and an endangered, and until recently, an endemic species – the hard ground barasingha. Besides works of several Indian conservationists and wildlife researchers, field studies by Dr. George Schaller, Dr. Claude Martin, and Dr. Paul Newton between the 1960s and the 1980s also disseminated widely the significance of Kanha as an outstanding example of in-situ biodiversity conservation in India.

These forest tracts were regarded as some of the finest and hitherto untouched wilderness areas in the country. Physical features, climatic factors and soils had imparted rich floral and faunal diversity to these forested tracts, and they supported a typical central Indian range of plant and animal species. Many widely traveled Indian and British conservationists, who had also enjoyed the finest wilderness areas of Africa, were also in awe of this region and expressed themselves generously in their accounts. Until around the first four decades of the last century, human populations in and around the present Kanha tiger reserve, was not a serious threat to the natural heritage. The region was then only sparsely dotted by small and sleepy human habitations, including marginal agriculture with an aboriginal touch. The forest tract was inhabited traditionally and chiefly by the Gond and Baiga tribes, with their basic nature friendly ways of life.

The total area of the core zone is 917.43 sq. km. The entire core zone is a Reserved Forest and derives its legal sanctity/ inviolability from Section-35 and 38-V (2) and (4) (i) of the Wildlife (Protection) Act, 1972 (amended subsequently). The core zone or the critical tiger habitat has been created as per provision envisaged under Section-38V (4)

(i) of the Wildlife (Protection) Act, 1972. This has also been notified by the MP State Govt. No. F 15-31-2007-X-2 dated 24-12-2007.

In 1976, the Govt. of Madhya Pradesh notified an area of around 1005 sq. km. as the buffer zone, which was carved out of four forest divisions of the undivided states of Madhya Pradesh and Chhattisgarh. The above conceptualized buffer zone was, however, to remain under the respective forest divisions until 1995 when the buffer zone was constituted as a separate division and placed under the unified control of the Kanha management. In 2010, the Motinala range of 203.17 sq. km. was also added to the buffer zone, and presently, the total area of the buffer zone is 1134.32 sq. km.

Goal oriented strategies, systematic conservation practices and periodic evaluation have over the years made Kanha an embodiment of the concept of biodiversity conservation in the country. While the Kanha eco-region is not a biodiversity hotspot, biodiversity conservation practices at Kanha operationally amounts to a host of highly significant objectives of conservation priorities, including sustained addressing of challenges and threats, set for this important protected area. The core zone effectively manages for posterity the over-all biodiversity of the Kanha wildlife ecosystem, including wildlife habitats for supporting a wide range of ungulate species, prey base for carnivores, specially the endangered tiger, and takes initiatives for conservation of the hard ground barasingha by garnering support from the local communities through well-established ecodevelopment committees and ecodevelopment programmes. Kanha's role also incorporates the strengthening of protection measures against all kinds of poaching, intrusion, illicit grazing and illicit collection of MFP, relocating forest villages from the critical tiger habitat to reclaim additional habitat for wildlife, translocating important wildlife species to other wildlife protected areas for reintroduction, and enhancing biodiversity in the tiger reserve by introducing locally extinct ungulate species, such as the blackbuck.

The tiger conservation plan for the core zone of the Kanha tiger reserve has been written as per basic guidelines issued by the National Tiger Conservation Authority, New Delhi, in Technical Document: NTCA/01/07, and by the MP Forest Department in *Karya Ayojna Nirdeshika, 2014*. Separate tiger conservation plans or sub-plans have been mandated for the core zone, the buffer zone and the Kanha corridor.

Volume-I (Part-I: The Existing Situation)

Volume-I of Part-I has been divided into the following 13 chapters.

Chapter-1: Introduction of the Core Zone

Name, Location, Constitution & Extent

This Tiger Conservation Plan for the core zone of Kanha tiger reserve attempts to address the conservation entity as per the final notification of the Govt. of Madhya Pradesh. The total area of the core zone is 917.43 sq. km., and is situated administratively in the Mandla and Balaghat districts of Madhya Pradesh, geographically lying in the central Indian highlands. The core zone is situated in the southern part of the Mandla district and in the north-eastern part of the Balaghat district at altitudes between around 500 and 800 meters. 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 orders. Access and approaches to the core zone by road, rail, air have been described.

Statement of Significance

Part of Kanha tiger reserve, the core zone, is one of the finest wildlife protected areas in the country. 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 floral and faunal attributes are concerned. The protected area encompasses, with around 850 plant species, typical central Indian sal and mixed woodlands along with densely foliaged large bamboo clumps as understory, and thick herbaceous and shrubby undergrowth. The woodlands are also interspersed with heterogeneous grassy plains and large clearings, with occasional tree groves. The luxuriant vegetation has manifested itself in many vegetal cover types and settings over many different physiographic features, resulting in a wide range of wildlife habitats. These wildlife habitats support a wide range of wildlife species, including major and minor fauna, some of them endangered like hard ground barasingha and tiger.

Chapter-2: Background Information & Attributes

The entire Kanha national park and the core zone are duly notified as such, and comprise legally constituted Reserved Forests 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 well-cut and cleared boundary lines of seven Reserved Forest blocks, namely Banjar valley (B/15), Jhapul (B/13), Indri (B/14), Maliadadar (B/7), Tendua (B/8), Khalondi reserve and Topla Raigarh east.

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. The flat-topped hills, or dadars, are capped by vesicular and clayey laterized rock often rich in bauxite.

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. 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 core zone also harbours some areas with high water tables that can easily be dug up as small water-pools, locally known as jhirias. The spatial and temporal distribution of water, however, is not satisfactory. And, this generally causes problems in several areas in the summer.

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: summer, rains and winter

The protected area is a fine representative of central highlands sal and mixed woodland and grassy expanses. It 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 sal forests on the lower slopes and in the valleys, the mixed forests on the upper slopes and hilltops, and the grasslands in valleys and on plateaus for a wide range of diverse wildlife habitats: distribution of forests, pinus plantations, grasslands, aquatic plants, rare plants, vegetal cover types and past studies.

The core zone supports a wide range of wildlife habitats and trophic Niches and with various faunal status. The following changes have been recorded in the wildlife habitats of the core zone since its inception: relocation of 35 forest villages, expansion of barasingha population, growth of gregarious woody trees on account of stringent protection, good regeneration of sal in many places and sporadic and gregarious flowerings of bamboos in several places etc.

Chapter-3: Status of Tigers, Co-predators & Prey Base

It is well recognized that the predator prey relationship involves the interactions between two species and their consequent effects on each other. The Kanha wildlife ecosystem supports populations of a wide range of carnivore and herbivore species, which are naturally managed and regulated under more or a less well-defined predator-prey relationship. General response of these predator and prey species to conservation practices in the core zone over the years has been encouraging, and these populations have registered a normal increase.

The assessment of prey-predator biomass and annual cropping by the carnivores is important to gauge the health of the Kanha wildlife ecosystem. As the tiger reserve supports a viable population of three major carnivore species – tigers, leopards, and wild dogs - for so many years, it is important to assess the availability of prey for them. Besides, it also needs to be determined what numbers of recruits are included into this population annually to ensure the right balance between predator and prey populations.

There are several prey species such as the barasingha, barking deer, nilgai and chousingha whose populations survive at low densities at Kanha. All these populations, however, also show their natural growth patterns and add to the overall annual recruitment into the total prey population. We have attempted to determine the tentative annual contribution of each of these ungulate populations to the total prey population of the core zone.

Kanha has been renowned worldwide for a good population of tigers. The viability of this population is reflected by frequent sightings/ photo-captures of animals of all age and sex classes. The core zone is generally regarded as a well-monitored high tiger density area. There exists a land tenure system whereby older and weaker tigers are gradually squeezed out by younger and more powerful ones so that they in turn may established their own territories and mate with tigresses. This whole systemic and tenurial complex has a strong bearing on the tiger population. Besides, abundance of tigers also results in their perpetual wandering and overlapping with dominant males, and also adding seriously to the vulnerability of cubs. Different reasons of intraspecific strife in tigers have been given.

Chapter-4: History of Past Management & Present Practices

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. 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: the Maikal range and the Satpuras.

Kanha is a promising biodiversity centre, and the following instruments of biodiversity conservation centre are used to maintain the status: effective combination of protection; species-specific and habitat-specific approaches through ecological restoration, monitoring, and cooperation of local communities: stringent protection, species-specific approaches, habitat-specific approach, monitoring and cooperation of local communities.

Three corridors have been identified and recognized connecting Kanha to three other protected areas, namely Pench, Achanakmar and Nawegaon-Nagzira. The Kanha-Phen ESZ has been finally notified by the government of India.

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.

This chapter also describes significance of management of wildlife health, proactive management, rearing & training of tigers, movement of wild elephants and wildlife tourism.

The chapter describes different aspects of ecological restoration in the core zone over the past decades on account of various conservation practices. Insect attacks and pathological problems have also been discussed: sal heart-wood borer, sal borer infestation, fluctuations in the insect population, animal response to ecological disturbance, assessment of infestation, intensity of infestation, inferential generalizations, sal defoliation at Kanha, effect of defoliation and sal borer monitoring) and other pathological problems.

Under the present administrative setup, the core zone and the buffer zone are under the unified control of the Field Director. The core zone along with the national park is in charge of a Deputy 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.

Chapter-5: Land Use Patterns & Conservation Management Issues

This chapter describes the significance of different land use patterns in the core zone, and also highlights man-animal conflict and its redress for the villagers. Assessment of inputs of other departments have also been discussed. Besides, various major conservation management issues have also been discussed.

Chapter-6: Grassland Habitat

Grarsslands, including the large and small ones, form around 11% of the critical tiger habitat, and constitute the most important habitat type. Grasslands constitute the most important habitat type in the core zone. They are regarded as highly dynamic ecosystems, dominated and co-dominated by graminoid vegetation i.e. grass and grass like plants of the family Poacae, including sedges of Cyperaceae and rushes of Juncaceae. Grasslands are said to have co-evolved with grazing ungulates, and provide a wide range of ecosystem services. Although grasses possess a wide ecological amplitude and a number of adaptations to withstand nature's vagaries, these plants also have to severely compete with woody species for light and nutrients.

Unlike natural and climatic-climax grasslands in the world, the Kanha grasslands, and for that matter most grasslands in India, are "plagioclimax", with human-induced stage of arrested ecological succession, and are regarded as anthropogenic. The chapter describes grasslands & forest edges, assessment of range conditions, reclaimed grassland habitat, structural changes on grasslands, general observations on grasslands in the core zone.

Chapter-7: Barasingha Conservation

The resurrection of the central Indian or hard-ground barasingha at Kanha is by far one of the most inspiring successes in the history of wildlife conservation in the country. Though the species has adapted to hard ground conditions of central India over a very long period of time, the cervid still shows evolutionary affinity for water and swampy areas. This chapter describes in details the successful barasingha conservation in the core zone, and also discusses the Indian swamp deer, the three sub-species, the hard ground barasingha, the Kanha enclosure, small population, metapopulations in the core zone, population expansion, population growth, reintroduction programme, practical considerations, threats to the barasingha population and timeline in barasingha conservation.

Chapter-8: Translocation and Reintroduction of Wildlife

Kanha, with its long managerial experience, is expected to play an important role in active wildlife management, which may include a number of futuristic/ anticipatory initiatives through translocation and reintroduction of wildlife species. Some major initiatives include tiger translocations, reintroductions of gaur, barasingha, blackbuck, and chital. Besides, now the proposal for reintroduction of wild buffalo is also in the final stages.

Chapter-9: Village Relocation

Village relocation is regarded as one of the most important management practices in the tiger reserve to reclaim additional wildlife habitat for increasing number of ungulates and consequent support to the tiger population. As per the guidelines/ instructions issued from the National Tiger Conservation Authority, New Delhi and the State Government, the Kanha management has put in tremendous efforts in gently persuading and encouraging target villages to relocate outside the protected area and join the mainstream of progress and development.

The village relocation programme had actually started in 1967-1969 when there was no relocation policy the first village, Sonf, was relocated. This programme continued under different schemes. The park management has successfully relocated as many as 37 forest villages (2187 families) outside the core zone between 1967-69 and 2016-17. The Kanha management reclaimed 8051.754 ha. from these villages.

The Kanha management has turned these reclaimed lands into excellent wildlife habitats attracting a number of wild animal species. Some important sub-headings include need for village relocation, further relocations, NTCA relocation policy (Option-I and Option-II), relocation of Sukdi village, brief procedure of village relocation and success of relocation.

Chapter-10: Ecotourism

Wildlife tourism in Kanha national park is a balance of conservation education and entertainment with the active participation of local people. The underlying principle is that the tourism should be ecologically and socio-culturally sustainable. The total area of the tourism zone of Kanha national park is 184.74 sq. km, which is around 20% of the core zone. It is divided into four sub-zones (with three entry gates), namely Kanha, Kisli, Mukki and Sarhi. Apart from the limited departmental accommodation at the two entry points (Mukki & Kisli/ Khatia), boarding and lodging facilities of the Madhya Pradesh Tourism Development Corporation Ltd. (MPSTDC) and private entrepreneurs also exist at these places. The total lodging facilities (governmental/non-governmental) amount to around 1800 beds per night. The park has a set of rules for regulating the tourism. Entry on foot and night driving are prohibited inside the park. Only light vehicles are allowed with a route guide. The Kanha management provides elephants and route guides, apart from the interpretation facilities, at a reasonable charge to the tourists. Viewing ungulates amidst meadows from a vehicle and spotting tiger are star attractions for the tourists. Some main sub-headings describes in the chapter are: Nature tourism, brief history of tourism, tourism zone, stakeholders in tourism, the NTCA guidelines for tourism, tourism zonation, carrying capacity, tourist influx, tourist accommodation, management of the Kanha jungle camps, Khatia, entry & park timings, tourism facilities, park interpretation programme and constraints of tourism.

Chapter-11: Wildlife Health & Elephant Management

The Kanha 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. Besides, there is also management of 19 departmental elephants in the core zone. While there has been no instance of any major epidemic in the core zone, the Kanha management is always alert and cautious as far as wildlife health management is concerned. A wildlife veterinarian is already deputed, and a well-equipped rescue-cum-quarantine centre is working at Kanha.

Chapter-12: Tiger Landscape Dynamics

Kanha has supported a viable population of tigers for the past many years. So far, no inexplicable instance of any serious downward fluctuation in tiger numbers or any controversy regarding tiger populations has been recorded. The topography of Kanha, with its several vegetal cover types, has given rise to different settings and transitions, with good perennial water holes and rocky outcrops, with natural shelters and dens. All these physiographic and habitat attributes have made the core zone a wonderful tiger nursery. Effectively juxtaposed and interspersed, these wildlife habitats have sustained a large number of ungulates, a good prey base for tigers. Besides, stringent and pro-active protection and adaptive management practices over the years have also ensured outstanding natal areas for tigers within these habitats that have since long witnessed a huge number of tiger cubs reared to adulthood and integrated into this wildlife ecosystem.

Detailed description is narrated about tiger landscape dynamics, breeding and natal areas, core as the source tiger population, field studies & new methodologies, population dynamics, prey monitoring, carrying capacity of tiger, population & habitat viability analysis of tiger (PHVA), identification of corridors, findings of genetic analysis, tiger & other carnivores in the Kanha-Pench corridor and some findings on the carnivores of Kanha have been discussed in the chapter.

Chapter-13: Miscellaneous Practices

The Kanha core zone is now an old wildlife protected area. Consequently, besides field works required for the development of forests, wildlife habitats and the whole gamut of wildlife species, some initiatives regarding staff welfare/ development have also been started by the Kanha management. Some of the major initiatives are: hospital at Mukki, Kanha Workers Society, staff welfare programme, Kanha vikas nidhi, Bhoorsingh public school at Mukki, community engagement, skill development, establishment of petrol pump, nature education awareness camp, wildlife week celebration and eco-anubhuti programme.

Volume-I (Part-II: The Proposed Management)

Volume-I of Part-II has been divided into the 16 chapters. All the chapters start with basic introduction and objectives of management:

Chapter-14: Vision, Goals, Objectives & Problems

The Kanha management has set the following vision for the management of the core zone:

“The core zone may be envisioned as a well-protected natural wildlife ecosystem for the conservation of the tiger as an umbrella species, and its safe dispersal on the Kanha landscape and beyond through ecologically functional corridors, with low impact tourism”.

The following management goal has been set for conservation:

“To conserve and enhance the biodiversity of the core zone, with special focus on large mammals, specially the tiger and the hard ground barasingha, along with low-impact, dispersed and diversified ecotourism ensuring maximum economic benefits for local communities”.

Some broad objectives of management are as under:

- Ensure the maintenance of a viable population of the tiger for scientific, economic, aesthetic, cultural and ecological values.
- Preserve, for all times, areas of such biological importance as a national heritage for the benefit, education and enjoyment of the people.

Based on ground realities, opportunities as well as constraints, some specific objectives of the management of the core zone are as under:

- Expand the area of the core zone by including the area of two relocated villages – Kariwah and Ranwahi.
- Strengthen protection against all kinds of poaching, intrusion, illicit grazing and illicit collection of MFP.
- Protect and manage over-all diversity of wildlife habitats in the Kanha ecosystem.
- Manage/ improve grasslands for supporting a good prey base of large ungulate species for carnivores.
- Ensure ecologically sustainable growth in tiger population.
- Increase small population of the hard ground barasingha.
- Conduct research and monitoring activities for technical support.
- Supplement ungulate species from high to low density areas within the tiger reserve.
- Manage and maintain the health of wildlife populations through veterinary interventions.
- Manage man-animal conflict in and around the tiger reserve.
- Management and training of semi-captive departmental elephants.

- Ensure low impact and ecologically sustainable wildlife tourism for the enjoyment of visitors and conservation awareness.
- Develop technical skills of select staff for the translocation of various wildlife species under proactive wildlife management.
- Reintroduce the wild buffalo under a well-planned and well-designed project.
- Manage stray, problematic and orphaned wildlife, specially tigers and leopards, and make efforts for their rehabilitation through rearing and captivity.

The following problems may obstruct full achievement of the above objectives:

- Islanded location of the core zone, surrounded by the buffer zone with biotic pressure of a large number of villages and cattle.
- Extremist/ naxalite insurgency movement in and around tiger expansion areas.
- Propaganda/ disinformation campaign by self-styled social activists and eco-illiterates against the core zone having a history of successful village relocation.
- Lack of special statutory protection to the frontline staff for acts done in good faith while discharging their duties, and delayed judicial proceedings.
- Rapid increase in hotels/ resorts etc. very close to the boundary of the core zone.
- Authorization of forest officers for legal action in the Environment (Protection) Act, 1986.

Chapter-15: Management Strategies

The Tiger Conservation Plan has adopted the zone and theme approaches in the proposed management strategies of the core zone. A zone plan is self-contained that identifies problems, develops strategies, and also relates realistically to the surrounding areas of the other zones. A theme plan, however, has to link all concerned zones for application of its prescriptions. In this way, several objectives and different problems created by a combination of factors are addressed by a theme strategy under which measures can be applied for the entire area.

The zone plans are proposed, and planning will be discussed in the forthcoming chapters:

- Barasingha conservation zone
- Ecotourism zone

The themes identified for the core zone, would be discussed in chapters:

- Research, monitoring and training
- Assessment of tigers, co-predators, ungulate populations & habitats
- Protection and anti-poaching strategy
- Fire protection
- Habitat management (grassland management, water development, habitat manipulation and meadow restoration)
- Wildlife health management.

Chapter-16: Research, Monitoring & Training

Research and monitoring in the wildlife management of vital importance. Considering the stature and importance of the core zone, research and monitoring activities are expected to generate sound information to help wildlife resource managers deal with increasingly serious and complex problems and threats, enhance public understanding, and encourage cooperation with scientists/ researchers of other institutions and organizations. Research studies are systematic and take time to reach logical conclusions, and should be carried on continuously.

The specific objectives of wildlife research, monitoring and training in the core zone are as under:

- Undertake animal specific and habitat specific basic and applied research studies compatible with the goals and objectives of wildlife management in the protected area.
- Undertake basic monitoring of wildlife populations and vegetation, and prepare and update inventories of different wildlife resources.
- Impart relevant professional training/ skill development to the staff for effective wildlife management.

The following broad prescriptions are proposed for undertaking wildlife research and motoring activities and training in the protected area: ecological/ eco-regional landscape, genetic studies, habitat degradation/ management, livestock depredation by carnivores & crop damage by wild ungulates, poaching, wildlife disease, fire, insects as agents of ecological change, in-situ conservation, eco-tourism, jurisprudence, animal monitoring & estimation techniques, vision beyond the PA, interface problems and social studies. Several issues related to the topic have also been discussed: permission/ permit for research, monitoring framework**,** long term vegetation monitoring, Inventorying, framework, plant herbarium, compartment history, training needs assessment.

Chapter-17: Assessment of Tigers, Co-predators, Ungulate Population & Habitats

Periodic assessment of wildlife, specially major species, and habitats are of vital importance, and a standardized monitoring protocol using standard methods and new technology can help the management understand the reason of certain trends in wildlife populations and habitat conditions in the protected area, and the factors responsible for good or bad changes.

The specific objectives of the assessment of tigers, co-predators, ungulate populations and habitat conditions are as under:

- Estimate population densities of tigers, leopards, wild dogs and principal prey species and monitor trends in their populations.
- Assess wildlife habitats and trends in vegetation.
- Monitor biotic pressure on the protected area, including natural mortality of wild animals and illegal activities.

Broad prescriptions are proposed for the assessment of tigers, co-predators, ungulate populations and habitat conditions in the protected area: Phase-IV tiger monitoring and patrolling strategy, photo registration of tigers, tiger pugmark and other signs, monitoring by telemetry, daily monitoring & forecasting, ecological component (tiger & other predator signs, ungulate density, human disturbance indices, habitat monitoring and dung density) and patrol data.

The Kanha management should also update the abundance status of various wildlife species occurring in the core zone. Presently, there is a wide range of wildlife species, including some endangered and endemic such as the tiger and the hard ground barasingha.

Chapter-18: Protection & Anti-poaching Strategy

Forest and wildlife protection need to be assigned the topmost priority among all conservation practices in the core zone. The Kanha management has to adopt a very stringent attitude towards protection of forest and wildlife in the protected area. The core zone faces perceptible biotic pressure along the periphery, and only strict enforcement of various Acts/ Rules, effective protection strategies and the gathering of reliable intelligence throughout the year can protect the core zone for posterity. Besides the eight forest villages inside the Kanha national park, a sea of humanity and livestock just outside the core zone is also proverbially waiting to engulf the protected area.

The broad objective of protection and intelligence gathering in the core zone is to overall secure/ guard the entire wildlife ecosystem from forest and wildlife offenders and a wide range of biotic pressure. The specific objectives, however, are as under:

- Protect the core zone from all forms of poaching and illicit MFP collection
- Control illicit grazing and protect wildlife habitats, specially on the peripheral areas of the core zone
- Protect wildlife habitats from fire hazards in the summer.

Broad prescriptions are proposed for protection and intelligence gathering: the tiger cell, law enforcement, strike force, forensics approach to wildlife crimes, general patrolling strategy, intensive patrolling of beats, monsoon strategy, elephant patrols, surveillance of footpaths, control on illicit grazing, temporary patrolling camps, M-STrIPES foot patrolling, night patrolling (on foot, by vehicle and night halt at camp), patrolling of sensitive areas, prevention of poaching by iron traps, saltlick checking, waterhole checking, checking for electrocution, patrolling by ex-army men, patrols by special tiger protection force (STPF), special protection along the eastern boundary, E-eye surveillance, surveillance through drones, fire protection, fire protection measures (preventive and control), interaction with judiciary and intelligence gathering & coordination.

Chapter-19: Ecotourism Management

Ecotourism is always sustainable and respects nature conservation and the culture of local communities credited with protecting such areas. In a way, it also resists environmental degradation, encourages nature conservation and sustains traditional communities. The core zone is one of the finest wildlife protected areas of the country, and offers excellent opportunities to the visitors for enjoying tremendous floral, faunal and natural attributes of pristine wilderness. Needless to add, protected areas like Kanha are also credited with the responsibility of generating positive public opinions about nature conservation.

The specific objectives of ecotourism management in the core area are as under:

- Develop facilities for promoting safe, restful and enjoyable tourism, and enhance the quality of visitors' experience.
- Complement the economy of local communities living mainly around the core zone.
- Develop/ maintain park interpretation facilities for creating conservation awareness.
- Ensure ecologically sustainable and light tourism and minimize its impact on the resources of the core area.

The strategies and management prescriptions are proposed for conducting ecotourism in the core zone under various components: principles of ecotourism management, preservation of natural values & promotion of conservation, minimizing pressure on the ecotourism zone, opportunities to increase understanding & appreciation, production of excellent publicity material, enhanced recreational facilities, respect for local traditions & cultures, promotion of local economies & employment, visitors' feedback and coordination among stakeholders.

The following planning imperatives should be undertaken for the development of an overall eco-tourism strategy, and will incorporate: rules & regulations, broad guidelines for stakeholders (for the Kanha management, for the tour operators, for the visitors and for the host community) and temple & pilgrimage boards.

Some miscellaneous prescriptions have also been proposed:

- No new tourism infrastructure shall be created in the core zone. The existing residential infrastructure inside the core zone shall be strictly regulated to adhere to low ecological impacts as decided by the Kanha management on a site specific basis.
- No area of the core zone from which relocation has been carried out, shall be used for tourism infrastructure.
- A provision needs to be made for the recruitment of 90% of the staff of hotels/ resorts from local communities.
- Special economy tourist vehicles (mini-buses/ canters with 15-20 seats) should be introduced for day-tourists and students to reduce vehicular pressure on the core zone. This should be started with five vehicles.
- The core zone should be opened from the 1st November as used to be the practice until a few years back.
- The Kanha management shall, as far as possible, provide for subsidized visits of students for excursions in the core area and while fostering educational extension activities.

- The Kanha management shall carefully monitor and record the impact of tourism activities on the wildlife and its habitat. Consultants/ experts from premier institutes/ organizations can also be hired for the assessment of tourism impact. Some indications are suggested as under:
    - Deposition of dust on both sides of the roads
    - Damage to wildlife habitats/ sites
    - Disturbance to animals, specially endangered ones, in breeding season
    - Changes in the behaviour of animals
    - Significant shift in home ranges
- Site-specific micro–planning for community based eco-tourism should be taken up.
- Periodic training programmes on eco-tourism should be conducted for tourism administration, planners, operators and general public.

The Kanha management should also regularly monitor and evaluate the impact of tourism on the core zone, and visitors' reactions to and feedback on tourism management. Visitors' books kept at different forest rest houses, hutments, dormitory, and interpretation complex, letters, and emails should form a good basis for such evaluation.

Chapter-20: Habitat Management

Besides forest and wildlife protection in the wildlife protected area, habitat management is another conservation practice of vital importance. The management of habitats for wildlife chiefly involves influencing the successional stage and physical structure of vegetation to benefit major herbivore species and/ or any endangered species of high conservation or other intrinsic value, for instance the hard ground barasingha in the core zone. Though there are several types of wildlife habitats in the core zone, considering the importance of grasslands for major ungulate species, habitat management practices are mainly focused on the improvement/ manipulation of these grasslands and forest edges and water development.

As the grassland habitat forms the mainstay of all the ungulate species in the core zone, the specific objectives of habitat management are as under:

- Restocking of grasslands.
- Create new wildlife habitats, specially in the non-tourism forest ranges where animal density has been low.
- Improve the present conditions of grasslands for increasing the population of prey base species.

Based on the existing situations and current knowledge, the following broad prescriptions should be followed for the management of grasslands in the core zone depending upon financial allocations received from the state govt. and the National Tiger Conservation Authority, New Delhi. Needless to add, prime grasslands should be taken up on a priority basis: grassland burning, relief exclosure, barasingha enclosure at Sukdi, treatment for problematic grasses, grass seed harvesting and storage, restocking of grasslands, non-expansion of grassland area, lantana eradication, weed eradication,

eradication of woody species, eradication of unpalatable grasses and prescriptions for bamboo.

Water development is a very important conservation input, and in the present context includes the distribution and quantity of water, not only in the dry regions, but also where it is plentiful. This includes, besides the construction of new water bodies, the maintenance of the old ones by deepening, desilting and reshaping them.

Chapter-21: Barasingha Conservation

The revival of the barasingha is a most inspiring success stories in wildlife conservation in the world. This conservation effort should continue to ensure a population of safe status in the core zone. Besides, in future, founders from this population may also be used to establish some more geographically separated populations in its former distribution ranges in or outside the state. This small population of the cervid has recorded an increase of around 72% in the past ten years, with 475 in 2010 to 956 in 2021. As the Kanha management has learnt many a lesson in the conservation of this species in the past so many years, it must build further on the technical expertise and successes to further improve the status of the cervid in the core zone.

Specific objectives of the conservation of the hard ground barasingha in the core zone are as under:

- Facilitate viable population growth for the hard ground barasingha within the habitat-prey–predator dynamics.
- Develop new habitats and connectivity between habitats to expand the dispersal of these animals.

The conservation of the hard ground barasingha in the core zone requires a long-term strategy based on the past and present experiences and observations recorded by the management. Empirical data relating to the ecology of this endemic sub-species needs to be kept in mind before taking up any major habitat interventions vis-à-vis its present status and distribution within the core zone. In view of the stated objectives, the following management strategy and prescriptions are proposed for the conservation of this sub-species: grassland management, weed eradication, eradication of woody species, maintenance of tall grass, exclosures for relieving pressure, connectivity between habitats, management of aquatic plants, swamp/ marsh creation, wallows, management of metapopulations, restoration of reclaimed habitat, management in the historical range, new conservation sites, maintenance & monitoring in the kanha enclosure, daily monitoring and mortality survey, surveillance of epidemics, and reintroduction to non-conventional habitats.

Chapter-22: Wildlife Health Management

Wildlife health management has now become very important, and been taken to new heights in several protected areas of the world, with advancement in drugs, equipment and transportation vehicles etc. This conservation practice has become all the more important in the core zone, as conservation in the protected area also involves the management of two endangered species – the tiger and the hard ground barasingha. Besides long-term management, wildlife health contingencies have also to be dealt with under the prescribed guidelines issued by the office of the CWLW, MP, and the NTCA, New Delhi.

While the broad objective of this chapter is to manage general health status of wild animals and departmental elephants in the core zone, the specific objectives are as under:

- Prevent occurrence of serious diseases, specially epidemics in the core zone, and ensure prophylaxis by vaccinating the cattle of villages around the core zone.
- Conduct postmortems of wild animals, specially endangered species, under a comprehensive protocol, and draw inferences about the cause of death.
- Treat and manage problematic as well as distressed wild animals.

Broad prescriptions are proposed for wildlife health management in the protected area: detection of illness, protocol for ill animals, diagnosis of disease, body condition evaluation, fat preserve estimation, tiger mortality, treatment of wild animals, transportation of wild animals, establishment of forensic laboratory, disease surveillance, nutritional analysis of fodder of wild animal, immunization programme and control of disease epidemic (prevention of disease, control of existing disease or eradication and disinfection).

Chapter-23: Management of Departmental Elephants

The management of departmental elephants in the core zone is also of vital importance. The Kanha management has been managing these elephants for many years, and their upkeep, medical supervision and treatment etc. are gradually learnt from experience and from the elephant experts of the north-east and south India.

Specific objectives of elephant housekeeping are as under:

- Optimize the use of elephant in patrolling, and to a limited extent in tourism while ensuring good health and humane treatment.
- Ensure recommended daily diets, and standard upkeep of elephants

Broad prescriptions are proposed for the health and dietary management and working of departmental elephants in the protected area: background of elephant health management, recommendations of elephant experts the IVRI, Izatnagar team.

Some more prescriptions include: annual physical examination, routine health check-up, vaccination, fecal examination for parasites & deworming, foot care, trimming of tusk, feeding/ diet schedule, rejuvenation camp, benefits of the rejuvenation camp, staff health monitoring, first-aid/ treatment kit for elephants, elephant hospital & primary laboratory, para-veterinary staff and management of musth.

Some practices need to be refined and fine-tuned to further improve the working of departmental elephants. Broad guidelines are as under:

- In the light of the death of a characutter in the past, they should not be allowed to go into the forest before daybreak for searching their elephants.
- The characutters should be provided with electrically charged staffs for minimum self-defense against carnivores.
- Preferably more than three elephants should be kept at one camp so that the characutters can move around in a group.
- The duration of work for working elephant should not be more than 6 hours / day, and at least one day a week rest should be given.
- Only two persons should be allowed to ride the elephants below 20 years.
- Mahouts/ characutters should be imparted training in the upkeep of elephants at least once in 3 years.

Also included are: work schedule of elephants, record keeping, service book of elephant, elephant mortality, elephant movement, rotational grazing of camp elephants, disposal of elephant dung, retirement age of elephant and chaining.

Chapter-24: Management of Wild Elephants

While the Kanha core is not necessarily a preferred habitat or historical distribution range of natural populations of wild elephants, the eventual arrival of a long-ranging fragmented cluster or a clan may find the protected area habitat suitable for staying back/ settling down for some time. Such clusters may range from 15 to 50 animals. During their stay in the core zone, they are also likely to stray into surrounding villages, leading to human-elephant conflict and causing serious disturbances. These conflicts may also include human deaths, creating unprecedented panic among villagers so far unfamiliar with serious rampaging of wild elephants. During their stay in the protected area, the Kanha management would be required to undertake a wide range of initiatives. Besides, some preparations would also need to be made in anticipation of their arrival and rampage.

Specific objectives of the management of wild elephants in the core zone are as under:

- Security/ protection of the entire forest employees/ staff, govt. properties and tourists against elephant attacks
- As far as possible, security/ protection of the villagers and their properties in surrounding villages
- Monitoring of the elephant cluster for their movements and poaching
- Full-fledged veterinary facility to deal with eventualities in or outside the core zone

Broad prescriptions are proposed for the management of wild elephants in the protected area: issuance of guidelines to line departments, workshops for staff, guides, and gypsy drivers, sharing knowledge with villagers, effective communication, monitoring, security of tourists, vigilance in bordering territorial divisions, construction of additional kraals, elephant-proof trenches, standing operating procedure, comparing notes with other states, full-fledged veterinary facility and draft recommendations on human-elephant mitigation in Madhya Pradesh.

Chapter-25: Support to the Village Community

There are 8 forest villages in the national park area contiguous to the core zone boundary. The Kanha management feels that until these 8 forest villages are not included in the buffer zone as per a recent proposal of reorganization sent to higher offices, the villages need development inputs for basic support. These initiatives will only strengthen trust between the Kanha management and the people, and help the management gain their support to wildlife conservation.

Specific objectives of village development in the national park close to the core zone boundary are as under:

- Reduce dependence of local communities on natural resources of the core zone.
- Garner support of the local communities of the forest villages for wildlife conservation.
- Support the local communities with basic amenities until they are relocated outside.

Broad strategies and management prescriptions for village development in the national park area are: essential framework, constitution of district coordination committees, mechanism of fund raising, village development initiative and provision of soft-loans.

Chapter-26: Vision Beyond the Buffer

Contains the Kanha management's vision beyond the buffer zone, including the significance of the Kanha landscape and its connectivity with some important protected areas, and basic management considerations for development, etc.

Chapter-27: Miscellaneous Issues

The chapter deals with some miscellaneous issues relating to management in the core zone. These issues are also important, and merit prescriptions: honing of proactive management skills, reintroduction of the wild buffalo, erection of chain-link fencing against crop raiding, no felling/ removal of trees, payment of crop compensation, wildlife Week celebration training for skill development, management & upgradation of the Kanha Bhoorsingh Public School, Mukki, staff health management, disposal of stocked antlers, mortality survey, management of forest road network, no construction of new buildings, demolition of old buildings, and management of the Kanha Workers Sahkari Sakh evam Kamgar Samiti Maryadit.

Chapter-28: Organization, Administration & Budget

The tiger reserve consists of two conservation entities, namely the core zone and the buffer zone. The tiger reserve is headed by Field Director of the rank of a Chief Conservator of Forests, with headquarter at Mandla.

Kanha tiger reserve receives funds from the Govt. of India through the National Tiger Conservation Authority, New Delhi under the Plan budget viz. Non-Recurring (60%) and Recurring (50%), on the basis of the Annual Plan of Operations (APO) submitted through the Principal Chief Conservator of Forests (Wildlife), Madhya Pradesh and the State Government. The APO has to be submitted in a prescribed format every year in the month of March or April.

Part of the Kanha Vikas Nidhi is used every year for the development of tourism infrastructure, development of relocated forest villages and existing forest villages, and as support funds to various ecodevelopment committees of the tiger reserve. Besides, money from the Kanha Vikas Nidhi is also utilized in anticipation of regular allocations made by the Govt. of India, and the same is returned after allocations are received.

The core zone needs adequate funds on a regular basis. While there are assured regular financial allocations from the State and Central governments, the Kanha management does require additional allocations in several inadequately funded budgetary heads. Naturally, under these circumstances, the Kanha management should welcome funds received from non-governmental individuals/ non-governmental organizations.

The Kanha management should raise its physical as well as financial requirement every financial year through the APOs on the basis of the objective needs of range-wise development works. As in the past, budgetary requirements are left to the discretion of the Field Director and senior officers visiting the tiger reserve from time to time. Tentative budget requirements only for grassland management and barasingha conservation are, however, proposed as under.

Chapter-29: Monitoring & Evaluation

The Kanha management also needs to plan monitoring and evaluation programme with potential responses in mind, if the monitoring detects levels of acceptable/ unacceptable change in the conditions of the natural resource base. It must focus on assessing the outcome of management initiatives specifically designed to resolve some threat to conservation issues. It should also lead to a response when expected results are not achieved and changes in management actions are required.

A theoretical framework and some broad indications for the monitoring and evaluation of the core zone are proposed for the consideration of the above Committee. The theoretical framework should also incorporate the following points:

- Health of wildlife ecosystem/ habitats.
- Population trends of endangered species of animals and plants.
- Management interventions vis-à-vis their intended effect on wildlife ecosystem.
- Tourism activities and conservation practices.
- Park-people interface.
- Staffing.

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The Committee can also develop the methodology of collecting, analyzing, crosschecking information/ data and verifying the same with the data collected from some other sources. The results/ findings of the monitoring and evaluation programme should be reported very clearly so that the Kanha management can act upon the recommendations and make the required improvements.

Volume-I (Maps: 1 to 40)
Volume-I (Tables: 1 to 107)
Volume-I (Bibliography)

Several maps have also been incorporated in these chapters. And, finally, the reference part includes several citations mentioned in different chapters.

Volume-II (Appendices 1 to 73)

This volume incorporates different relevant Appendices mentioned throughout both the Text parts.

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KANHA TIGER RESERVE

A. General Introduction:

Kanha is regarded as one of the finest protected areas not only in India but also in south-east Asia. The tiger reserve is among the first nine tiger reserves launched under an ambitious conservation scheme "Project Tiger" during 1973-74, and was regarded as an excellent representative of central highland sal and miscellaneous forests along with grasslands with a great potential for conservation of tigers and a number of other wildlife species.

Situated in the Mandla and Balaghat districts of Madhya Pradesh, Kanha forms part of an eco-region once renowned internationally for rich floral and faunal attributes of central Indian highlands. Nestled on the northern slopes of the Maikal hills of the Satpuras, the tiger reserve and its surroundings were once 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, till recently, the only world population of the hard ground barasingha (*Rucervus duvaucelii branderi*), a wide range of plant and animal species considerably add to the significance of this landscape. All the floral and faunal attributes make the tiger reserve a significant centre of biodiversity in the country.

As per the biogeographic classification of India, the tiger reserve area lies in zone-6E – Deccan Peninsula – Central Highlands. The Halon and the Banjar valleys, forming the eastern and the western parts, two ecological units, of the core zone respectively, are connected by a narrow ridge/ corridor known as the "chicken's neck". Some Kanha enthusiasts also liken a large area of the core zone to the Ngorongoro conservation area of Tanzania. Though Kanha is greener and the horseshoe-shaped valley is surrounded by more densely wooded cordon of hills, this comparison, however, sounds convincing to a lot many Kanhaphiles. Another basis for comparison is the large number of wild ungulates that throng the Kanha meadow almost throughout the year.

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.

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.

B. Notifications:

Final notifications by the Central/ State governments relating to all the three conservation entities within the tiger reserve are as under:

Table-1: Notifications by the Central/ State Governments

Sl. No.	Central/State Gazette Notification	Area (sq. km.)	Relevant Act	District	Total Area (sq. km.)
1	State F.D. No. 15-13-76-2-10 dated 29/09/1976	939.94 National Park	The Wildlife (Protection) Act, 1972 (Section 35)	Mandla & Balaghat	939.94
2	State F.D. No. 15-5-83-X-2 dated 10/03/1983	110.74 Phen Wildlife Sanctuary	The Wildlife (Protection) Act, 1972 (Section 18 (1))	Mandla	110.74
3	State F. No. 15-31-2007-X-2 dated 24/12/2007	917.43 Critical Tiger Habitat within the NP	The Wildlife (Protection) Act, 1972 (Section 38V)	Mandla & Balaghat	917.43
4	State No. F-15-11-2010-X(2) dated 05/10/2010	1134.31 Buffer Zone	The Wildlife (Protection) Act, 1972 (Section-35 & Section-38V 4 (ii))	Mandla & Balaghat	1134.31
5	India Gazette No. S.O. 1198 (E) dated 12/03/2021	1217.674 ESZ around Kanha NP & Phen WLS	The Environment (Protection) Act, 1986 (Sub-section-1 and Clause-V and XIV of sub-section-2 and sub-section-3 of section-3)	Mandla & Balaghat	1217.674

Source: Kanha Tiger Reserve (2021)

The tiger reserve is under the administrative control of a Chief Conservator of Forests, designated as Field Director, with his headquarters located at Mandla. The tiger reserve consists of the following conservation entities:

a) **The Core Zone (Critical Tiger Habitat):** The total area of the core zone is 917.43 sq. km. The present core zone is technically 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.

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

c) **The National Park:** The core zone is technically a part of the national park notified as such. The total area of the national park, which was not notified as core zone, is now 22.57 sq. km., and harbours several forest villages.

d) **The Phen Wildlife Sanctuary:** Regarded as a satellite micro-core, with an area of 110.74 sq. km., it is not technically a part of the tiger reserve, but is also under the administrative control of the Kanha management. For all practical purposes of management, however, the sanctuary is also considered a part of the core zone. The proposal to include the Phen wildlife sanctuary as part of the core zone has already been sent to the Chief Wildlife Warden, Madhya Pradesh.

The tiger reserve is surrounded by a forested landscape falling in the territorial divisions of east & west Mandla, north Balaghat, Kawardha (Chhattisgarh), and Mohgaon project of forest development corporation (Madhya Pradesh).

C. Administrative Control:

The Field Director of the Kanha tiger reserve is administratively overall in-charge of the tiger reserve. The zonation or division-wise setup of the tiger reserve is as under:

Table-2: Division-wise Setup

Broad Zonation			
Zone	**Area (In sq. km.)**	**Status**	**Control**
Core Zone (Inviolate CTH)	917.43	Core Zone	Kanha tiger reserve
National Park (Outside the CTH)	22.57	National Park	Kanha tiger reserve
Buffer Zone	1134.31	Multiple use area	Kanha tiger reserve
Total Area of Tiger Reserve	**2074.31**		

Source: Kanha Tiger Reserve (2021)

Table-3: Area Description (Core Zone)

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

Source: Kanha Tiger Reserve (2021)

Table-4: Area Description (Buffer Zone)

Sl. No.	Range	Area Description					Total Area (Ha.)
		RF	PF	Orange Area (Suitable)	Orange Area (Unsuitable)	Revenue	
		Mandla District					
1	Khatia	9485.060	0.000	272.600	257.920	3927.250	13942.830
2	Sijhora	6534.060	0.000	321.540	116.130	11601.020	18572.750
3	Motinala	14807.450	0.000	107.790	181.450	5220.320	20317.010
	Total:	**30826.570**	**0.000**	**701.930**	**555.500**	**20748.590**	**52832.590**

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Balaghat District							
4	Khapa	6937.965	0.000	0.000	0.000	9973.030	16910.995
5	Garhi	15307.799	0.000	0.000	0.000	17528.180	32835.979
6	Samnapur	5484.126	0.000	0.000	0.000	5368.270	10852.396
	Total:	**27729.890**	**0.000**	**0.000**	**0.000**	**32869.480**	**60599.370**
	G. Total:	**58556.460**	**0.000**	**701.930**	**555.500**	**53618.070**	**113431.960**

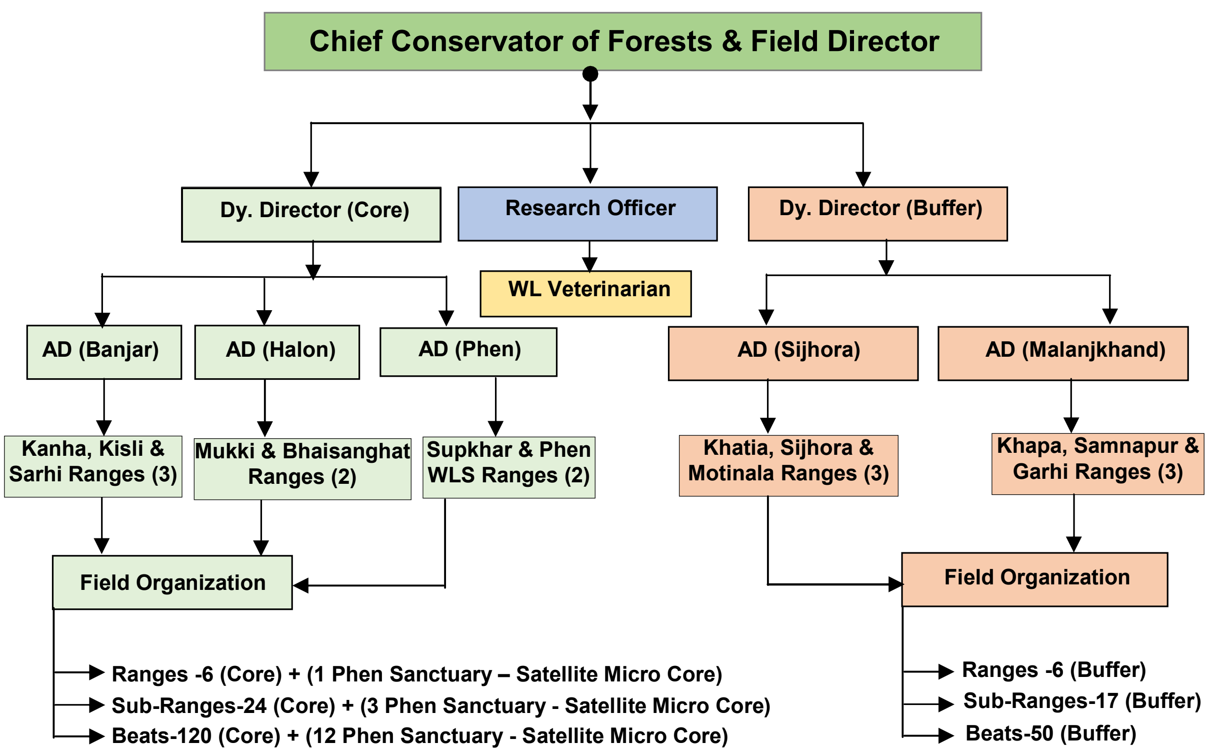
Source: Kanha Tiger Reserve (2021)

Table-5: Area Description (Phen Wildlife Sanctuary)

Sl. No.	Range	Area Description					Total Area (Ha.)
		RF	PF	Orange Area (Suitable)	Orange Area (Unsuitable)	Revenue	
		Mandla District					
1	Phen WLS	110.740	0.000	-	-	-	110.740
	Total:	**110.740**	**0.000**	**-**	**-**	**-**	**110.740**

Source: Kanha Tiger Reserve (2021)

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

The Annual Plan of Operations (APO) of the tiger reserve is prepared under the guidance of the Field Director in consultation with the officers and field staff of the core and buffer divisions, and the same is submitted to the Additional Director General (Project Tiger) & Member Secretary, National Tiger Conservation Authority, New Delhi, through the Principal Chief Conservator of Forests (Wildlife) & Chief Wildlife Warden, Madhya Pradesh, Bhopal. Budgetary allocations are also provided to both the divisions by the Field Director, once sanction is received from competent authorities. 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.

PART-I: THE PROTECTED AREA

(EXISTING SITUATION)

CHAPTER – 1

INTRODUCTION OF THE CORE ZONE

1.1 Name, Location, Constitution & Extent:

1.1.1 **Name, Location & Constitution:** This Tiger Conservation Plan for the core zone of Kanha tiger reserve will attempt to address this conservation entity as per the final notification of the Govt. of Madhya Pradesh.

The total area of the core zone is 917.43 sq. km., and is situated administratively in the Mandla and Balaghat districts of Madhya Pradesh, geographically lying in the central Indian highlands.

Table-6: Geographical Coordinates of the Core Zone

Sl. No.	Conservation Unit	Geographical Coordinates	
1	**2**	**3**	
1	Core Zone	Latitude	22^{o} 02' 52.6" to 22^{o} 25' 48.8"
2		Longitude	80^{o} 30' 09.3" to 81^{o} 02' 48.4"

Source: Kanha Tiger Reserve (2021)

Extent (Legal Status & Area Statement): The core zone is situated in the southern part of the Mandla district and in the north-eastern part of the Balaghat district at altitudes between around 500 and 800 meters.

The total area of the Kanha national park is 940 sq. km. Now this area technically also incorporates 917.43 sq. km. of the critical core or Critical Tiger Habitat (CTH). The core zone has also been notified as such by the MP State Govt. No. F 15-31-2007-X-2 dated 24-12-2007. The entire core zone and the 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, and advises on the selection, establishment and management of protected areas throughout the world. 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 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 under category-II of the IUCN protected area management classification system.

While the detailed compartment-wise area statement is appended **(Appendix-1)**, 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.

Table-7: Sub-division and Range-wise Area Statement

Sl. No.	Sub-Division (HQ)	Range (HQ)	Area (sq. km.)
1	Banjar (Kisli)	Kanha (Kanha)	121.668
2		Sarhi (Bichiya)	139.881
3		Kisli (Kisli)	138.955
4	Halon (Mukki)	Mukki (Mukki)	130.225
5		Bhaisanghat (Garhi)	169.238
6	Phen (Garhi)	Supkhar (Supkhar)	217.460
7		Phen WLS (Motinala)	110.704

Source: Kanha Tiger Reserve (2021)

Table-8: Detailed Existing Status of Forest Area in the Core Zone

Sl. No.	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.)
1	2	3	4	5	6	7	8	9	10	11
1	Reserved Forest	Core Zone	7	91742.996	-	-	-	-	7	91742.996
2	Demarcated Protected Forest		-	-	-	-	-	-	-	-
3	Undemarcated Protected Forest		-	-	-	-	-	-	-	-
	Total:		**7**	**91742.996**					**7**	**91742.996**

Source: Kanha Tiger Reserve (2021)

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. Notifications pertaining to the tiger reserve are appended **(Appendix-2)**.

Table-9: Madhya Pradesh Gazette Notifications

Sl. No.	MP Gazette Notification	Area (sq. km.)	Relevant Act	District	Total Area (sq. km.)
1	2	3	4	5	6
1	FD No. 2813-98-42/XI-55 dated 22/05/1955 w.e.f. 01/06/1955	253.040	The MP NP Act, 1955 (VII of 1955 Section 3 (2) & (3))	Mandla	253.040
2	FD No. 5725-4184-X dated 13/05/1964	65.400	The MP NP Act, 1955 (VII of 1955 Section 3 (2) & (3)	Mandla	318.440
3	FD No. 8893-X- 2-70 dated 15/12/1970	128.257	The MP NP Act, 1955 (VII of 1955 Section 3 (2) & (3)	Balaghat	446.686
4	FD No. 4021-1643-X-II-74 dated 03/09/1974	487.720	The WL (P) Act, 1972 (Section 18)	Mandla & Balaghat	487.720
		5.621	The WL (P) Act, 1972 (Section 18)	Mandla	493.341
5	FD No. 15-13-76-2-10 dated 29/09/1976	939.940 National Park	The WL (P) Act, 1972 (Section 35)	Mandla & Balaghat	939.940
6	F No. 15-31-2007-X-2 dated 24/12/2007	917.430 Critical Tiger Habitat within the NP	The WL (P) Act, 1972 (Section 38V)	Mandla & Balaghat	917.430

Source: Kanha Tiger Reserve (2021)

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-Kabirdham-Chilpi-Supkhar-Mukki: 178 km.
- Raipur-Malanjkhand-Baihar-Mukki: 180 km.
- Raipur-Simga-Kabirdham-Chilpi-Supkhar-Mukki-Baihar-Tatri-Khatia-Kisli: 248 km.
- Raipur-Simga-Kabirdham-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.
- 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 of South Eastern Railway), Nainpur (Nainpur-Balaghat), and Nagpur (Central Railway Junction).

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By Air

- Jabalpur (Madhya Pradesh), Raipur (Chhattisgarh) & Nagpur (Maharashtra) are operative civil airports.
- A permanent helipad exists at Khatia.
- A permanent air strip exists at Birwa, Balaghat around 15 km. from the Mukki gate.

1.3 Statement of Significance:

The core zone, is one of the finest wildlife protected areas in the country. 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 floral and faunal attributes are concerned. The protected area encompasses typical central Indian sal and mixed woodlands along with densely foliaged large bamboo clumps as understory, and thick herbaceous and shrubby undergrowth. The woodlands are also interspersed with heterogeneous grassy plains and large clearings, with occasional tree groves. The luxuriant vegetation has manifested itself in many vegetal cover types and settings over many different physiographic features, resulting in a wide range of wildlife habitats. The core zone and its immediate surroundings are nestled slightly east of the centre of the highlands and it largely occupies 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 valleys 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. The long history of stringent protection against all kinds of biotic pressure and a range of diverse habitat types along with conservation oriented villages 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 (*Rucervus duvaucelii branderi*), whose commendable resurrection over the years has become a very inspiring success story in wildlife conservation. Besides, a viable population of the 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 supports a wide range of faunal species, some of which figure prominently in the IUCN Red List of Threatened Species. Some of these species are the tiger (*Panthera tigris tigris*), leopard (*Panthera pardus*), wild dog (*Cuon alpinus*), sloth bear (*Melursus ursinus*), gaur (*Bos gaurus*), smooth-coated otter (*Lutra perspicillata*) and *python* (*Python molurus*). They include 325 species of birds, 30 of mammals, 40 of reptiles, including 25 species of snakes and 15 of lizards, 15 species of frogs, around 500 of insects, 115 of arachnids (spiders), several species of crustaceans, mollusks and fishes, and also lots of species of moths and butterflies. The floral diversity is comprised of around 850 species of angiosperms belonging to 506 genera and 134 families, besides 22 species of Pteridophyte belonging to 14 genera and 14 families (Pandey & Namdeo, 2009). The above floral diversity also includes two species of Gymnosperm belonging to two genera and two 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 rich in avifauna, and Kailash Chandra et al. (2005) have reported around 300 species of birds of 60 families. 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 the protected area makes their conservation extremely important.

Concerted managerial efforts in the past through checkered history of some of these endangered species, Kanha has also made its mark as an important conservation arena. Presently, the Kanha core zone constitutes a significant source population for tigers and several other endangered species in the central Indian landscape.

Kanha also forms an important watershed for the rivers Narmada and Mahanadi. The Narmada is the fifth largest river in the country, and almost a third of its basin is forested, supporting some wonderful wildlife protected areas, including Kanha and Satpura. The Mahanadi is also a major river in the east central India. The hydrology of the Kanha wildlife ecosystem has gifted it with a number of rivers and their seasonal tributaries draining out into these two rivers. The conservation of these forests and grasslands is also important for the health of these rivers as crucial source of water for millions of people and their vast agricultural lands and livestock.

Besides biodiversity conservation in general, and conservation of some endangered wildlife species and their habitats in particular, 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 INFORAMTION AND ATTRIBUTES

2.1 Boundary:

The entire Kanha national park and the core zone are duly notified as such, and comprise legally constituted Reserved Forests 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 well-cut and cleared boundary lines of seven Reserved Forest blocks, namely Banjar valley (B/15), Jhapul (B/13), Indri (B/14), Maliadadar (B/7), Tendua (B/8), Khalondi reserve and Topla Raigarh east.

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.

Alongside 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-tiered 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.

The core zone supports 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 three 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 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 *dadar* 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, 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. The elevation on the main ridge varies from 800 meters to 900 meters or more above MSL.

The Sulkum is the most important drainage for the Banjar valley. The river originates as the Sulkum nala/ Ghoorpani nala from Bamhnidadar. The river is also known as the Surpan river in the lower reaches and after it crosses the tiger reserve boundary in the north-east. The Halon rises from near Chhatarpur forest village in the Supkhar range, but outside the range boundary (Kabirdham district) in Chhattisgarh, meanders through the core and buffer until it joins the Budner well outside the tiger reserve. The origin of the

Banjar lies near Salewara in Chhatisgarh, not far from Madhya Pradesh. The river enters the Samnapur range of the buffer, flows on to form the boundary of the core upto the Khatia forest range, and leaves the buffer to join the Narmada at Mandla.

Besides the above, the core zone also harbours some areas with high water tables that can easily be dug up as small water-pools, locally known as *jhirias*. The spatial and temporal distribution of water, however, is not satisfactory. And this generally causes problems in several areas in the summer. 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. Major streams in the lower valleys areas of Kanha, Kisli and Mukki retain their flow upto 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 *"dadar"*. Some of these dadar are 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.

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 late February and lasts until around mid-June when the core zone receives pre-monsoon showers. The last fortnight of May remains 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. On account of precautions and a very effective fire protection strategy, only less than 1% of the area gets burnt every year. This, however, also depletes the habitat of forage and browse during the pinch period to some extent. Such man-made fires usually originate from the peripheral areas close to the park boundary, as the locals clear the ground by setting fires to collect mahua fruits, or 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:

Table-10: Fire Incidents in the Core Zone

Sl. No.	Year (Feb.-June.)	No. of Incidents	Area Burnt (Ha.)	% of Area Affected
1	2	3	4	5
1	1999	167	925.160	1.01%
2	2000	75	276.950	0.30%
3	2001	32	147.300	0.16%
4	2002	51	274.300	0.30%
5	2003	101	665.800	0.73%
6	2004	42	198.000	0.22%
7	2005	100	564.800	0.62%
8	2006	21	99.514	0.11%
9	2007	105	567.400	0.62%
10	2008	24	372.700	0.41%
11	2009	85	467.750	0.51%
12	2010	85	1050.700	1.15%
13	2011	47	225.720	0.25%
14	2012	45	217.250	0.24%
15	2013	69	1548.418	1.69%
16	2014	51	333.759	0.36%
17	2015	43	516.469	0.56%
18	2016	65	956.417	1.04%
19	2017	24	461.333	0.50%
20	2018	21	345.100	0.38%
21	2019	27	147.954	0.16%
22	2020	3	17.000	0.02%
23	2021	27	143.570	0.15%

Source: Kanha Tiger Reserve (2021)

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 59.73% of the total annual rainfall is received in the season, which is around 1555 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.

The climatological data relating to the Kanha centre for the period 2010 to 2019 has been presented. The analysis of total rainfall in a season, and its distribution offers very interesting managerial considerations, which are as under:

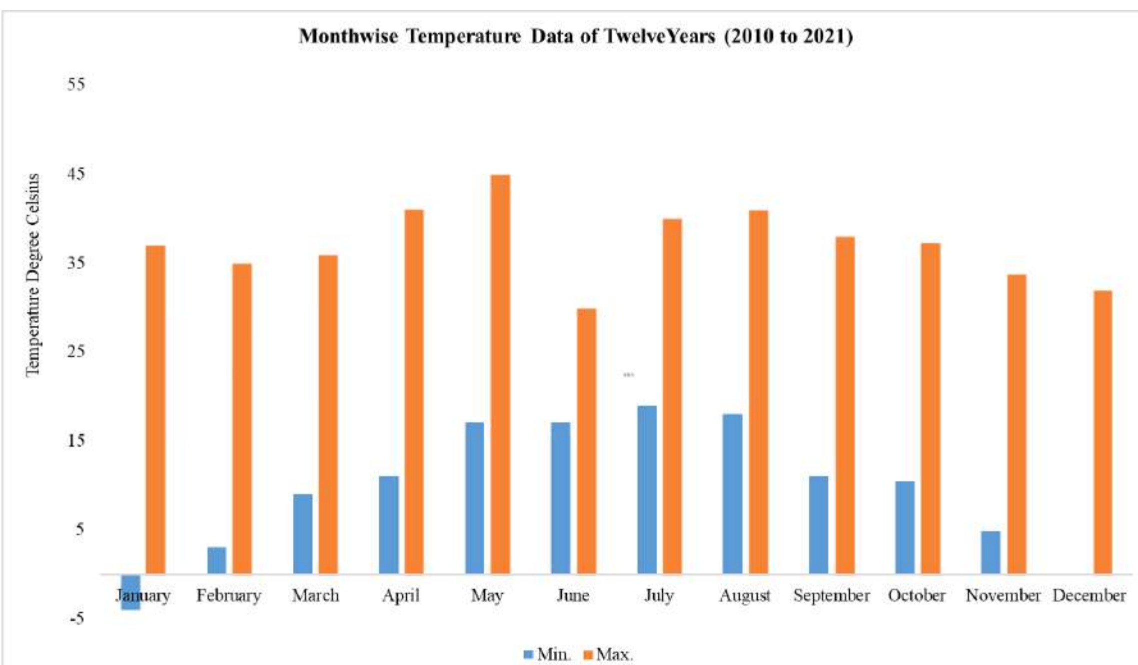
- Substantially low rainfall in a particular year, succeeded by a long dry spell (no winter rains) causes reduction in fodder production. The following summer witnesses extensive and severe fires despite effective fire protection measures. This phenomenon also leads to water scarcity.
- Substantially 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.

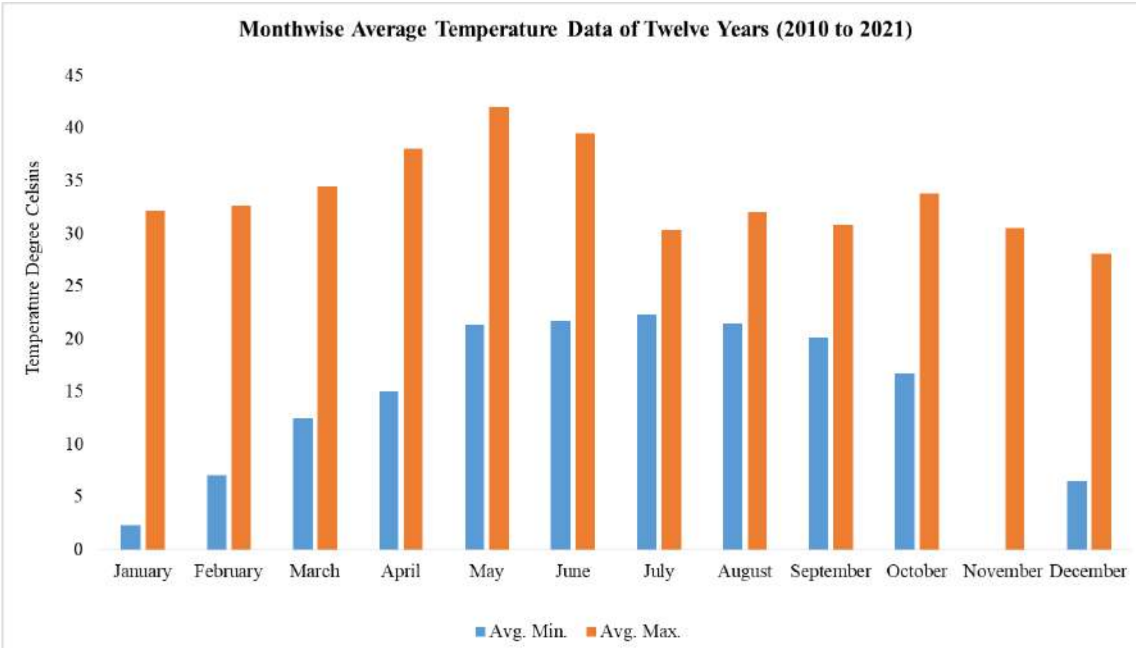
- An average rain year succeeded by a long dry spell results in a reduction of palatable grasses in the meadows, forcing the ungulates to take to water-courses and waterholes where green forage is available.

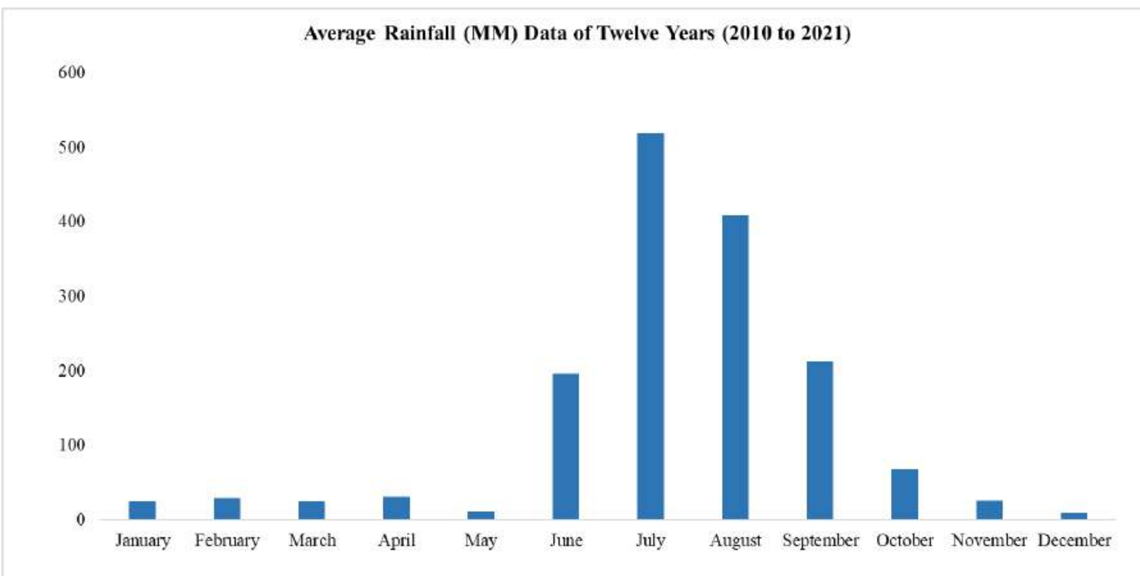
Table-11: Average Meteorological Data of Twelve Years (2010 to 2021)

Sl. No.	Month	Temperature (0^{o})				Rainfall (mm.)
		Min.	Max.	Mean Min.	Mean Max.	
1	2	3	4	5	6	7
1	January	-4.00	37.00	2.35	32.16	25.25
2	February	3.00	35.00	7.10	32.70	30.14
3	March	9.00	36.00	12.50	34.50	24.57
4	April	11.00	41.10	15.00	38.10	31.38
5	May	17.00	45.00	21.30	42.00	11.25
6	June	17.00	30.00	21.70	39.50	196.25
7	July	19.00	40.00	22.30	30.40	519.75
8	August	18.00	41.00	21.50	32.00	408.99
9	September	11.00	38.00	20.20	30.80	213.35
10	October	10.50	37.40	16.70	33.80	68.17
11	November	4.80	33.80	10. 60	30.50	26.00
12	December	0.00	32.00	6.50	28.10	9.80
	Total:					**1564.90**

Source: Kanha Tiger Reserve (2021)







2.4.3 **Winter:** The winter sets in November and lasts until 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°C or sometimes even to the sub-zero temperatures. These frosts also kill sal seedlings on the periphery of groves and in the openings, and also 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% 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 several past winters, the minimum temperature dropped to sub-zeros in the month of January. The Supkhar, Kanha and Mukki ranges of the core zone specially experienced severe frosty mornings, with a white sheet of ice spread over grasslands, and frost-damaged plants under open sky. At many places specially in the Supkhar and Kanha ranges, the canopies of large areas of sal turned brown due to severe frost.

There are three distinct seasons, viz:

- **Winter:** November to February (with the night temperature dropping to -2^{o}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^{o}C).
- **Rain:** 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 Kanha management. Though the hydrology of the wildlife ecosystem has gifted it with a number of perennial and seasonal streams, streamlets, and some rivers, 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*.

Table-12: Some Main Rivers and Streams Flowing through the Core Zone

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

Source: Kanha Tiger Reserve (2021)

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

Currently, the total number of different types of water bodies in the core zone is 579, excluding wells (natural-310 and artificial-269). Of this number, 343 are perennial (Density: one water body per 2.55 sq. km.) and 236 are seasonal (Density: one water body per 3.89 sq. km.). In this way, the total density of water bodies in the core zone is one water body per 1.58 sq. km.

2.6 Quasi/ Semi-Natural Wetlands:

Natural wetlands are distinct ecosystems, and they must possess some basic characteristics to qualify for this category. There are no true wetlands in the real sense of the term in the core zone, and the existing water bodies 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. Natural wetlands are highly productive, providing food for a large range of organisms. There are, however, some quasi or semi-natural wetlands or water bodies which may pass off as natural wetlands.

There are, however, some water bodies in the core zone which may well pass off as wetlands.

Table-13: Some Water Bodies in the Core Zone

Sl. No.	Name of Water bodies	Name of Range
1	2	3
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
8.	Ajanpur tank	Bhaisanghat
9.	Sukdi tank-1	Bhaisanghat
10.	Sukdi tank-2	Bhaisanghat

Source: Kanha Tiger Reserve (2021)

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

2.7 Forest and Vegetation, Biogeographic Classification, Habitats & Changes:

2.7.1 **Forest and Vegetation:** The protected area is a fine representative of central highlands sal and mixed woodland and grassy expanses. It 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 sal forests on the lower slopes and in the valleys, the mixed forests on the upper slopes and hilltops, and the grasslands in valleys and on plateaus for a wide range of diverse wildlife habitats.

2.7.1.1 **Distribution of Forests:** Forests are distributed over almost all physiographic and topographic features of the protected area. Some other features they are interspersed with are: extensive meadows, large clearings and frost-hollows, meandering rivers and streams, and large water bodies. Different tree species of these forests undergo typical phenological phases of their life cycles.

The plateaus 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 plateaus, support bamboo (*Dendrocalamus strictus*), mango

(*Mangifera indica*), jamun (*Syzigium cumuni*) and arjun (*Terminalia arjuna*). The upper slopes of the core zone support mixed forests, with a large number of mahul (*Bauhinia vahlii*) climbers that span the space between trees. Besides, many other species of tree also grow here. The middle reaches of the slopes have 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. Excellent patches of *Dalbergia latifolia* also occur in the Bhaisanghat and Kanha ranges.

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.

2.7.1.2 **Pinus Plantations:** The British also took up planting the chir pine, *Pinus longifolia/ roxburghii*, at Supkhar to cover the blanks resulting from the failure of sal regeneration. It was attributed to severe frost that prevented the sal to reach the pole stage. Being also tolerant of poor soil conditions and adapted to degraded sites, the chir pine shows good growth here. Consequently, there is a patch of around five thousand chir pine trees among sal stands. The undergrowth of these plantations sometimes also support *Chloroxylon swietenia* and and *Colebrookia oppositifolia*. While herbaceous flora under these pine plantations is poor, these conifers strike as a pleasant surprise and lend certain splendor to this particular area of the range close to the Supkhar forest rest house.

Technically, however, after Champion and Seth (1968), the following forest types have been identified:

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

2.7.1.3 **Grasslands:** The Kanha ecosystem is characterized by undulating landscape, dotted with dense groves of vegetation, hillocks and large 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 populations of chital, barasingha, sambar, and gaur and, indirectly, populations of predators and co-predators.

These are, however, not natural grasslands with grass species as their climax vegetation. The Kanha grasslands, and for that matter most grasslands in India, are "plagioclimax", with human-induced stage of arrested ecological succession, and are regarded as anthropogenic. Some of the main anthropogenic activities in Indian context are lopping, burning, grazing, and farming etc. These grassy expanses, except for the frost-hollows, are actually the sites of relocated villages, their agricultural fields and old shifting cultivation sites. The existing grasslands, which used to serve as pasturelands for the village livestock, were already under grazing pressure.

After the relocation of the villages since 1969, old abandoned village sites have 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. These grassy expanses can be divided into three types for the convenience of management: plateau, valley, and riparian meadows (on silted stream-beds). The Kanha management has to maintain these grasslands very assiduously under various managerial practices in order to keep them sufficiently healthy for ungulates.

2.7.1.4 **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 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 these 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)**.

2.7.1.5 **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)**.

2.7.1.6 **Vegetal Cover Types:** Different physiographic, geographic, edaphic, and anthropogenic factors have also given rise to several vegetal cover types in the core zone. It is interesting as well as managerially important to know vegetal coverage of a protected area and changes therein over a period of time. The assessment of this vegetal coverage is based on photo-interpretation of imageries taken by satellites from time to time. Depending upon the resolution, the imagery can be interpreted upto species level vegetal coverage. They can also tell about decrease or increase in forest cover and grassland area.

2.7.1.6.1 **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 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, one class of bamboo brakes and four 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 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 topo-sheet. 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.

  All the above 5 studies are detailed in the proceeding of seminar-cum-workshop on Wildlife Habitat Evaluation Using Remote Sensing Techniques (October, 22-23, 1986) edited by Mr. DS Kamat and Mr. HS Panwar.

- The hard ground barasingha (*Rucervus duvaucelii branderi*) is classified as endangered and occur in Madhya Pradesh, mainly confined to Kanha national park. Conservation and propagation of this deer is the need of the hour and finding newer places conducive for their conservation should be based on environmental factors and ecological premises. The basic premise for

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predicting species distributions lies in quantifying species–environment relationships. The scientists of SAC (ISRO), Ahmedabad has taken up a study in close collaboration with Kanha national park to find newer grounds possible for hard ground barasingha. The findings of the study are presented in this report (Singh, CP et al., 2012).

- Grassland ecosystem is critical for survival of herbivores and plays an important role in conservation and management of wildlife. These habitats are widely studied for various issues, including biodiversity, biomass assessment, carrying capacity, etc. Woody species ingression in grasslands is one such important aspect that needs critical attention in protected area as this leads to shrinking of grasslands habitat. This study presents a case of Ronda grassland in Kanha national park – a well-known protected area in India, known for its herbivore diversity and hard-ground Barasingha (*Rucervus duvacelii branderi*), in particular. Long-term satellite observation for five decades was carried out to understand spatiotemporal changes. Declassified Corona satellite data, aerial photographs along with satellite datasets in the subsequent period were utilized for this study. The study revealed that 88 ha. (16% of Ronda and surrounding) have been ingressed during 1962–2011, in and around Ronda grassland of Kanha national park. Rates of ingression on linear transects were found to be 60–120 m. per decade. Field studies and NDVI analysis along the edge of grassland pixels as well as inside region using 1972 as baseline data, indicated woody vegetation replacing area of grassland. It was noted that *Butea monosperma* is invading more than other species in Ronda grassland, particularly along the stream where moisture availability is higher. Grassland habitats in Kanha are thus shrinking and thus leading to reduction in the area available for herbivore population which has increased in recent years. This can lead to severe impact on carrying capacity of these grasslands (Lele, Nikhil et al., 2015).
- The Supkhar forest range of Kanha tiger reserve is one of the six forest ranges of the core zone or Critical Tiger Habitat. The forest range typically represents the floral and faunal attributes of the Kanha core zone, with sal (*Shorea*

robusta) and miscellaneous forests. The climate of the study site is typical monsoonal, with average annual rainfall around 1300 mm. Temperature soars to 45°C in summer and may drop to even -2°C for a few days in winter. This bio-climatically unique forest range of KTR showed the maximum value of the fundamental niche indicating potential climatic conditions for Giant squirrel. More such efforts will be required within this fundamental environmental niche to understand its current status and abundance in the area to save it from local extinction. The squirrel is mainly hunted for meat and trade therefore; its habitats need to be specially protected through regular monitoring of all nesting sites (Chauhan, et al., 2015).

- Conservation practitioners require strata specific, seasonal species densities for habitat management. Herein, we use stratified distance sampling in Kanha tiger reserve with 200 spatial transects and an effort of 1200 km. walk in the 2013. Analysis was done to access (a) impact of human use and (b) effect of habitat and season on ungulate densities in Kanha tiger reserve. While a single detection function for each species was use for estimating density within human-restricted core and multiple use buffer of Kanha tiger reserve, species-specific seasonal detections were modelled for each habitat. Ungulate biomass was 4.8 times higher in the core area compared with the buffer zone. The core supported a herbivore density and biomass of 50 ± 4.80 per sq. km. and 26806 ± 2573 kg. per sq. km., respectively. Chital were found to be most abundant, having a density of 30.1 ± 4.34 per sq. km. and contributing 33% of the biomass with a habitat preference for grasslands (106 ± 39 per sq. km.) in summer and winter. Sambar had highest density (15.4 ± 3.34 per sq. km.) in bamboo-mixed habitat, in both seasons. Gaur contributed 39% of the ungulate biomass and showed a seasonal shift in density from sal forests (9.65 ± 3.55 per sq. km.) in summer to miscellaneous forests (8.13 ± 1.94 per sq. km.) in winter. Barasingha were restricted to grasslands with similar summer and winter densities of 1.56 ± 0.76 per sq. km. Chousingha were rare (0.1 ± 0.04 per sq. km.), found mostly in miscellaneous forests and plateau grasslands. Grassland and bamboo-mixed forests supported 58% of the total ungulate biomass. Management for an optimal habitat mosaic that maintains ungulate diversity, addresses the specific needs of endangered species and maximizes ungulate biomass is recommended (Awasthi, et al., 2016).

- Most large carnivore populations are declining across their global range except in some well managed protected areas. Investments for conserving charismatic apex carnivores are often justified due to their umbrella effect on biodiversity. We evaluate population trends of two large sympatric carnivores, the tiger and leopard through spatially-explicit-capture-recapture models from camera trap data in Kanha protected area, India, from 2011 to 2016. Our results show that the overall density (100 sq. km.) of tigers ranged between 4.82±0.33 to 5.21±0.55 SE and of leopards between 6.63±0.71 to 8.64±0.75 SE, with no detectable trends at the protected area scale. When evaluated at the catchment scale, Banjar catchment that had higher prey density and higher conservation investments, recorded significant growth of both carnivores. While Halon catchment, that had lower prey and conservation investments, population of both carnivores remained stable. Sex ratio of both carnivores was female biased. As is typical with large carnivores, movement parameter sigma (an index for range size), was larger for males than for females. However, sigma was surprisingly similar for the same genders in both carnivores. At home-range scale, leopards achieved high densities and positive growth rates in areas that had low, medium or declining tiger density. Our results suggest that umbrella-species conservation value of tigers is likely to be compromised at very high densities and therefore should not be artificially inflated through targeted management (Ujjwal et al., 2019).
- The study entitled "Soil-vegetation-atmosphere fluxes" is currently carried out as part of the National Carbon Project (NCP) of Indian Space Research Organisation (ISRO), funded by ISRO's Geosphere Biosphere Program (ISRO-GBP). The project is envisaged to assess the net ecosystem exchange (NEE) of carbon by establishing a network of eddy covariance flux towers across representative forest ecosystems in India. Seasonal, intra- and inter-annual mass and energy fluxes are analyzed with reference to climatic drivers

and net forest ecosystem productivity will be assessed. The tower based productivity and NEE estimates are up-scaled to regional context using remote sensing proxies. It is envisaged to quantify the net ecosystem exchange of carbon 'in and 'out' of forest ecosystems. This gives an account of a) how much forests are sequestering carbon dioxide for photosynthesis (gross primary productivity-GPP), and how much is given out as respiration losses (Ecosystem respiration including autotrophic and heterotrophic) and the net gain (net primary and ecosystem productivity-NPP & NEP). This is achieved by measuring fluxes of CO_2, H_2O and energy (latent heat, sensible heat and soil heat) at very high frequency of the order or 10 Hz (10 readings per second) along with meteorological parameters. This is a micro-meteorological method popularly known as 'eddy covariance' technique, which is, by-far the most reliable and accurate method to measure ecosystem scale carbon fluxes. Globally there are approximately 700 towers of which ISRO has established a network of 5 towers in forest ecosystems. The present tower is established near Neela Nala of the Kanha tiger reserve, which is envisaged to measure the fluxes of Sal ecosystem. Other similar towers are in the following locations. Kanha flux tower was established in January 2017 and is operational for continuous measurements. Annual average of carbon fluxes during 2017 and 2018 suggest that Sal forests of Kanha are carbon sink with NEP (-NEE) of the order of 303 g.C m^{-2} $yr^{-1.}$

- 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:

Table-14: Broad Classification of the National Park

Sl. No.	Broad Classes	National Park	
		Area (sq. km.)	% of Zone Total
1	**2**	**3**	**4**
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
	Total:	**940.00**	**100.00**

Source: Kanha Tiger Reserve (1998)

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

Table-15: Vegetation Cover Types in the National Park

Sl. No.	Vegetation Cover Types	National Park	
		Area (sq. km.)	%
1	**2**	**3**	**4**
1	Dense Sal	124.191	13.21
2	Low Density Sal	54.619	5.81
3	Sal Without Undergrowth	49.668	5.28
4	Sal Mixed With Misc. Species	171.342	18.23
5	Dense Moist Deciduous Forest	109.593	11.66
6	Medium Dense Moist Deciduous Forest	82.931	8.82
7	Open Moist Deciduous Forest	97.239	10.34
8	Dry Deciduous Forest	53.772	5.72
9	Dense Bamboo Mixed With Misc. Species	44.194	4.70
10	Grasses	47.582	5.06
11	Grasses With Shrubs	25.383	2.70
12	Agriculture	5.470	0.58
13	Open Bamboo Mixed With Misc. Species	63.547	6.76
14	Fallow	6.440	0.69
15	Water	4.028	0.43
	Total:	**940.000**	**100.00**

Source: Kanha Tiger Reserve (1998)

2.7.2 **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 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".

2.7.3 Habitats & Trophic Niches and Faunal Status:

2.7.3.1 **Habitat & Trophic Niches:** The occurrence of a wide range of wildlife species depends exclusively upon the suitability of vegetation and habitat types - home to wildlife - with food, water and cover. Vegetation and habitat types in turn depend upon the physiography, geology, climate, and precipitation in a wildlife ecosystem. The physiography of the core zone, is characterized mainly by grassy expanses and forested shallow undulations, hills with varying degrees of slopes, plateaus, and valleys. These physiographical features, including seasonal and perennial streams, along with sal, mixed crops, and bamboo; offer distinctive settings and ecotones, giving rise to diverse types of micro, macro and specialized wildlife habitats, and form ideal niches or animal specific spaces/ haunts for various animal species.

In the Kanha wildlife ecosystem, the above factors help create large habitat mosaics and a wide spectrum of floral and faunal diversity. This heterogeneity in physiographic features, vegetation and habitat types support thousands of animals of different wildlife species in the core zone. Some major terrestrial wildlife species are carnivores, meat-eaters; herbivores, plant-eaters; and omnivores, opportunistic eaters. Some big names in the carnivore species are the tiger, leopard and wild dog. Their populations in this zone depend exclusively on the meat of herbivores for survival, the sole reason for maintaining a good population of these herbivores at Kanha. Besides the endangered hard ground barasingha, and the gaur, other herbivores include the sambar, chital, barking deer and nilgai etc. All these herbivore species feed on various types of grass and parts of plant species such as leaves, shoots, flowers, fruit, seeds and barks. The sloth bear and wild pig, omnivores, depend on a wide variety of food items.

Table-16: Habitat Uses by Some Major Wildlife Species in the Core Zone

Sl. No.	Animal Species	Shelter/ Escape Route	Loafing Cover	Breeding Cover
1	2	3	4	5
1	Tiger	Dense sal and miscellaneous forests, close to grasslands	Forest/ forest edges, along forest roads and nullahs	Rocky outcrops in dense forests
2	Leopard	Dense sal and miscellaneous forests, close to grasslands	Forest/ forest edges, periphery of habitations	Dense forests
3	Wild dog	Open sal and miscellaneous forests, close to grasslands and water bodies	Open spaces, including grasslands, along forest roads	Dens in dense forests
4	Jackal	Open forests and forest edges	Open spaces, including grasslands, along forest roads	Dens/ ground rock crevices in forests
5	Sloth bear	Rocky outcrops in Dense forests	Dense forests and along forest edges	Dense forests
6	Gaur	Dense forests/ grasslands, close to water bodies	Forest and open spaces	Dense forests
7	Nilgai	Scrub forests	Flat areas of open forests	Scrub forests
8	Barasingha	Grasslands, small groves, close to water bodies	Open grasslands	Tall grass
9	Sambar	Dense forests and undulating landscape	Dense forests and along the edges	Dense forests
10	Chital	Open forests and forest edges	Forest edges and grasslands	Open forests
11	Barking deer	Dense forests	Open forests and forest edges	Dense forests
12	Chousingha	Open forests	Open spaces and forest edges	Dense forests
13	Wild pig	Open forests	Open forests	Dense grassy cover
14	Langur	Dense and miscellaneous forests	Forest and riverine areas	Dense groves of trees
15	Hare	Open forests	Open grassy expanses	Dense shrubby undergrowth
16	Jungle cat	Forest areas	Open forest areas	Forest areas
17	Civet cat	Forest and dense grassy areas	Along forest roads and trails	Burrows/ under the rocks
18	Porcupine	Forest areas	Along forest roads and trails	Burrows in dense grassy under growth

Source: Kanha Tiger Reserve (2021)

2.7.3.2 **Intra & Inter-Specific Relations:** As there are several species of carnivores and herbivores in the zone, their coexistence results in various intra and inter-specific relationships. Ecologically, these interactions result in the adjustment of equilibrium. Some of these relations are as under:

Table-17: Intra and Inter-specific Relationship

Sl. No.	Interaction Type	Species	Nature/ Effect
1	**2**	**3**	**4**
1	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
2	Direct competition	Tiger – Leopard Leopard – Wild dog Barasingha – Chital	Inhibition of species in some areas
3	Indirect competition	Ungulates – Livestock	Inhibition in peripheral areas of forest villages
4	Antagonism	Ungulate – Villagers	Inhibition of wild species inside or close to forest villages
5	Mutualism	Chital – Langur	Favourable interactions between the two
6	Neutralism	Chital – Sambar Gaur – Chital Gaur – Sambar	No species is affected

Source: Kanha Tiger Reserve (2021)

2.7.3.3 **Faunal Status:** The above-mentioned typical faunal species of the central Indian highland, part of the Oriental-Zoological Realm, is a fusion of the Indo-Chinese, Ethiopean and 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 is also a strong driver of 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 and Sarhi ranges) 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 carry 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 core zone is renowned internationally for the successful conservation of two endangered wildlife species - the tiger and the central Indian barasingha. The tiger is now regarded as an 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 core zone has effectively conserved a viable population of the tiger ever since the ambitious "Project Tiger" was launched around 50 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 (*Rucervus duvaucelii duvaucelii*) 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.

2.7.3.4 **Birdlife**: Kanha supports an equally rich birdlife, with around 300 species of birds. Belonging to 186 genera and 60 families, these birds represent typical central Indian avifauna. At least six species are reported to be new records added to the fauna of Madhya Pradesh. Birdlife is also regarded as a good indicator of the health of a wildlife ecosystem. Amid tranquil environ, a wide range of vegetal cover types, ground cover, water bodies, and agriculture close to the periphery of the national park, with a host of structural varieties therein, ensure good nesting, feeding and roosting areas for birds. Depending upon their food habits and adaptations, these bird species can be categorized as terrestrial (ground), aquatic (water), and arboreal (tree). Birdwatchers are sure to appreciate, amid symphony of jungle sounds, birdcalls of different pitches and notes on the early morning excursions. While most bird species are resident showing local or seasonal movements depending upon their requirements, some species are winter visitors and stay until around early March.

The main ground-nesting birds in the tiger reserve are the peafowl, red jungle fowl and the painted spur fowl. Among the commonly seen birds are the Indian roller, racket-tailed drongo, red and yellow-wattled lapwings, green bee-eater, grey hornbill, tree pie, paradise flycatcher and golden-backed woodpecker. During vehicular excursions and joy rides on elephants one may also spot the black-headed and golden oriole, Indian pitta, Indian stone curlew, common grey and painted partridges and green pigeon. Black ibis, white-necked and lesser adjutant storks, and occasionally cormorants can also be seen around ponds and streams near Kanha, Sonf, Sondar, Kisli and Mukki. There are also several species of birds of prey, and commonly seen are the crested serpent and hawk eagles, crested honey buzzard, white-eyed buzzard, harriers, black-winged kite, shikra, laggar and shaheen falcon.

2.7.3.5 **Reptiles:** They are regarded as a very important component of food web in most ecosystems. As they are both predator and prey species, their role automatically becomes very critical. Reptiles' significant anthropogenic role lies in the control of many pest species that are harmful to agriculture. The supports 39 species of reptiles belonging to 30 genera and 12 families. It is not easy to see these creatures often as they generally remain hidden or move in dense undergrowth. Two major orders of the reptiles are represented in the core zone: tortoises and turtles, and lizards, geckos and snakes.

Some important lizards commonly seen are: the Indian monitor lizard, garden lizard, fan-throated lizard, flying lizard, and chameleon.

The largest snake here is the Indian rock python. It is massively built, with nearly six meters maximum length recorded, and is easily identifiable. It is a good climber and swimmer but generally lethargic. It feeds on birds, reptiles, mammals and, sometimes, even chital. Once the prey is swallowed it takes a rather long time for the python to digest it during which time it more or less remains sedentary. Some other snakes found in Kanha are the cobra, saw-scaled viper, wolf snake, rat snake and egg-eating snake. In fact, all the four main poisonous snakes of India the Russell's viper, saw-scaled viper, cobra and common krait are found in the tiger reserve.

2.7.3.6 **Invertebrates:** These animals without the backbone are regarded as the most abundant organisms on this planet. Consequently, they occupy almost all the habitats in the tiger reserve, and may be found crawling, flying, swimming, floating or digging in their respective habitats. While the commonest invertebrates also include protozoans, annelids, echinoderms, and molluscs, the tiger reserve is teeming with over 500 species of insects, the largest group of Arthropods. These insects include a variety of butterflies, moths, beetles; bees, wasps and ants; grasshoppers, crickets, mantids, bugs and termites. These insects contribute significantly to the ecology of the wildlife ecosystem.

Butterflies we all see and admire because of their fascinating colours and design, but spiders, dung beetles, termites, ants, caterpillars, and scores of such smaller creatures are no less interesting. Though tiny, they play a major role in keeping a forest alive and healthy by tilling the earth and helping in pollination of plants. Besides, they form an important food source for birds and other insectivorous creatures. A termite mound may at times contain as many as half a million termites. In a forest termites are not perceived as pests. Their digestive system helps turn dead and decaying vegetation into soil-enriching nutrients. Small and big termite mounds are a common sight throughout the reserve.

2.7.3.7 **Ecological Separation**: Thousands of wild animals in Kanha belong to at least three major carnivore and nine herbivore species. All these species coexist in a natural segregation amongst them on the basis of ecological niche partitioning, means routine occupation-based separations, which includes different food habits and habitat types and also their specific ecological needs. Nature has helped these species evolve different hunting/ feeding strategies and mobility to reduce competitions between themselves. The hunting techniques of a tiger, leopard or a pack of wild dogs are quite different. The tiger stalks large-sized quarry through stealth. Leopards usually go for small sized prey, and also kill common dogs and goats near the villages, while wild dogs chase and kill their prey. Similarly, different herbivore species have different preferences, and they also adopt different foraging tactics. For instance, while the barasingha is a grazer, restricted almost always to grasslands, the chital is also a browser. The barasingha can readily enter a waterbody to feed on aquatic plants, the chital does not feed on these plants. The sambar is mostly restricted to undulating and hilly landscapes in dense forests, browsing on different species. These separations may not be noticeable to an untrained observer.

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:

Table-18: IUCN Red List of Threatened Species

Sl. No.	Name of Species	Scientific Name	IUCN Status	WPA Schedule
1	**2**	**3**	**4**	**5**
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	Wolf	*Canis lupus*	Least Concern	I
7	Jackal	*Canis aureus*	Least Concern	II
8	Swamp deer	*Rucervus duvaucelii branderi*	Vulnerable	I
9	Chital	*Axis axis*	Least Concern	III
10	Sambar	*Rusa unicolor*	Vulnerable	III

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11	Barking deer	*Muntiacus muntjak*	Least Concern	III
12	Nilgai	*Boselaphus tragocamelus*	Least Concern	III
13	Gaur	*Bos gaurus*	Vulnerable	I
14	Four-horned antelope	*Tetracerus quadricornis*	Vulnerable	I
15	Wild pig	*Sus scrofa*	Least Concern	III
16	Langur	*Presbytis entellus*	-	II
17	Rhesus macaque	*Macaca mulatta*	Least Concern	II
18	Hare	*Lepus nigricollis*	Least Concern	IV
19	Jungle cat	*Felis chaus*	Least Concern	II
20	Smooth coated otter	*Lutra perspicillata*	Vulnerable	II
21	Mouse deer	*Moschiola indica*	Least Concern	I
22	Civet cat	*Viverricula indica*	Least Concern	II
23	Common mongoose	*Herpestes edwardsii*	Least Concern	II
24	Porcupine	*Hystrix indica*	Least Concern	IV
25	Indian python	*Python molurus*	Near Threatened	I
26	Monitor lizard	*Varanus bengalensis*	-	I
27	Pea fowl	*Pavo cristatus*	Least Concern	I
28	Red jungle fowl	*Gallus gallus*	Least Concern	IV
29	Green munia	*Estrilda Formosa*	Vulnerable	IV

Source: Kanha Tiger Reserve (2021)

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

2.7.3.8 **Uncommonly Sighted Animals:** Besides major carnivore and herbivore species, Kanha is also home to a wide range of lesser faunal species. They include 300 species of birds, 30 of mammals, 40 of reptiles, including 25 species of snakes and 15 of lizards, 15 species of frogs, around 500 of insects, 115 of arachnids (spiders), several species of crustaceans, mollusks and fishes, and also lots of species of moths and butterflies.

This is by no means an exhaustive account, and there are also a large number of smaller life forms belonging to different phyla and classes of the animal kingdom. Still some others may remain unidentified due to their perceived academic significance only. Though the main attention is focused on the management of larger mammals in the core zone, these less iconic or obscure wildlife species have their own ecological role and importance in the Kanha ecosystem and their protection automatically emanates from over-all conservation efforts, the tiger being the umbrella species for all these lesser animals.

All these species are distributed at Kanha over time and space, following their basic habits and survival skills throughout their life span. While some species follow diurnality or nocturnality, there are also others that remain active at dawn and dusk, showing crepuscularity. All animals have their own biorhythm, which is a recurring cycle in their physiology and daily functioning, such as sleeping, waking and also emotional responses. There are also some cryptic species that have camouflaged bodies or colouration as an ante-predator strategy to avoid detection by natural predators. This could, however, also be a predation strategy to confuse and deceive their prey species. Some of these lesser species remain arboreal most of the time, while others live in burrows, tunnels and thickets. In this way, most of these species remain elusive even to the frontline staff that intensively patrols the protected area during the day and night.

However, for recording evidence of some of these small, cryptic and nocturnal animals, use of camera traps under a systematic design has now become extremely popular, with, of course, its own limitations. These cameras trap images of animals, record dates and times, and show presence of different species in a protected area. Kanha has an excellent network of camera traps installed for the monitoring of wild animals, especially tigers. The cameras remain functional during day and night, and photograph all the animals passing in front of them and through the field of view. The camera trap stores the images on a SD card, which is periodically removed and downloaded onto a computer.

Some less commonly seen animals camera-trapped at Kanha are: striped hyenas (*Hyaena hyaena*), small Indian civets (*Viverricula indica)*, common palm civets (*Paradoxurus hermaphroditus*), mouse deer (*Moschiola indica)*, Indian vultures or long billed vultures (*Gyps indicus*), honey badgers, or ratels (*Mellivora capensis*), jungle cats (*Felis chaus*), rusty spotted cats (*Prionailurus rubiginosus*), porcupines (*Hystrix indica)*, and smooth coated otters (*Lutra perspicillata)*, small Indian mongoose (*Herpestes javanicus*), ruddy mongoose (*Herpestes smithii*), Indian pangolin (*Manis crassicaudata*), tree shrew (*Anathana ellioti*) and white-tailed wood rat (*Madromys blanfordi*) etc.

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*

2.8 Major Conspicuous Changes in the Habitat:

Protected areas are a dynamic ecosystem depending upon climatic conditions, specially rainfall, vegetation production, habitat use by wild ungulates, and nature's unpredictability. The following changes have been recorded in the wildlife habitats of the core zone since its inception:

- Presently, after the relocation of 35 forest villages, there is no village inside the core zone, and this has resulted in tremendous amelioration of wildlife habitats, and creation of large tranquil zones for wildlife. The relocated village sites, specially

Jami, Sukdi, Ajanpur and Jholar, have morphed into excellent heterogeneous grasslands, the mainstay of thousands of ungulates.

- The small population of hard ground barasingha was once restricted to only some habitat pockets of the Kanha, Sarhi, Mukki and Supkhar ranges only. They are now also sighted in good number in several habitats of Kisli and Bhaisanghat ranges. The population is expanding.
- 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.
- 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.
- Water development measures have ensured availability and almost equitable distribution of water for wildlife throughout the core zone. The pinch period, however, turned more problematic in past years, and in some areas water had to be supplemented through water tankers.
- Some invasive species such as *Phoenix acaulis*, *Desmostachya bipinnata* and *Parthenium hysterophorus* etc. are invading prominent grasslands.
- *Pogostemon benghalensis 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*.

2.9 Value Assessment/ Documentation:

The core zone has a long conservation history. It has evolved through shooting blocks, wildlife sanctuaries and national park to reach this coveted status of being one of the first nine and an excellent tiger reserve of the country. Needless to add, its gradual upgradation through various conservation statuses is, to a large extent, a result of identified and assessed values, it has preserved during all these years. The identification and assessment of these values in the past may not have been very systematic and formal in today's comparison, but the protected area has certainly made its mark by conserving all important values.

Over the past several years, under gradually refined framework of identification, documentation and assessment, the core zone has been credited with encompassing a wide range of values. These values can be categorized into: Direct and Indirect use values. The Direct use values, as the term itself suggests include being a great depository of natural resources, recreation, tourism, gene pool services, research, education and awareness etc. The Indirect use values include all ecological functions, for instance, watershed protection, natal areas/ breeding habitat of tigers, special habitat for the only world population of the hard ground barasingha, ecosystem services, and climate stabilization etc. Some more values under a different category may also include pride in local culture, heritage, and spiritual, and landscape etc.

All these values of the core zone have been systematically identified, assessed and monitored and find their rightful mention in various in-house documents for the core zone. Periodic changes in and review of managerial strategies are made to effectively conserve these values.

CHAPTER – 3

STATUS OF TIGERS, CO-PREDATORS & PREY BASE

3.1 Background:

It is well recognized that the predator prey relationship involves the interactions between two species and their consequent effects on each other. The Kanha wildlife ecosystem supports populations of a wide range of carnivore and herbivore species, which are naturally managed and regulated under more or a less well-defined predator-prey relationship. General response of these predator and prey species to conservation practices in the core zone over the years has been encouraging, and these populations have registered a normal increase. Stringent protection and various management practices in the core zone have ensured a good prey base for the 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. Besides conventional field monitoring, the Kanha management has also been making efforts in collaboration with the National Tiger Conservation authority and the Wildlife Institute of India to periodically ascertain the status of all these predator and prey populations by using new methods and advanced technology.

3.2 Development of Monitoring Methods for Wildlife and Habitat:

Earlier method of monitoring was based on intensive monitoring of tigers within areas, identifying individual tigers by visual inspection of the pugmark tracings/plaster casts, mapping tiger distribution at the local scale and inferring total numbers from the above information (Choudhury, 1970; Panwar, 1979; Sawarkar, 1987; and Singh, 1999). This Pugmark based methodology, which had a number of shortcomings and was not statistically robust, came under severe criticism (Karanth et al., 2003). The National Tiger Conservation Authority along with the Wildlife Institute of India envisioned the need and strived for the refinement of standard monitoring methods in collaboration with the Madhya Pradesh Forest department through a pilot project in the Satpuda-Maikal landscape (2002-2005). Kanha tiger reserve was the main testing ground for these monitoring methods. Later, the Tiger Task Force (2005) recommended implementing this protocol for the National Tiger Estimation at every four years and annual monitoring at the tiger reserve level. These monitoring methods outline the following phases:

3.2.1 **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 are collected in simple formats on carnivore signs and ungulate sightings in forested areas of the region within each forest beat. Data are also recorded on indices of human disturbance and habitat parameters (Jhala, Qureshi & Gopal, 2005). These constitute the Phase I data and are collected by the State Forest Department. This stage consists of mapping:

a) tiger presence and relative abundance (Karanth and Nichols, 2002);
b) tiger prey presence and relative abundance, and
c) habitat quality and anthropogenic pressures at a high spatial resolution of 15-20 sq. km.

A forest beat is considered a unit for sampling. Since each beat is allocated to a beat guard for patrolling and protection, the boundaries of a beat are well recognized by forest staff. The sampling is 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.

The detailed methodological approach for sampling carnivore signs, ungulate encounter rates, pellet/dung counts, habitat and anthropogenic pressures are presented in the Field Guide issued by the Wildlife Institute of India, Dehradun. The target data are very easy to collect and do not require a high level of technical skills or advanced 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 instils ownership and accountability of this agency which is primarily responsible for the protection and management of wildlife resources. The forest department staff is to be trained in the data collection protocol. The spatial data generated are 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 are analyzed in a GIS domain, several spatial and attribute data like human density, livestock density, road network, topographical features, forest type and cover, poaching pressures and landscape characteristics are 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 several 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 are relatively easy to pinpoint. There is an audit mechanism in place to scrutinize the data collection, compilation and analysis.

3.2.2 **Phase II - Spatial & Attribute Data:** The spatial data that are likely to influence tiger occupancy of a landscape are used for modeling in a GIS domain. The vegetation map, terrain model, night light satellite data, drainage, transportation network, forest cover, climate data, Normalized Difference Vegetation Index, livestock abundance, human density, socio-economic parameters, etc are used for modeling habitat conditions 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. Parts of this component are done in collaboration with the Forest Survey of India and the 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 forest divisions are used to spatially link the Phase-I data in a Geographic Information System.

3.2.3 **Phase III - Estimating the Population of Tigers & Its Prey:** Phase III stage of countrywide monitoring entails estimating the actual tigers, co-predators and prey densities within the sampled area with the help of modern tools like camera traps and Distance sampling. Tiger and leopard densities are estimated using spatially explicit capture recapture framework (Borchers and Efford, 2008). Prey density is estimated trough Distance sampling.

3.3 Distribution of Wildlife:

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 core zone, 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, and rugged terrain 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.

3.4 Abundance Status:

3.4.1 **Tiger Numbers:** Spatial data on individual tiger photo-captures is used in combination with spatial data on prey, habitat, and anthropogenic factors as covariates in a joint likelihood spatially explicit capture-mark-recapture (SECR) framework (Borchers and Efford, 2008) to arrive at tiger population estimates for each tiger landscape. Tiger population estimates during four cycle of All India tiger estimation is as under:

Table-19: Tiger Population Estimates (Phase-I: Tiger Monitoring)

Sl. No.	Year	Population
1	2006	89
2	2010	60
3	2014	80
4	2018	88

Source: NTCA, New Delhi and WII, Dehradun (2021)

3.4.2 **Tiger Prey:** After considering the shape, size, vegetation, and terrain type of the beat, a transect line of a minimum of 2 km. and not exceeding 4 km. were marked for sampling. The transect line traverse similar habitat (broad vegetation types) as far as possible. Transects were walked early morning and data were recorded on species (prey) sighted, group size, group composition, bearing of walk and bearing of the animal sighted, and distance of the animals using a laser range finder (Bushnell) and see through compass (SUNTO). To convert encounter rates of prey on the transect 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 different observers and animal behaviour (Buckland et al., 1993). Effective strip widths are being modelled through Distance software. The prey density estimates for the tiger reserve is as under:

Table-20: Prey Density Estimates

Sl. No.	Division	Species	No. of Transects	Observation	Density (SE)
1	2	3	4	5	6
1	Core	Chital	150	312	40.43 (6.9)
2		Sambar	150	189	9.41 (1.25)
3		Gaur	150	75	5.38 (1.15)
4		Wild pig	150	64	5.58 (1.35)
5		Barking deer	150	96	2.09 (0.29)
6		Chousingha	150	12	0.17 (0.09)
7	Buffer	Chital	46	48	3.00 (1.08)
8		Sambar	46	16	0.45 (0.14)
9		Gaur	46	7	0.29 (0.21)
10		Wild pig	46	38	3.91 (0.97)
11		Barking deer	46	41	2.65 (0.67)
12		Nilgai	46	8	0.28 (0.18)

Source: Kanha Tiger Reserve (2021)

3.5 Total Count:

This is carried out by an old conventional method known as the block count. The entire core zone is divided into 120 census/ counting units for the estimation of ungulate species by this old methodology. While the new methodology for wildlife estimation has replaced the old one, the Kanha management also conducts the block count exercise every year to have a grasp of the trends of ungulate populations in the core zone and keep the frontline staff in the practice of sighting and counting wild animals and engaging in data collection. Besides, the new methodology does not cover some species at low densities, and by this block count method low populations of barasingha, nilgai, and chousingha etc. can also be estimated. The block count methodology is conducted for four days under several prescribed formats. This exercise is usually conducted in the month of July after the core zone has received a few showers, so that most animals, especially chital, can be seen and counted easily on the grasslands and in open areas. The range-wise population figures for different wildlife species for 2021 are as under:

Table-21: Range-wise Population Estimation for Different Wildlife Species

Animal Species	**Kisli**	**Kanha**	**Sarhi**	**Mukki**	**Bhaisanghat**	**Supkhar**	**Total**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Chital (*Axis axis*)	5265	9383	7762	5367	1059	1623	**30459**
Sambar (*Rusa unicolor*)	353	205	266	278	124	394	**1620**
Barking deer (*Muntiacusmuntjak*)	30	31	39	64	49	120	**333**
Barasingha (*Rucervus duvaucelii branderi*)	80	103	324	248	83	48	**886**
Blue bull (*Boselaphustragocamelus*)	1	0	32	0	3	0	**36**
Chousingha (*Tetracerusquadricornis*)	0	7	0	4	20	7	**38**
Gaur / Indian Bison (*Bos gaurus*)	508	639	379	420	402	516	**2664**
Langur (*Semnopithecus entellus*)	771	908	857	1123	683	1602	**5944**
Wild pig (*Sus scrofa*)	438	335	264	420	292	1189	**2938**
Sloth bear (*Melursusursinus*)	3	5	2	4	13	12	**39**
Indian wild dog (*Cuonalpinus*)	17	0	2	8	27	47	**103**
Jackal (*Canis aureus*)	19	15	39	12	10	26	**121**
Blackbuck (*Antelope cervicapra*)	0	61	0	0	0	0	**61**

Source: Kanha Tiger Reserve (2021)

3.6 Sex Ratios:

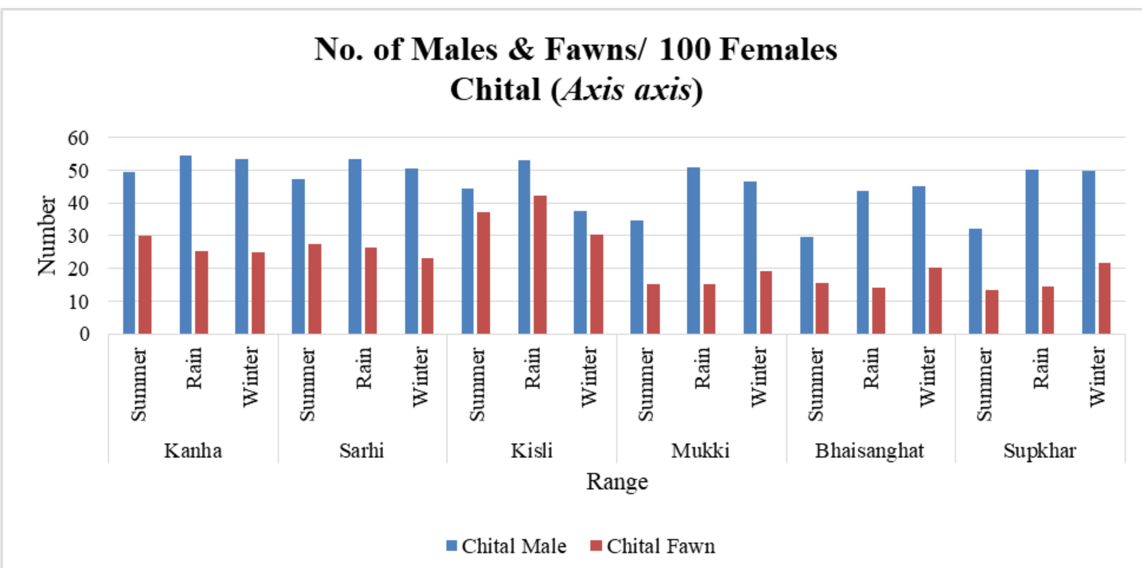
Kanha supports several habitat types and habitat conditions that have a bearing on the group size and composition of different ungulate species. For instance, while large herds of chital are seen in the rains on some prime and large grasslands, they split into smaller ones after the monsoon. Group size and composition may be influenced by food conditions, availability and foraging efficiency, and aggregation and segregation of the sexes with special reference to the hard ground barasingha. Besides, males also tend to travel longer distances and join other herds. Although the data on group size and composition of different ungulates species does not give any significant information on the dynamics of these populations, they can, however, provide some useful insights into population characteristics and trends. The knowledge about sex and age ratios is important to determine the status and trend of the population of a species. Regular monitoring of sex and age ratios in the field can caution the management about any unusual skewness in the ungulate populations. This is especially important about the production of fawns in a population. On the basis of several seasonal observations on the sex ratios of the male and fawn per 100 females of several major ungulate species in different forest ranges are as under. These are not the sex ratios of the overall populations, but only opportunistic observations of species herds in different seasons:

Table-22: Opportunistic Observations of Species Herds in Different Seasons

Sl. No.	Range	Season	Chital		Sambar		Barasingha		Gaur	
			Male	Young	Male	Young	Male	Young	Male	Young
1	2	3	4	5	6	7	8	9	10	11
1	Kanha	Summer	49.52	29.84	60.35	33.53	40.33	17.54	55.28	28.45
2		Rain	54.33	25.33	62.34	39.98	41.93	11.19	43.54	23.54
3		Winter	53.45	24.85	47.89	31.72	55.34	34.22	34.62	21.77
4	Sarhi	Summer	47.24	27.64	63.22	37.19	37.28	19.53	57.32	28.91
5		Rain	53.51	26.28	62.77	40.90	42.21	16.28	44.52	23.46
6		Winter	50.61	23.22	49.61	31.26	57.45	36.34	33.45	20.34
7	Kisli	Summer	44.32	37.24	49.95	29.24	33.40	13.24	49.20	36.27

8		Rain	53.22	42.34	46.21	31.55	40.32	7.32	33.54	29.39
9		Winter	37.45	30.22	53.32	35.52	50.32	31.77	42.28	28.33
10	Mukki	Summer	34.81	15.25	51.95	35.34	40.21	19.85	59.34	26.24
11		Rain	50.82	15.24	65.23	23.24	44.35	15.34	53.75	27.88
12		Winter	46.54	19.34	67.61	35.33	56.72	41.42	45.55	25.21
13	Bhaisanghat	Summer	29.50	15.72	45.30	29.42	31.14	13.51	55.42	22.20
14		Rain	43.75	14.24	51.90	22.34	40.52	10.12	49.31	25.55
15		Winter	45.12	20.12	66.39	31.25	49.51	31.24	41.24	22.12
16	Supkhar	Summer	32.20	13.34	55.22	35.34	37.21	16.38	57.40	23.52
17		Rain	50.21	14.53	67.34	25.42	43.10	10.25	53.34	26.99
18		Winter	49.72	21.65	69.35	36.75	56.54	27.85	48.52	26.42

Source: Kanha Tiger Reserve (2021)



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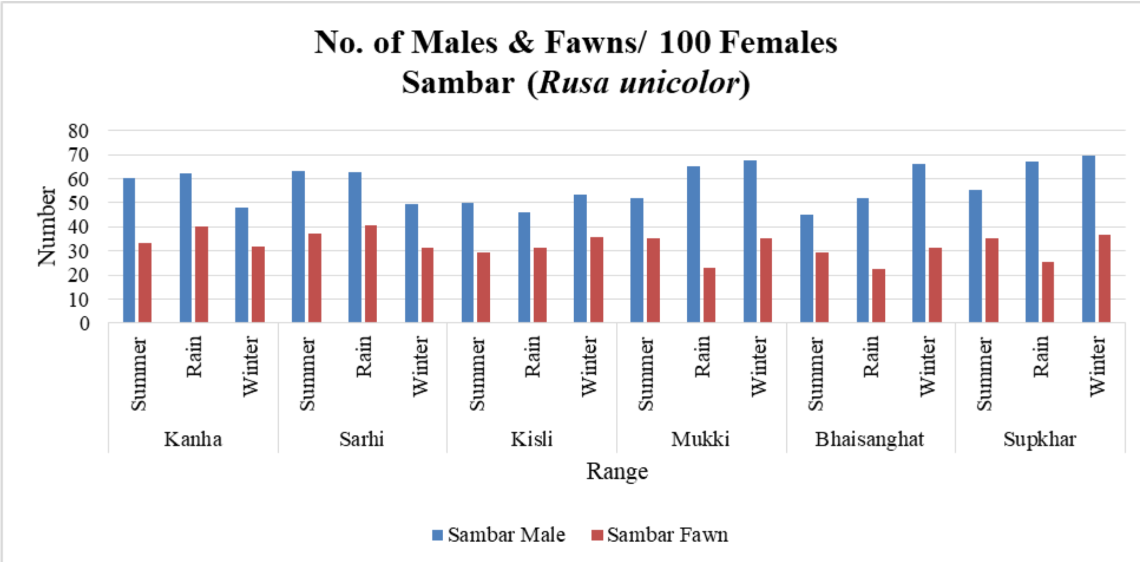

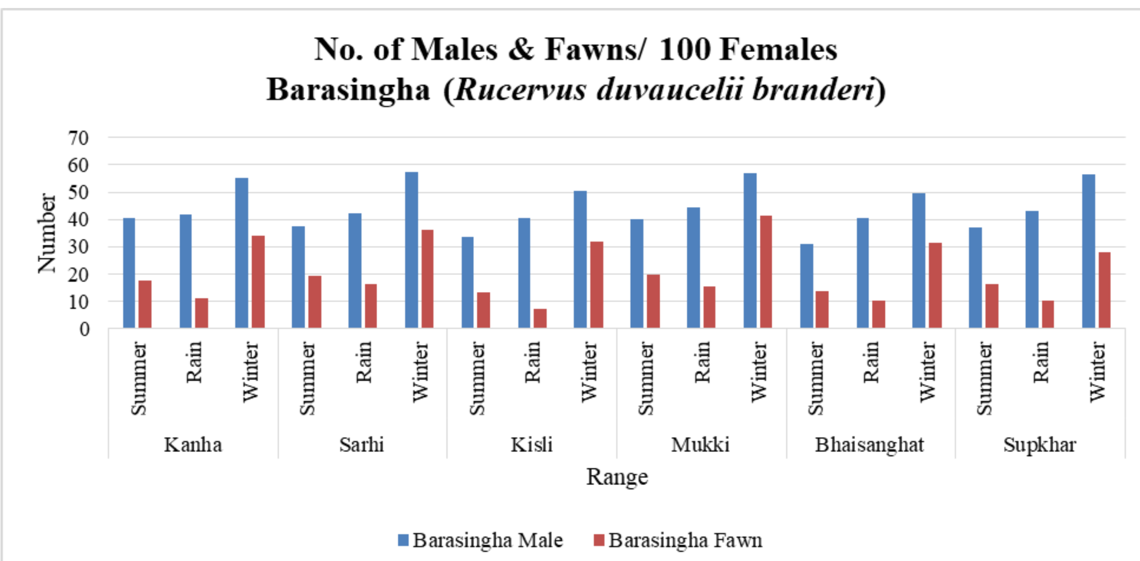

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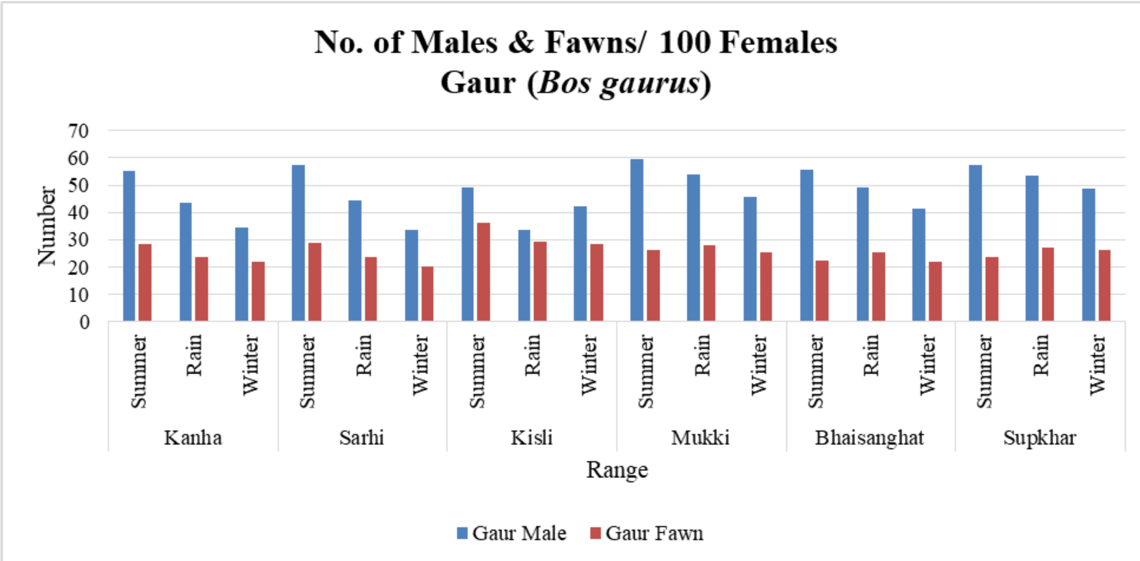
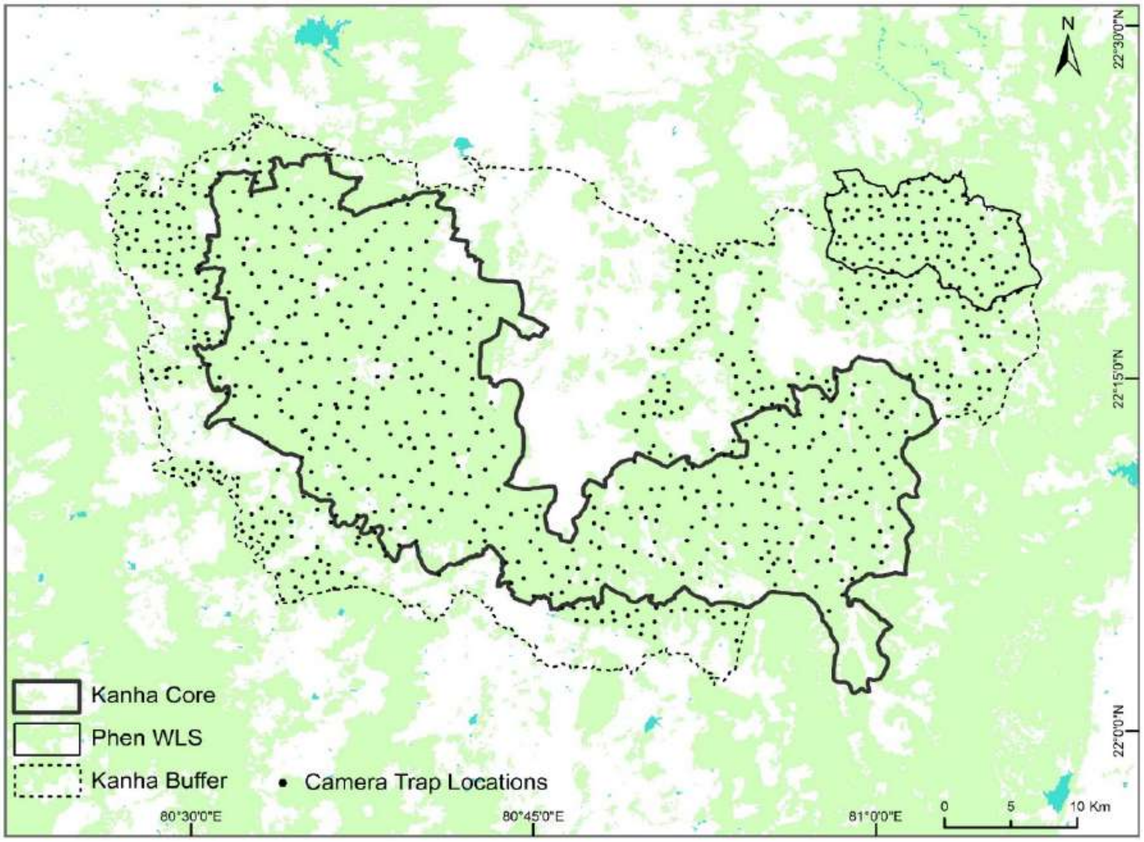


3.6.1 **Annual Phase-IV: Intensive Monitoring of Source Populations:** It was proposed that source populations of tigers (tigers in tiger reserves and protected areas) in each tiger landscape complex be monitored intensively. The following methodology for this monitoring is proposed: ***Photo registration 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 practiced 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, metapopulation dynamics (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.

The annual Phase-IV estimation at Kanha was started from 2011 along with the NTCA funded WII-MP FD collaborative project. During the first years the logistics were limited, hence camera traps were done in a block wise manner. Later, however, the entire core division was covered. The mandate of Phase-IV monitoring is to monitor the tiger population annually and get the minimum number of tigers through camera trap based photo-captures. Other protocols of occupancy survey for tigers, co-predators and prey estimation as envisioned in Phase-I of the national monitoring protocol were replicated twice in a year during the summer and winter.

3.7 Methodology:

3.7.1 **Tigers:** Camera trap based mark-recapture framework (Karanth & Nichols, 1998) are used to estimate minimum number of tigers in the Kanha tiger reserve since tigers and leopards can be identified from their pelage pattern. Extensive sign surveys are conducted to select the best possible location of camera traps as shown on the map. Two camera traps are placed at a single location to photo-capture both flanks of each animal that passed between them. Cameras are placed on forest roads, animal trails and dry streams that were intensively used by to maximize their detections (Karanth & Nichols, 1998). Cameras are set at a height of 40-45 cm. from the ground to photo-capture tigers.



3.7.2 **Prey:** 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). Line transects were established within the tiger reserve 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). Based on management zones, the core area had 150 transects, while the forest of buffer zone had 46 transects. Line transects of 2 km. are marked within each strata and walked during early morning (6:00 am to 8:00 am), for three consecutive mornings in summer and winter.

3.8 Results:

The results of minimum tiger and leopard numbers, and prey populations in the tiger reserve are as under:

Table-23: Results of Minimum Tiger Numbers

Sl. No.	Year	Adults	Cubs	Remarks
1	2	3	4	5
1	2011	43	6	Area sampled 450 sq. km. of core zone
2	2012	49	18	Area sampled 450 sq. km. of core zone
3	2013	60	22	Core zone was sampled
4	2014	77	35	Core zone + buffer zone
5	2015	62	24	Core zone was sampled
6	2016	70	28	Core zone + buffer zone + Phen WLS (1 tiger)
7	2017	81	31	Core zone + buffer zone
8	2018	88	30	Core zone + buffer zone + Phen WLS (2 tiger)
9	2019	83	35	Core zone + buffer zone + Phen WLS (3 tiger)
9	2020	83	35	Core zone + buffer zone + Phen WLS (3 tiger)

Source: WII, Dehradun (2021)

Map Showing Tiger Density in 2020

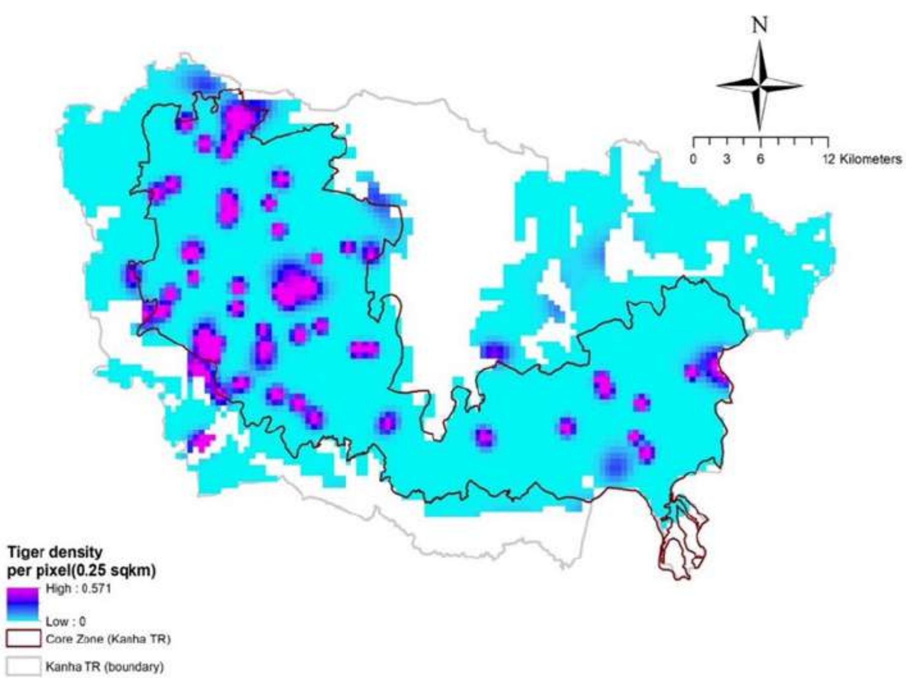
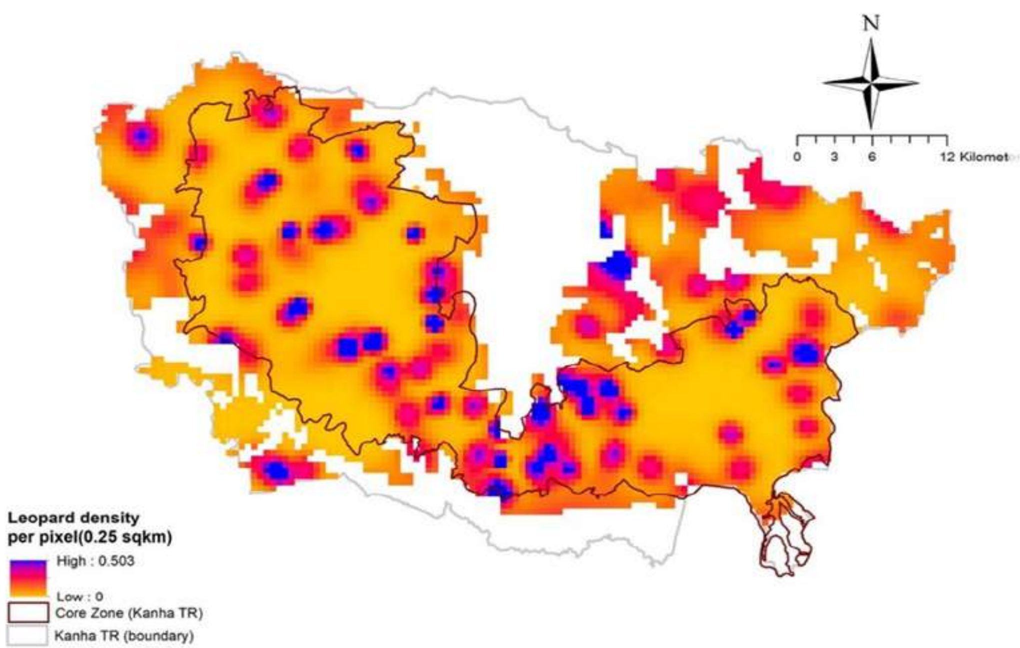


Table-24: Results of Minimum Leopard Numbers

Sl. No.	Year	Adults	Remarks
1	2	3	4
1	2011	35	Area sampled 450 sq. km. of core zone(majority tiger bearing)
2	2012	42	Area sampled 450 sq. km. of core zone(majority tiger bearing)
3	2013	57	Core zone was sampled
4	2014	84 + 40* = 118#	Core zone + buffer zone* # 6 leopard were common between core and buffer
5	2015	85	Core zone was sampled
6	2016	105 + 40* = 146#	Core zone + buffer zone* # only one leopard was common between core and buffer
7	2017	146	As per the previous estimation
8	2018	146	As per the previous estimation
9	2019	146	As per the previous estimation
9	2020	146	As per the previous estimation

Source: WII, Dehradun (2021)

Map Showing Leopard Density in 2020



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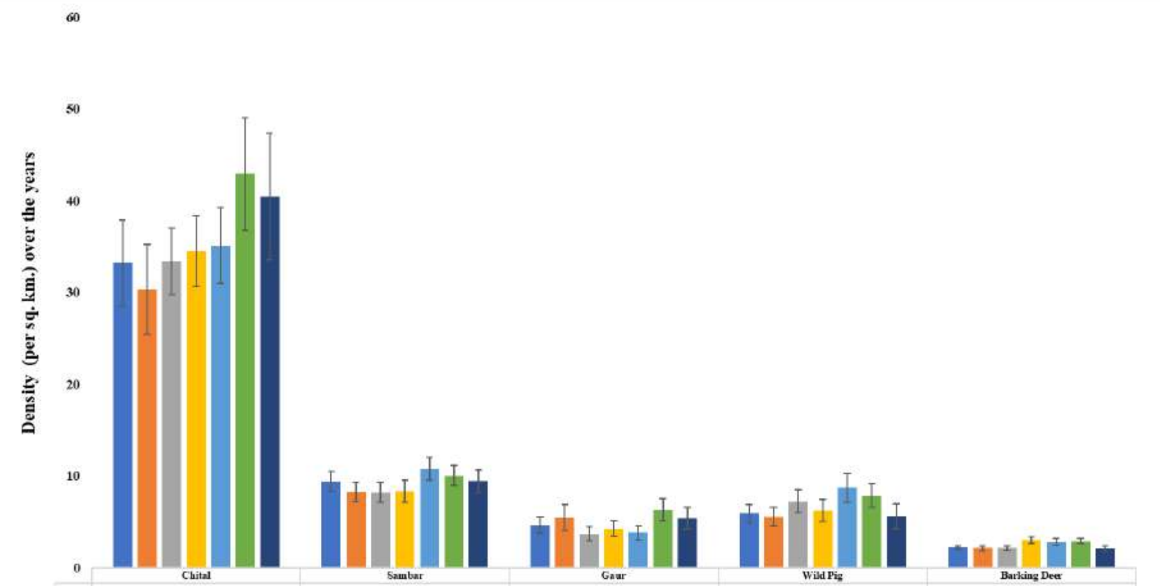
Major Ungulate Prey in the Tiger Reserve for the Past 5 Years



	Chital	Sambar	Gaur	Wild Pig	Barking Deer
2012	33.2	9.4	4.6	5.9	2.19
2013	30.3	8.27	5.46	5.55	2.12
2014	33.38	8.18	3.7	7.21	2.15
2015	34.49	8.31	4.25	6.23	2.99
2016	35.1	10.75	3.79	8.71	2.81
2017	42.9	10.05	6.34	7.82	2.89
2018	40.43	9.41	5.38	5.58	2.09

The report of Phase-IV monitoring for the tiger reserve is appended **(Appendix-5)**.

3.9 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, major wildlife species in the core zone are sighted, and their signs/ evidence are recorded in the following places:

Table-25: Wildlife Species Sighted and Sign/ Evidence Recorded

Wildlife Species	Probable Places of Sighting in Different Ranges
2	3
Tiger	**Kisli:** Khairwadi, Katankware, Bandrichhapar Talab, Siddiware, Bandh Pulia, Chunnurghati, Banjari, Jamun Talab, Kakaghat, Rajakachhar **Kanha:** Schaller hide, Chhoti Chuhri, Badi Chuhri, 7 No., 9 No., Bison Road, Kanha meadow **Sarhi:** Sonf, Ronda, Mahua dabri road, Jamun tola, Silpura meadow, Ramaghat

	Mukki: Ghorella, Sondar, Andhkua, Bishanpura, Mukki Nawatola **Bhaisanghat:** Ronda, Deoridadar, Katoldih, Gadaghat **Supkhar:** Kamkodadar, Jatadabra, Piperwada, Kusera, Supkhar
Leopard	**Kisli:** Banjari, Sandukkhol Talab, Digdola, Kanha Ghat, Naktighati Anicut, Bandrichhapar Talab **Kanha:** Keraghat, Ghoorpani, Bijadadar, Naktighati, Koylabhatta, Badrinath, Kanha meadow **Sarhi:** Sonf, Ronda, Mahuakhol, Silpura **Mukki:** Bishanpura, Khapa, Algidadar, Mukki **Bhaisanghat:** Pongapani, Katoldih, Adwar, Khamodidadar, Saraitola **Supkhar:** Chakarwah, Behind the FRH, Chhawarighat, Ladua
Wild Dog	**Kisli:** Kisli meadows, Bandrichhapar Talab, Silyari tank, Khudiakhero, Chuppe Meadows **Kanha:** Kanha Ghat, Ghodachhapar, Benipat, Kanha meadow, Bhoindabara, Bamhnidadar, Mundidadar **Sarhi:** Sonf, Ronda, Kariwah road **Mukki:** Andhkua, Algidadar, Bishanpura, Babathenga, Sondar **Bhaisanghat:** Kauajhardadar, Garhidadar **Supkhar:** Piperwada, Kusera, Supkhar
Wolf	Supkhar meadow, Kisli and Bhaisanghat ranges
Jackal	Throughout the core zone
Hyena	Kisli and Supkhar Ranges
Sloth Bear	**Kisli:** Kopedabri, Naktighati **Kanha:** Shravan tal, Bamhnidadar, Benipat, Chuhri, Circular road, 7 No., 9 No. **Sarhi:** Sonf, Ronda, Kariwah road, Mahuadabri, Garneridadar **Mukki:** Andhkua, Sondar
Gaur	**Kisli:** Chuppe Meadows, Banjari Near Saucer, Kisli Tank, Jamun Tank, Lendia Meadows, Rajakachhar, Sondar Meadows, Indri Meadows **Kanha:** Bamhnidadar, Chuhri, Dhawadadar, Kanha meadow, Bijadadar, Khamerpani, Ghangharmuda, Benipat, Kanha ghat **Sarhi:** Silpura meadow, Ramaghati, Ganeridadar, Jamuntola, Sonf **Mukki:** Umarjhola, Bishanpura, Shringarpur, Ghorella, Khadari
Chital	**Kisli:** Kisli meadows, Balaribehra, Chuppe meadows, Bhapsa anicut, Silyari tank, Chamarighati, Sandukkhol **Kanha:** Kanhari meadows, Umarpani, Kanha meadow, Naktighati, Mundidadar, Kodaidadar, Bhapsabehra, Parsatola, Bhoindabra **Sarhi:** Sonf, Ronda, Jamuntola, Silpura meadow, Ganeridadar **Mukki:** Mukki, Sondar, Mavaikheda, Orai, Ghorella, Bisanpura **Bhaisanghat:** Adwar, Katoldih, Deoridadar, Ajanpur **Supkhar:** Piperwada, Kusera, Supkhar
Sambar	**Kisli:** Kisli tank, Bhapsa anicut, Sandukkhol tank, Bandrichhapar, Chamarighati, Jamun tank, Kopedabri, Banjari near saucer,

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	Balaribehra, Silyari tank, Baneli tank **Kanha:** Mundidadar, 9 No., Kanha meadow,7 No., Bamhnidadar, Ghangharmuda, Parsatola, Kanha ghat **Sarhi:** Sonf, Ronda, Mediware, Ramaghati road, Jamuntola, Silpura meadow, Ganeridadar **Mukki:** Bishanpura, Malkhedi, Sondar, Ghorella, Jodapulia, Muwala, Gaidhar
Barasingha	**Kisli:** Sondar, Indri,Chuppe meadow **Kanha:** Kanha meadow, Kanhari, Parsatola, Menhar nala, Kanha anicut, barasinhga enclosure **Sarhi:** Sonf, Ronda, Urnakhero, Matigahan, Silpura **Mukki:** Bishanpura, Sondar, Oari, Gorella **Bhaisanghat:** Ronda, Adwar, Dudhania, Lanjiabehra, Ajanpur, Sukdi, Jholar **Supkhar:** Jatadabra, Chakarwah, Ladua, Baspehra, Jami, Peeparwada, Katrakhol, Bithli
Barking Deer	Kisli, Kanha, Sarhi, Mukki, Bhaisanghat and Supkhar ranges
Nilgai	**Sarhi:** Matigahan, Silpura, Charibarra meadow
Chousingha	Kanha, Sarhi, Bhaisanghat and Supkhar Ranges (occasional sightings)

Source: Kanha Tiger Reserve (2021)

3.10 Signs/ Evidence of Tigers:

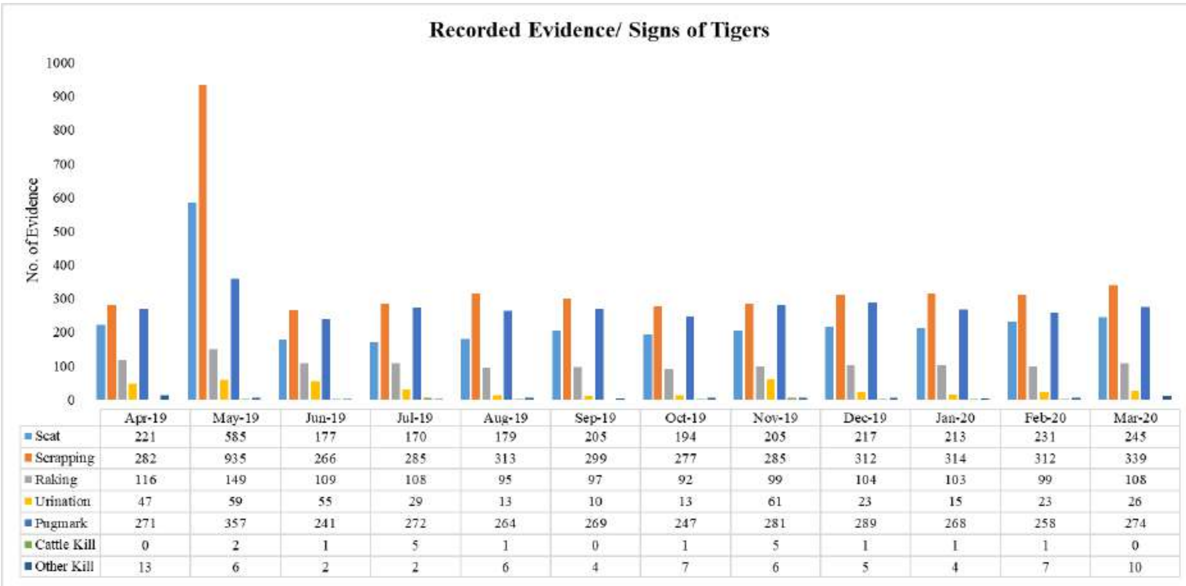
As per the National Tiger Conservation Authority, New Delhi letter No. PS-DIR (PT)/ 2005-MISCE dated 28/02/2005 the tiger reserve is required to record all the signs/ evidence of tigers seen in the last week of every month in every beat of the core zone. Besides, total patrolling efforts of all the forest guards of all the beats are also recorded. As per the instructions, the data recorded in the past year is as under:

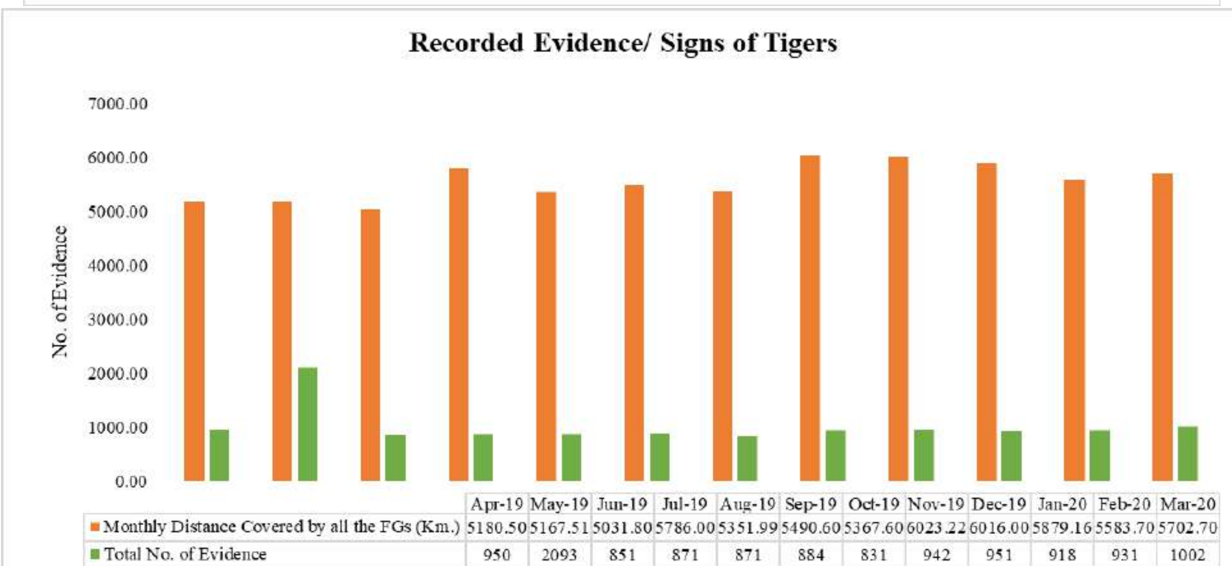
Table-26: Signs/ Evidence of Tigers

Sl. No.	Month	Scat	Scrapping	Raking	Urination	Pugmark	Cattle Kill	Other Kill	Total No. of Evidence	Monthly Distance Covered by all the FGs (Km.)
1	2	3	4	5	6	7	8	9	10	11
1	Apr-19	221	282	116	47	271	0	13	950	5180.50
2	May-19	585	935	149	59	357	2	6	2093	5167.51
3	Jun-19	177	266	109	55	241	1	2	851	5031.80
4	Jul-19	170	285	108	29	272	5	2	871	5786.00
5	Aug-19	179	313	95	13	264	1	6	871	5351.99
6	Sep-19	205	299	97	10	269	0	4	884	5490.60
7	Oct-19	194	277	92	13	247	1	7	831	5367.60

8	Nov-19	205	285	99	61	281	5	6	942	6023.22
9	Dec-19	217	312	104	23	289	1	5	951	6016.00
10	Jan-20	213	314	103	15	268	1	4	918	5879.16
11	Feb-20	231	312	99	23	258	1	7	931	5583.70
12	Mar-20	245	339	108	26	274	0	10	1002	5702.70
	Total:	**2842**	**4219**	**1279**	**374**	**3291**	**18**	**72**	**12095**	**66580.78**

Source: Kanha Tiger Reserve (2021)





3.11 Herd Formation & Dispersal:

Day to day direct observations of wild animals are recorded in patrolling registers. While the sizes of the herds of ungulates vary from small to large, some specific observations are as under:

- The population of barasingha has been rising over the past years.
- The cervid has recorded its presence in habitat pockets of all the forest ranges.
- A small barasingha population has established in the Sukdi-Ajanpur-Jholar complex of grasslands in the Bhaisanghat range.
- The largest herd sizes of the barasingha are seen during the peak breeding season, in December and January.
- The in-situ enclosure practice for assured multiplication and release of the barasingha in the Sarhi range has improved its sightings.
- Barasingha herds split into smaller ones due to sexual segregation after the breeding period is over.
- Mixed herds of the barasingha and chital are common in barasingha habitat pockets.
- The chital is the most numerous of all the ungulate species, with herd sizes the largest in the rains.
- After the autumn, the herd size of chital starts decreasing, with 5-20 animals.
- Water bodies play an important role in the movements of gaur herds after January/ February.
- Average herd size of the gaur is 5-15 animals.
- The sambar population has increased over the years.
- 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.

3.12 Empirical Assessment of Prey-Predator Biomass

The assessment of prey-predator biomass and annual cropping by the carnivores is important to gauge the health of the Kanha wildlife ecosystem. As the tiger reserve supports a viable population of three major carnivore species – tigers, leopards, and wild dogs - for so many years, it is important to assess the availability of prey for them. Besides, it also needs to be determined what numbers of recruits are included into this population annually to ensure the right balance between predator and prey populations.

The assessment has been made on the basis of the total available biomass of the prey species and its annual consumption by the three major carnivore species as per their dietary requirements. The annual population estimates of the following animal species have been considered for assessing the animal biomass in the core zone of 917.43 sq. km.:

Table-27: List of Co-predators and Prey Animals

Sl. No.	Tiger & co-predators	Prey animals
1	**2**	**3**
1	Tiger	Chital
2	Leopard	Sambar
3	Wild Dog	Gaur
4		Barasingha
5		Nilgai
6		Chousingha (four horned antelope)
7		Barking Deer
8		Wild Boar
9		Langur

Source: Kanha Tiger Reserve (2021)

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

Table-28: Average Body Weight of Predator – Prey Animals

Sl. No.	Predator	Average weight in Kg. for both the sexes
1	**2**	**3**
1	Tiger	182.50
2	Leopard	59.00
3	Wild dog	17.50
	Prey Animals	**Assumed Body Weight for Computation in Kg. (Panwar, 1990)**
4	Gaur	300.00
5	Sambar	150.00
6	Barking deer	20.00
7	Barasingha	80.00
8	Chousingha	15.00
9	Chital	50.00
10	Langur	12.50
11	Wild pig	80.00
12	Nilgai	100.00

Source: Kanha Tiger Reserve (2021)

To work out the prey biomass requirements of the predators per annum, the calculations are based on the projections 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 the 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 2020 estimates (Phase-IV monitoring), the following projections are made:

Table-29: Assessment of Predator Biomass

Sl. No.	Animal Species	Average Weight (Kg.)	Estimate Number	Calculated Biomass (Kg.)	Biomass (Kg./ Sq. Km.)
1	2	3	4	5	6
1	Tiger	182.50	118	21535.00	23.47
2	Leopard	59.00	146	8614.00	9.39
3	Wild Dog	17.50	93	1627.50	1.77
	Total:			**31776.50**	**34.63**

Source: Kanha Tiger Reserve (2021)

Table-30: Assessment of Prey Biomass

Sl. No.	Species	Assumed Body Weight of Average Prey Size (Kg.) (Panwar, 1990)	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	2	3	4	5	6	7	8
1	Chital	50.00	1.00	37229	1861450.00	2028.98	37229.00
2	Sambar	150.00	3.00	8083	1212450.00	1321.57	24249.00
3	Gaur	300.00	6.00	5009	1502700.00	1637.95	30054.00
4	Wild pig	80.00	1.60	5266	421280.00	459.20	8425.60
5	Barking deer	20.00	0.40	2110	42200.00	46.00	844.00
6	Barasingha	80.00	1.60	816	65280.00	71.16	1305.60
7	Chousingha	15.00	0.30	156	2340.00	2.55	46.80
8	Nilgai	100.00	2.00	312	31200.00	34.01	624.00
9	Langur	12.50	0.25	5934	74175.00	80.85	1483.50
	Total:				**5213075**	**5682.26**	**104261.50**

Source: Kanha Tiger Reserve (2021)

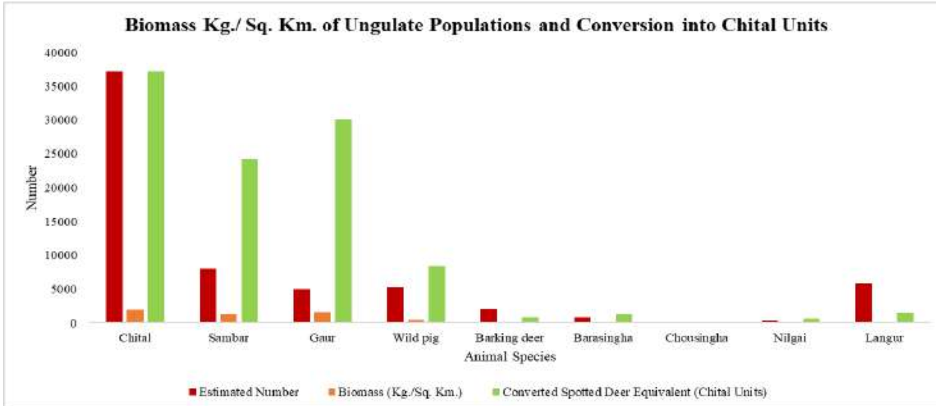


Table-31: Prey Biomass Requirement for the Predators/ Annum

Predator	Average Body Weight (Kg.)	Average Requirement for a Year (Kg.) for a Single Animal	Total Population	Average Requirement (Kg.) for the Predator Animal Population/ Annum
1	**2**	**3**	**4**	**5**
Tiger	182.50	3600.00	118	424800.00
Leopard	59.00	1163.88	146	169926.48
Wild dog	17.50	345.24	93	32107.32
				626833.80

Source: Kanha Tiger Reserve (2021)

Table-32: Predator–Prey Biomass Assessment

Area (Sq. Km.)	PREDATOR NUMBERS			Prey Requirement (Kg./ Yr.)	Prey Biomass (Kg.)	Prey Available (Kg./ Yr.) * (20%)	Prey Available Requirement (%) **	Prey (Kg./ Sq. Km.)	PREDATOR BIOMASS (Kg./ Sq. Km.)			Total (Kg./Sq. km.)	Predator- Prey Biomass Ratio	Prey Biomass Requirement (Kg./Sq. Km.)	Compensation (2014-15 to 2018-19) (Rs. In Lakh)
	Tiger	Leopard	Wild dog						Tiger	Leopard	Wild dog				
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
917.43	118	146	93	626834.00	5213075.00	1042615.00	166.33	5682.00	23.47	9.39	1.77	34.64	164.05	683.25	291.40

Source: Kanha Tiger Reserve (2021)

* The value of annual growth of prey animals is around 20%, and almost 20% of the prey biomass in the habitat is available to the predators in a year.

** Prey availability (kg. per year) is more than 100% for the predator population, besides predators also sometimes crop livestock from the surrounding villages.

It is evident from the above animal biomass assessment that the predators have surplus of their food requirement (166.33%) from the prey biomass available in the habitat. Besides, carnivores also offtake prey biomass in the form of livestock in the peripheral villages, which form part of the prey base for tigers and co-predators in any protected area system. This empirical assessment, however, may not be construed as any hint at the carrying capacity of tigers at Kanha, which is a complex issue involving a number of factors.

3.13 Tentative Recruitment Per Annum:

There are several prey species such as the barasingha, barking deer, nilgai and chousingha whose populations survive at low densities at Kanha. All these populations, however, also show their natural growth patterns and add to the overall annual recruitment into the total prey population. We have attempted to determine the tentative annual contribution of each of these ungulate populations to the total prey population of the core zone. We have used sex ratios and annual fawning/ calving capacity of each prey species (Schaller, 1967; Newton, 1987; Shukla, 1990; Chhangani, 2002; This study, 2020) to compute its contribution. An assumption has also been made regarding the percentage of adult females in each species population that can give birth annually. Karanth (1987) has assumed that 90% of the adult females of all principal prey species give birth every year. As Kanha already supports a large population of the chital and a good population of the wild pig, a prolific breeder with 3-5 piglets per litter, we have made a conservative assumption that only 60 % of the total adult females of each species give birth to fawns/ calves. With this assumption, total population of each species, and its age and sex class structure, the following computation has been made:

Table-33: Annual Requirement of Chital Units

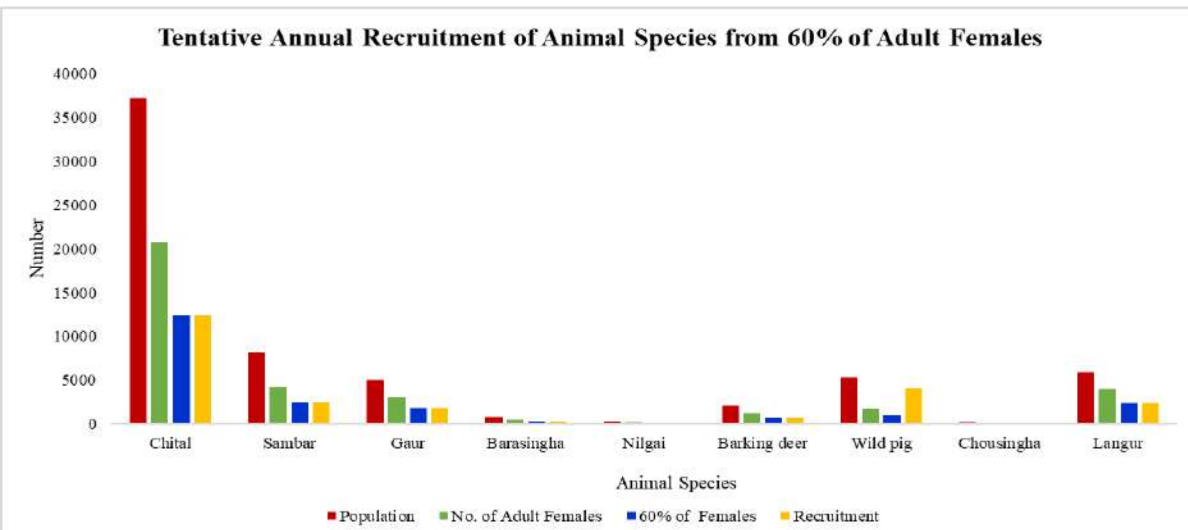
Sl. No.	Carnivore Species	Number	Annual Requirement of Chital Units
1	2	3	4
1	Tiger	118	8496
2	Leopard	146	3399
3	Wild Dog	85	587
	Total:		**12481**

Source: Kanha Tiger Reserve (2021)

Table-34: Tentative Recruitment Per Annum

Sl. No.	Ungulate Species	Population	No. of Adult Females	60% of Females	Recruitment	Chital Units/ Year	Total Biomass (Kg.)	Biomass (Kg/ Sq. Km.)
1	2	3	4	5	6	7	8	9
1	Chital	37229	20786	12472	12472	12472	623578.13	679.70
2	Sambar	8083	4211	2527	2527	7580	379015.65	413.13
3	Gaur	5009	3002	1801	1801	10808	540377.58	589.01
4	Barasingha	816	483	290	290	463	23167.19	25.25
5	Nilgai	312	159	95	95	190	9517.03	10.37
6	Barking deer	2110	1187	712	712	285	14244.69	15.53
7	Wild pig	5266	1703	1022	4087	6539	326969.58	356.40
8	Chousingha	156	73	44	44	13	657.00	0.72
9	Langur	5934	3979	2387	2387	597	29842.50	32.53
	Total:				**24415**	**38947**	**1947369.36**	**2122.64**

Source: Kanha Tiger Reserve (2021)



The conclusions drawn from the above computation is as under:

- The annual biomass requirement of the three carnivore species is 624072.00 kg., and the production of the recruitment biomass per annum is 1947369.36 kg. Hence, the percent increase in the required biomass from the recruitment is 212.04% per annum.
- The annual prey requirement of the carnivore species is 683.25 kg./ km., and the prey biomass production through recruitment is 2122.64 kg./ sq.km. Hence, the percent increase from the annual recruitment is 212.04% per annum.

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- The annual chital unit requirement of the carnivore species is 12481.00 units, and the production of recruited chital units per annum is 38947 units. Hence, the percent increase in the required chital units for consumption from the recruitment is also 212.04% per annum.

In this way, presently different prey populations in the core zone is self-sustaining and can support the carnivore populations. The size of the entire prey population is directly linked to habitat management practices to ensure availability of good large chunks of different habitat types. The prey population carries a strong bearing on the numbers and distribution of carnivore populations. The prey availability is also governed by various attributes prevailing in the habitat in a combined manner. And the unique topographical and vegetal components prevailing in the core zone habitat also foster tiger abundance. This influence of the prey population, however, is limited up to self-regulation mechanism in carnivore populations. Besides, the interspersion and juxtaposition of welfare factors in the core zone also affect the predation, and accordingly the prey animals adapt themselves by eliciting various anti-predator strategies. 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.

3.14 Intraspecific Strife in Tigers:

Kanha has been renowned worldwide for a good population of tigers. The viability of this population is reflected by frequent sightings/ photo-captures of animals of all age and sex classes. The core zone is generally regarded as a well-monitored high tiger density area. There exists a land tenure system whereby older and weaker tigers are gradually squeezed out by younger and more powerful ones so that they in turn may established their own territories and mate with tigresses. This whole systemic and tenurial complex has a strong bearing on the tiger population. Besides, abundance of tigers also results in their perpetual wandering and overlapping with dominant males, and also adding seriously to the vulnerability of cubs. As stated above, this whole social organization and land tenure system automatically gives rise to five broad conditions in a tiger population:

- A transient tiger, separated from his mother, younger and behaviorally too much explorative and relatively less skilled gets into fights with either another transient or a powerful resident tiger and gets killed, sometimes after a fierce fighting.
- Two resident tigers may fight for territoriality or over a female and the weaker may get killed on the spot or injured seriously to die later of his wounds.
- A resident tiger may kill one or all the cubs, usually not more than three, of a tigress, not sired by him, so that he may mate with the mother-tigress to produce his own progenies. Infanticide has become a known behavior in a tiger population. Generally, however, a tiger does not kill his own cubs, and is also known to sometimes share a kill with the tigress and cubs.
- A tigress may also sometimes be killed either protecting her cubs from a dominant male or for being unreceptive to the male's overtures for mating.
- A tiger may also kill all the small cubs of a tigress to bring her into heat for mating. In most cases, such tigresses are known to mate with these tigers and produce cubs. It is generally observed that no tigress with cubs will mate with a tiger. In this way, evolutionary intricacies and genetics have strong bearings on this phenomenon.

While a few adult tigers and cubs have been cannibalized partly in the past several years, it does not mean there is any dearth of prey species for tigers at Kanha. It is not that some tigers have turned cannibals and will wipe out most of the population. Whether or not fully understood across animal species, cannibalism is a purely natural phenomenon occurring due to various reasons and under different situations. As far as the cannibalistic behavior of tigers at Kanha is concerned, our empirical knowledge of tigers and their ways suggest that it is actually aggression induced killings, tigers being highly territorial and extremely intolerant of their conspecifics. The aggression of tiger sometimes culminates in the partial devouring of the killed conspecific, and the behavior brings the ultimate sensation of killing a rival and defending his territory. Besides, high tiger densities in some areas of Kanha, systematic tiger monitoring, and prompt reporting of tiger deaths throughout the year under a prescribed protocol also make tiger infighting and killing more noticeable than otherwise.

Table-35: Tiger Deaths due to Infighting/ Territorial Fight

Sl. No.	Year	Tiger Deaths
1	**2**	**3**
1	2010	3
2	2011	0
3	2012	1
4	2013	0
5	2014	2
6	2015	4
7	2016	6
8	2017	1
9	2018	9
10	2019	7
11	2020	3
12	2021	3
	Total:	**39**

Source: Kanha Tiger Reserve (2021)

Needless to add, each tiger death is examined under a strict protocol issued by the National Tiger Conservation Authority. This includes close site inspection for signs of a crime, postmortem by a trained wildlife veterinarian, bio-sampling of different organs for further toxicological and forensic investigations at the State Forensic Laboratory, Sagar and the School of Wildlife Forensic and Health, Jabalpur. Almost the entire procedure is video-graphed in the presence of two independent witnesses from civil society.

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CHAPTER – 4

HISTORY OF PAST MANAGEMENT & PRESENT PRACTICES

4.1 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 22^{nd} parallel of north latitude and between the 76^{th} and 82^{nd} 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 Chhota Nagpur Plateau of Bihar and other hill chains in Orissa and Andhra Pradesh, and extend well into the States of Gujarat and Maharashtra 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.

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

4.2 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.

4.2.1 **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:

4.2.1.1 **The Gond:** 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. Anthropologically, the Gond are Proto-Australoid, having a supposed racial affinity with the aborigines of Australia, and belonging to the Dravidian stock of Asian origin.

The Gond were 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 Gond 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 was temporary, and the Gond practiced shifting cultivation. A significant percentage of the Gond 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 Gond 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 Gond are meat consumers.

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.

4.2.1.2 **The Baiga:** Another ethnic group of the same stock, living around the tiger reserve is the Baiga that 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 Baiga 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 Baiga 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 Baiga 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 Baiga believe that the forest grows denser after the abandonment of a *bewar*, much damage is inflicted on the existing forests.

4.2.2 **Brief History:** The Kanha eco-region, which includes the present core and buffer zones and its contiguous large forest tracts of the various territorial divisions of Mandla and Balaghat districts, 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.

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 seven 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 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.

4.3 Conservation History:

4.3.1 **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 Wasteland Rules, however, were introduced in 1862 to form basic outlines of forest management. These rules restricted the cutting of some tree species like teak, sal, saja, shisham and bija. The First Forest Act came into force around 1865, and sal forests were brought under its purview. Simultaneously, the Banjar valley and a few other forest blocks were also declared Reserved Forest. Most of these forests were also duly demarcated in the field in 1873-74. The legendary Mr. D Brandis also visited areas of the Banjar Reserve, Kisli and Kanha 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. Sir William Schlich and Mr. Berthold Ribbentrop, Inspector-Generals of Forests, also visited these areas of the Mandla and Balaghat districts in 1883 and 1885-86 respectively and submitted detailed reports. Ever since, the forests have retained a firm legal status, and are credited with accurate and reliable topographic maps.

4.3.2 **Dependence of Local People on Forests:** Generally speaking, the dependence of local communities on these forest resources was heavy. Fortunately, however, it was dictated by need rather than greed. The extraction of forest produce for domestic and agricultural use under the commutation system was introduced in 1879 to regulate unrestricted cutting by villagers. This system, however, also proved ineffective and was gradually curtailed, and ultimately stopped in 1933. Villagers were drawing most of their domestic requirements from the landlords' proprietary forests, which were not included in the present 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 the petty cut material was made available from special depots opened in the villages. There was also unrestricted grazing until 1915, when grazing rules came into force. These rules regulated grazing through grazing units and closure of regeneration areas. However, as the cattle population rose and governance grew weaker in the post-independence period, control over grazing was also lost significantly, and grazing pressure rose tremendously in the areas close to villages.

4.3.3 **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 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 onwards.

Table-36: Salient Points of Past Forest Management

Until 1860	No commercial exploitation
1862	Wasteland Rules formed
1865	Sal Forests - First Forest Act

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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
Since 01-06-1959	No commercial exploitation

Source: Kanha Tiger Reserve (2021)

4.3.4 **Shooting Block System:** Hunting, sport-hunting or *shikar* was very popular pastime of Indian and British royalties, army officers and elites in the bygone era. However, with the development of technical forestry, some semblance of control over hunting was gradually being exercised, and creation of exclusive shooting blocks in potentially rich wildlife areas was one such measure. These shooting blocks were accessible to only very influential people through payment for requisite shooting permits. Needless to add, a famous wilderness area like Kanha also had to accommodate shooting blocks. Ironically, areas of the Kisli, Kanha, Sarhi, and Supkhar ranges, including Sijhora and Naktighati, were parts of several famous shooting blocks and also witnessed decimation of wildlife by the high and the mighty.

4.3.5 **Forest Village:** Indian forests have been sustaining local communities and forest dwellers, regarded as guardians of forests, since time immemorial, and there are thousands of villages in or close to forests. But “forest villages” are legally different as they were established by the forest department in the early 19th century during the British period to ensure uninterrupted supply of laborers to meet the government’s demands of timber and other forest resources. These forest villages were created under Section-28 of the Indian Forest Act, 1927.

These forest villages in this forest acts were either past habitations declared as forest villages or colonies/ settlements of laborers brought from outside and settled in temporary camps. They were also given lands without tenancy rights to raise cultivation and build temporary houses. There was a framework of rules, regulations and duties that needs to be followed by these villagers. And one such important duty was to help the forest department protect forests from fire and illicit felling etc.

4.3.6 **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, greater 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. 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.

4.3.7 **The Valleys:** The history of Kanha is, actually, that of the Banjar and the 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, New Delhi) in 1973.

4.3.7.1 **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 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 Kanha national park. In the subsequent extensions in 1964 and 1970 the national park assumed the size of 446 sq. km.

Table-37: Salient Points of Banjar Valley

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	Banjar 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.)
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
2011	Blackbuck reintroduction to Kanha

Source: Kanha Tiger Reserve (2021)

4.3.7.2 **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.

Table-38: Salient Points of Halon Valley

1931	District Officers’ shooting block
1935	Supkhar 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

Source: Kanha Tiger Reserve (2021)

4.3.7.3 **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 sq. 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 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, now in Chattisgarh. 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 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 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, 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.

4.4 Promising Biodiversity Centre:

Goal oriented strategies, systematic conservation practices and periodic evaluation have over the years made Kanha an embodiment of the concept of biodiversity conservation in the country. While the Kanha eco-region is technically no biodiversity hotspot, biodiversity conservation practices at Kanha operationally amounts to a host of highly significant objectives of conservation priorities, including sustained addressing of challenges and threats, set for this important protected area, part of the central Indian highland bio-geographic region, with its typical floral and faunal attributes.

The tiger reserve, specially the core zone, conserves and effectively manages for posterity the over-all biodiversity of the Kanha wildlife ecosystem, including wildlife habitats for supporting a wide range of ungulate species, prey base for carnivores, specially the endangered tiger, and takes initiatives for conservation of the hard ground barasingha, also an endangered and endemic deer species by garnering support from the local communities. Kanha's role also incorporates the strengthening of protection measures against all kinds of poaching, intrusion, illicit grazing and illicit collection of MFP, relocating forest villages from the critical tiger habitat to reclaim additional habitat for wildlife, translocating important wildlife species to other wildlife protected areas for reintroduction, and enhancing biodiversity in the tiger reserve by introducing locally extinct ungulate species, such as the blackbuck. Management practices undertaken at Kanha has also been adopted as standard to follow in several other tiger reserves. As already mentioned in a previous chapter, Kanha is a repository of a wide range of floral and faunal species, some of them endangered and even endemic. And the conservation of this diverse biodiversity is of utmost importance.

4.5 Instruments of Biodiversity Conservation:

These are an effective combination of protection; species-specific and habitat-specific approaches through ecological restoration, monitoring, and cooperation of local communities.

4.5.1 **Stringent Protection:** The Kanha management is known to have adopted a protectionist attitude for a long time with its reliable communication system, strategically placed forest patrolling camps and intensive patrolling strategies throughout the year, resulting in an appreciable increase in wildlife populations, and forest and wildlife offences well under control.

4.5.2 **Species-Specific Approaches:** Some high priority animal species require special treatments owing to their endangered status and specialized habits and habitats. One such species is the hard ground barasingha. Under its recovery/conservation plan, all sub-populations are monitored daily, and its habitats and microhabitats are specially improved and modified to facilitate its speedy recovery.

The Tiger is another flagship species seriously endangered and its effective conservation requires excellent natal areas and good prey base. The tiger population is monitored regularly under the seasonal monitoring programme. Long-term ecological studies are also underway to gather important information on densities, social organization, prey-predator relationship and other ecological parameters.

4.5.3 **Habitat-Specific Approach:** Ecological restoration is an important practice to initiate or accelerate ecological pathway to make the ecosystem resilient and self-sustaining with respect to natural species composition and function. This approach at Kanha ensures that wildlife habitats are managed properly to suit the requirements of respective wildlife species. All the meadows are systematically maintained by eradicating Lantana shrubs, obnoxious weed species, woody species/ restocking grassland for herbivores. Besides, eco-restoration also includes creating linkages within the ecosystem, improving soil and moisture regime, water development and fire protection.

4.5.4 **Monitoring:** The tiger reserve management has adopted a multi-pronged strategy for monitoring the biodiversity in the protected area. This includes collaborative programmes with the Wildlife Institute of India, Dehradun, in-house periodic floral and faunal monitoring by trained staff under a prescribed format, quinquennium monitoring of vegetation, photo captures by fixed camera traps, photographic album of grass species etc. Most of in-house monitoring data have also been used in various documents such as Management Plans/ Tiger Conservation Plans/ Technical Reports etc. Besides in-house short-term studies, special consultancies are also assigned periodically to different institutions/ experts for assessing/ quantifying biodiversity status of the protected area.

4.5.5 **Cooperation of Local Communities:** The Kanha management has had to move very carefully in building trust and confidence, and has now successfully put commitments of socio-economic upliftment across to these stake-holders. The Kanha management has successfully developed participatory conservation through ecodevelopment committees. The management's past efforts have oriented all these villages positively to the conservation of the core and buffer zones. They are given exclusive preference for employment generated through management practices in the tiger reserve. The communities also realize that the conservational success of the tiger reserve is also in their interest, and they will be accruing benefits through ecodevelopment, stake-holding claims and employment and soft loans etc. The park-people cooperation approach has resulted in a positive change in the majority of people's attitude towards conservation of the tiger reserve and will further go a long way in biodiversity conservation.

4.6 Broad Outcome:

The change of status of these forests through shooting blocks, wildlife sanctuaries, national park and now finally tiger reserve has, fortunately, given an immense scientific impetus to the ecological restoration/ conservation of this area. The regeneration of sal (*Shorea robusta*) and its associates such as *Terminalia tomentosa*, *Pterocarpus marsupium*, *Lagerstroemia parviflora*, *Anogeissus latifolia*, *Lannea coromandelica* and *Bombax malabaricum* etc. once suppressed due to illicit grazing and indiscriminate fires, has revived with characteristics understory and undergrowth. Many areas in the core and at the periphery in the buffer are now restocked with this original vegetation. The degraded bamboo forests of the Seventies have now given way to an excellent growth of the species as an understory, particularly in the Kanha, Sarhi and Supkhar forest ranges. Vegetation along river and stream banks has also revived with tall grass species in the beds. The Kanha management has over the years created many water bodies in the core to ensure equitable distribution of water for wildlife. Presently, due to stringent protection these water bodies harbour around 50 species of aquatic plants. Besides, the core also supports 17 species of rare plants. Most old clearings/ openings in these forests have also gradually become colonized. The forests of the core are in an excellent condition with 12 clear vegetal cover types, with around 850 species of Angiosperms. The dominant family is Poaceae, with 109 species.

The core is renowned for its excellent grassland habitats sustaining thousands of ungulates of at least nine major species, including the endangered hard ground barasingha (*Rucervus duvaucelii branderi*). Till several years back, these grasslands were typical village sites with pasturelands and agricultural fields. With gradual change of the status of this forest tract, and managerial interventions and reduction of biotic pressure with village relocation, these village sites have morphed into excellent grasslands with a wide range of palatable grass species for herbivores.

Availability of a good prey base commands a direct bearing on the population of predator species. Consequently, the core has viable populations of tigers and leopards. The population of wild dogs is also good.

The Kanha management has been taking up habitat improvement programme over all these years. Consequently, the grassland habitat has improved considerably. The revival of barasingha at Kanha is ample proof of the congeniality of grassland habitats. The hard ground barasingha is almost a total graminivore and its survival depends solely on grasslands. These grasslands need regular interventions for the survival of a wide range of ungulate species in the core.

Kanha has also added to the biodiversity status of the Bandhavgarh tiger reserve by reintroducing 51 gaur under an ambitious multi-disciplinary collaborative programme, which has given confidence and opened new possibilities of such ventures anywhere in the country. Besides, the reintroduction of blackbucks into the Kanha national park in 2011 has paved the way for rebuilding a new population. A total of 85 barasingha, an endangered species, endemic to Kanha, have also been translocated to the Van Vihar national park (7 barasingha) and Satpuda tiger reserve (78 barasingha) to establish two geographically separate populations. Besides, Kanha is the first tiger reserve in the country with a functional buffer zone, having supported it since 1995. The tiger reserve has so far followed an effective core-buffer strategy successfully for biodiversity conservation, inspiring others to emulate the Kanha model.

Kanha is also renowned for wildlife/ eco-tourism and a centre of excellence for creating awareness about biodiversity/ wildlife conservation through its tourism activities, including an outstanding park interpretation package. While some studies on/ systematic quantifications of ground water recharge, carbon sequestration and nutrient retention is in progress, it can be safely assumed that a protected area of such long standing is also accruing these tangible/ intangible benefits. Kanha is also regarded as an excellent field laboratory for demonstrating various conservation/ managerial techniques.

4.7 Corridor Connectivity:

Under this concept, two protected areas or forest areas of old growth need to be linked by a viable ecological corridor to facilitate animal movement, specially tigers. While tigers are safe in a protected area, they have to face a hostile environment of diverse land uses and poaching outside that ultimately lead to their extermination. In this way, the core zone cannot carry a tiger population beyond a certain limit, and the survival of spill-over tigers outside the core zone is rendered difficult by the incompatibility of land uses for tiger conservation. These incompatible land uses also include many managed forest divisions where forestry operations/ workings prevail over tiger conservation, and the degree of protection is perilously low.

Though connectivity between Kanha tiger reserve and these protected areas may be fragile, there is an ample scope for ensuring gene flow from the Kanha core conservation unit by resorting to appropriate site-specific restorative management. Thus, the tiger reserve is considerably significant as a conservation nucleus. Three corridors have been identified for the tiger reserve: Kanha-Pench, Kanha-Achanakmar (CG), and Kanha-Nawegaon-Nagzira (MH). While much has to be done in future to make these corridors effectively functional, the concept is agreed upon in principle.

4.8 The Kanha-Phen Eco-Sensitive Zone:

As per the instructions/ guidelines issued by the Ministry of Environment, Forest and Climate Change, New Delhi regarding declaration of Eco-Sensitive Zones (ESZ) around protected areas, the Kanha management had drafted a proposal for declaring ESZs of Kanha National Park and Phen Wildlife Sanctuary. This proposal contains the entire buffer zone of the tiger reserve along with the area, where there is no buffer zone, extendable to two kilometers from the boundary of the Kanha national park and Phen wildlife sanctuary to be declared the Kanha-Phen ESZ. The extent of ESZ varies from zero kilometers (due to interstate boundary between Madhya Pradesh and Chhatisgarh) to 30 kilometers around the Kanha national park, the buffer zone, and the Phen wildlife sanctuary. The area of the Kanha and Phen ESZ is 1217.684 square kilometers. The ESZ also includes some area of the east Mandla (T) division. The Govt. of India has now issued the final notification pertaining to the ESZs of Kanha NP and Phen WLS **(Appendices-6A & 6B)**. After the notification, a Master Plan will be prepared for its management.

4.9 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. Depending upon food habits, an animal species, however, may require more than one habitat type for its existence. It is, therefore, desirable that there is good intermixing of different habitat unit types, and they are well distributed and not clumped into one area. This ideal situation helps the animals minimize energy loss.

The core zone consists of several mosaics of habitats that support populations of various wildlife species. Needless to add, these habitats continually 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, a finer classification of habitats may suggest the following types:

- Sal forest.
- Miscellaneous forest.
- Miscellaneous forest with bamboo.
- Sal 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-7)**.

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.

4.10 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 very 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.

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 Kanha 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.
    - Restocking of grasslands.
    - Expansion of grassland areas.
    - Cool burning.

- **Dr. HS Negi & Dr. Rakesh Shukla (2011-12 to 2020-21)**
    - Systematic grassland burning.
    - Relief exclosure.

- Treatment for problematic grasses.
- Restocking of grasslands.
- Weed eradication.
- Eradication of woody species.
- Prescriptions for bamboo.
- Water development.
- Maintenance of tall grass cover.

As experience shows the greatest impact on wildlife species generally result from habitat modifications, which result in changes in wildlife species. In this way, these wildlife habitats need to be "managed" 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 Kanha management manages major habitat types under a habitat improvement programme as prescribed in the previous Management Plans (Gopal & Shukla, 2001; Negi & Shukla, 2010). 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.

4.11 Wildlife Protection:

4.11.1 **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.

4.11.2 **Wildlife Offences:** 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 Plans (Gopal & Shukla, 2001; Negi & Shukla, 2010), the Kanha management ensures protection of forest and wildlife throughout the year under various protection strategies. 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 peripheral villagers, fuel-wood collection for *bonafide* use, and removal of MPF do sometimes occur **(Appendices-8 to 9)**. The Kanha management deals with wildlife offences very severely under provisions envisaged in various relevant Acts and Rules.

4.11.3 **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 sometimes do risk driving 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-10)**. There are still 8 forest villages in the national park.

The Kanha management has already earmarked some *nistar* areas for the inhabitants of these villages to meet their *bona-fide* requirements.

Table-39: Information on the Earmarked Area for Grazing in the Villages

Sl. No.	Name of Forest Village	Grazing Area (In ha.)
1	**2**	**3**
1	Jhapul	555.633
2	Bhilwani	1911.791
3	Mukki	80.000
4	Dhaniajhor	26.245
5	Kadla	18.886
6	Patuwa	55.360
7	Chatarpur	21.370
8	Janglikheda	53.002
	Total:	**2722.287**

Source: Kanha Tiger Reserve (2021)

4.11.4 **Wild Fires:** As stated above, though the core zone has no forest village, there are still eight 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 Kanha management. The fire season sets in around mid-February and lasts until the area receives the first showers of the monsoon. The Kanha 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 Forest Fire Alerts System 3.0, developed by the Forest Survey of India, Dehradun. The system uses this information and identifies the concerned active fire locations which are within administrative units of forest department. Then it automatically sends SMS to the concerned field staff and monitoring officers. They in turn verifies the locations of fires and areas burnt, and upload the feedback into the same App.

4.12 Wildlife Health:

Surveillance and monitoring of wildlife diseases under comprehensive wildlife health management is another concern of the Kanha management. As conservation in the protected area also involves the management of two endangered species - the tiger and the hard ground barasingha - the wildlife health management issue becomes all the more important. The reserve has a modest veterinary setup, with a wildlife veterinarian, also trained in wildlife management. Broadly, all the wildlife health management practices aim at preventing the occurrence of serious diseases, specially epidemics; ensuring prophylaxis by vaccinating cattle of surrounding villages, conducting postmortems of wild animals and drawing inferences about cause of death, and treatment and management of sick, problematic and distressed wild animals.

4.13 Proactive Management:

Being one of the best wildlife protected areas of the country, the core zone and has witnessed a host of wildlife conservation practices, including the conservation of some endangered species. In this way, the Kanha management has gained much experience and managerial expertise over the years. With sizeable populations of different wildlife species to share with some other protected areas, and its own need to reintroduce some species into the core zone, Kanha is also expected to play an important role in active wildlife management. Over the years, the Kanha management has successfully translocated and reintroduced a few wildlife species to some other protected areas, and has also reintroduced the blackbuck into Kanha itself. It will be described in detailed in a separate chapter.

4.14 Rearing & Training of Tigers:

In the backdrop of the killing of a radio-collared encumbered tigress by a dominant male in 2005, the Kanha management constructed a specially designed large *in-situ* enclosure (around 35 ha.) at Ghorella in compartment number 24 of the Mukki range. The idea behind this decision was to give these two orphaned cubs an opportunity to learn the ways of the jungle, including predation and free movement, in a large area of a typical tiger habitat so that they may be reared and trained for rewilding. This initiative would minimize the probability of such orphaned cubs being sent to a zoo for the entire life. Ever since, 9 tigers have been reared and trained in this enclosure.

4.15 Movement of Wild Elephants:

Presently, India supports around 27000 Asiatic wild elephants (*Elephas maximas*), moving frequently across their habitats in search of food, water, and cover. There was always a possibility that wild elephants would enter through the Madhya Pradesh-Chattisgarh state border and move around forest areas in the state. The presence of wild elephants in Madhya Pradesh is not very old. Elephants from Jharkhand and Odisha started entering the districts of Sarguja and Raigarh of united Madhya Pradesh in the last decade of 20th Century. In the present Madhya Pradesh, the first entry was reported from Baikunthpur of Chhattisgarh into Sanjay national park in the Sidhi district. After this, elephants started entering the Sidhi and Singrauli districts regularly. They stayed there for a few months from September-October to February-March and went back to Chhattisgarh. However, in the year 2017 a herd of 7 elephants did not leave Madhya Pradesh but continued to stay in Sanjay Dubri Tiger Reserve, Sidhi. Shortly thereafter, in early 2018, another herd of about 40 elephants entered Madhya Pradesh and began residing in Bandhavgarh Tiger Reserve, Umaria. Kanha is now a new visiting location for elephants. In November, 2021, 14 elephants entered Phen wildlife sanctuary through Dindori division and stayed for around four months. They returned in February, 2022. Again, a small herd of five elephants visited Phen wildlife sanctuary in the month of May, 2022. Besides, presently, a large herd of wild elephants has already become resident in Bandhavgarh tiger reserve for the past several years.

Recently, the movement of two strayed wild elephants in Madhya Pradesh was again reported in July-August, 2019. These two wild tuskers, aged around 14-16 and 16-18 years respectively, were reported to have strayed into the Baihar range of the north

Balaghat division from Chhatisgarh. The pachyderms continued their movement, so typical of wild elephants, through forests and agricultural fields of different forest divisions/ districts of the state. During this time, they foraged on a wide range of available forest vegetation, including bamboo shoots and leaves, and grass etc. They, however, sometimes also raided agricultural crops, specially the sugarcane, and damaged properties inflicting monetary losses on several people. The elephants also attacked a man in the Narsinghpur division in January, 2020, and killed a person in early April, 2020 near Dhanora in the N. Seoni division. These tuskers characteristically went on with this rampage throughout their onward journey. Alert staff of different forest divisions tried its best to monitor their daily movements. Some aware citizens at Mandla also helped the forest staff with aerial images/ evidence captured with the help of a private drone. The wild tuskers would either move on without any long stoppages, or stay for 3-4 days in a forest depending upon the availability of cool shade, forage and water.

In view of the above, it was decided that these elephants should be captured, transported and trained in the Kanha tiger reserve. As per the Principal Chief Conservator of Forests (Wildlife), Madhya Pradesh instructions vide letter No./Tech.-2/02-II/53 dated 07-02-2020, the Kanha management was instructed to construct kraals to sedate/restrain and tame these elephants for training at Kanha, similar to the ones at Bandhavgarh. In pursuance of this letter, the Kanha management arranged to transport all the necessary logs/ materials from Bandhavgarh tiger reserve. Presently, two kraals have been constructed at Kanha.

The Principal Chief Conservator of Forests (Wildlife), Madhya Pradesh vide order No./Tech.-2/02-II/52 dated 07-02-2020 also constituted a team of forest officers and wildlife veterinarians, headed by Field Director, Pench tiger reserve, to capture these two elephants and transport them to Kanha for training. The constitution of the team is as under:

- Shri VS Parihar, Field Director, Pench tiger reserve
- Shri Sunil Sinha, Assistant Director, Kanha tiger reserve

- Dr. Sandip Agrawal, Wildlife Veterinarian, Kanha tiger reserve
- Dr. Akhilesh Mishra, Wildlife Veterinarian, Pench tiger reserve
- Dr. Abhay Sengar, Wildlife Veterinarian, Sanjay tiger reserve
- Shri Raju Singh Rajput, Forest Range Officer, Pench tiger reserve

The above team met on 19-02-2020 at the office of the Field Director, Pench tiger reserve, Seoni to discuss all aspects of this capture and transportation operation. Later, on the information that the wild elephants are getting close to Mandla, the capture team along with the local forest officers of the east and west Mandla divisions held a meeting at Mandla on 16-04-2020 to plan capture operations. The strayed tuskers had by then reached a forest near Phoolsagar in the west Mandla division, not far away from Mandla town. By this time the Kanha management had also transported six semi-captive elephants from Kanha to the Rasaiyyadona forest depot, on the Mandla-Dindori road, near Mandla for help in the capture of these two wild elephants. These wild tuskers were moving fast covering on an average 25-30 km. per day. Officers and staff of the east and west Mandla divisions were also monitoring these movements, and the team was kept informed about the tuskers' movements. The capture team along with Kanha elephants used to follow these wild elephants as per their latest locations based on information from villagers and animal signs such as tracks and dung. Mr. L. Krishnamoorthy, Field Director, Kanha tiger reserve, Mr. AK Singh, CCF, Jabalpur forest circle, and Ms. Anjana Suchita Tirkey, Deputy Director, Kanha tiger reserve also joined this team in search operations in the field and in discussions. The search operation continued for 5-6 days, and different approaches were adopted to close in on the strayed elephants for drug immobilization, but without any success. It was later realized that these elephants were moving fast through dense forests failing all logistics, always several kilometers ahead of the capture team, and it was not possible to capture them. Besides, the health of the semi-captive elephants in hot days was also a concern. As the wild tuskers were expected to move towards and beyond the Chhattisgarh border, it was decided that the operation should be called off. The wild elephants, however, changed their direction, and moved towards Sijhora and Bichiya and entered the Kanha tiger reserve. Presently, both the tuskers foraged in the core zone, and also attacked and injured Ranapratap, Chanchankali female semi-captive elephants of the tiger reserve.

The broad movement of these tuskers for the past several months is as under:

Chhattisgarh → Baihar range (N. Balaghat division) → Malanjkhand (Buffer Zone) → Mohgaon Development Corporation area → Keolari (S. Seoni division) → Narsinghpur division → Hoshangabad division → Satpura Tiger Reserve → near Patalkot area (Chhindwara division) → Narsinghpur division → Dhanora (N. Seoni division) → Maharajpur range → Phoolsagar area → Rasaiyyadona area (W. Mandla division) → Patpara area → Bagrodi (E. Mandla division) → Sijhora (Buffer Zone) → Bichiya (E. Mandla division) and Kanha tiger reserve.

Ultimately, one elephant was captured on 06-12-2020 from the core zone near the Sijhora road area by a well-equipped team of forest personnel and wildlife veterinarians. In the meantime, the Kanha management had already built a kraal at Kisli for restraining and training this elephant. The captured elephant was duly trained and included in the elephant squad of Kanha, and now there are 18 elephants. These elephants are primarily used for tiger monitoring and special patrols in the core zone. Their role is especially important during the monsoon and they are used by the park staff to reach difficult and inaccessible parts of the protected area.

4.16 Wildlife Tourism:

One of the outstanding wildlife/ ecotourism destinations, Kanha draws a large number of domestic and international tourists every year. It is renowned for pristine nature and tourism and as centre of excellence for creating awareness about biodiversity/ wildlife conservation through a wide range of tourism activities/ facilities.

Tourism at Kanha is based on the idea of a fine balance of conservation education and enjoyment of forest and wildlife that is ecologically and socio-culturally sustainable, with active participation of local communities. What also underlies this concept is over-all conservation of a viable population of the tiger, biodiversity and tourist resources in Kanha and to preserve, for all times, the tiger reserve as part of our national heritage for the benefit, education and enjoyment of posterity. As per the guidelines issued by the National Tiger Conservation Authority (NTCA) and the MP forest department, the Kanha management has accordingly delineated the current tourism zone in the core and has also prescribed vehicular carrying capacity for it.

4.17 Ecological Restoration:

Over the years these stringent protection and habitat management practices have considerably restored the Kanha ecosystem. This eco-restoration has resulted in the overall betterment of vegetation cover, hydrology, 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 creation and maintenance of excellent wildlife habitats.

The present 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. 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. Laxity in the enforcement of the existing Acts/ Rules relating to forest 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. Illicit felling, encroachment, wanton fire and uncontrolled collection of MFP in these tracts had already taken a considerable toll on these forests.

The change of status of these forests through wildlife sanctuaries, national park and now finally critical tiger habitat (CTH) has, fortunately, given an immense scientific impetus to the ecological restoration/ conservation of this area. The regeneration of sal (*Shorea robusta*) and its associates such as *Terminalia tomentosa*, *Pterocarpus marsupium*, *Lagerstroemia parviflora*, *Anogeissus latifolia*, *Lannea coromandelica* and *Bombax malabaricum* etc. once suppressed due to illicit grazing and indiscriminate fires, has revived with characteristics understory and undergrowth. Many areas of the core zone are now restocked with this original vegetation. The degraded bamboo forests of the Seventies have now given way to excellent growth of the species as an understory, particularly in the Kanha, Sarhi and Supkhar forest ranges. Vegetation along river and stream banks has also revived with tall grass species in the beds. The Kanha management has over the years created many water bodies in the core zone. Presently, due to stringent protection they harbour around 50 species of aquatic plants. Parihar & Kotwal (1989) has also recorded 17 species of rare plants in the core zone. Most old clearings/ openings in these forests have also gradually become colonized.

The core zone is renowned for its excellent grassland habitats sustaining thousands of ungulates of at least 9 major species, including the highly endangered hard ground barasingha. These grasslands were initially typical pasturelands of old villages. With the gradual change of status of this forest tract and managerial interventions and reduction of biotic pressure with village relocation, these old pasturelands have morphed into excellent grasslands with a wide range of palatable grass species for herbivores.

The Kanha management has been taking up habitat improvement programme over all these years. Consequently, the grassland habitat has expanded and improved considerably. The revival of barasingha in the core zone is ample proof of the congeniality of grassland habitats. The hard ground barasingha is almost a total graminivore and its survival depends solely on grasslands. These grasslands need regular interventions for the survival of a wide range of ungulate species in the core zone.

4.18 Insect Attacks & Pathological Problems:

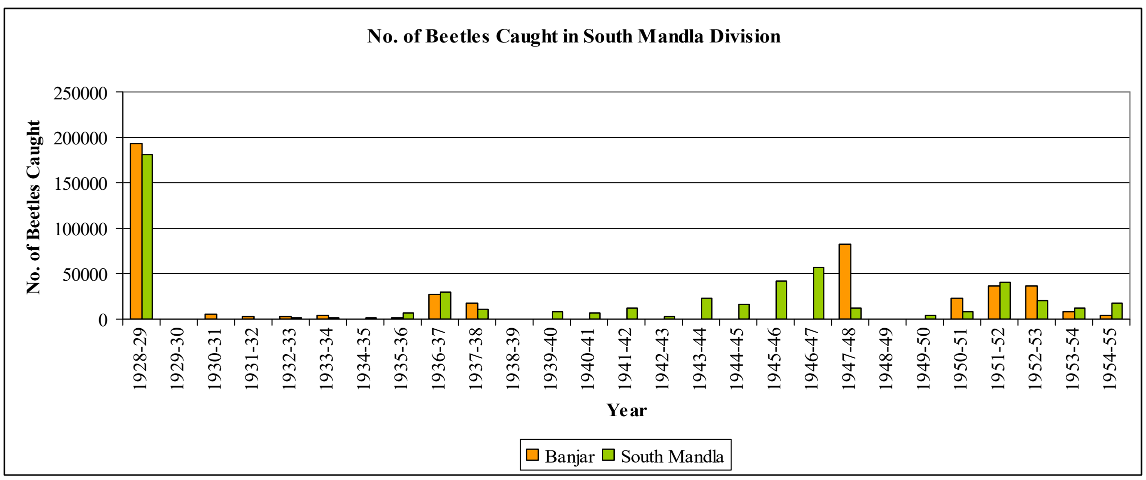
4.18.1 **Sal Heart-Wood Borer:** The infestation of the sal heart-wood borer (*Hoplocerambyx spinicornis,* Order: Coleoptera, family: Cerambycidae, subfamily: Cerambycinae) in the core zone raised a serious concern among forest officers, wildlifers and a host of national and international wildlife enthusiasts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

4.18.1.1 **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.

Table-40: Beetles Caught in the South Mandla Division (1928-29 to 1954-55)

Sl. No.	Year	No. of Beetles Caught	
		Banjar	South Mandla
1	1928-29	192645	181026
2	1929-30	-	-
3	1930-31	6035	459
4	1931-32	2303	350
5	1932-33	2969	1694
6	1933-34	4158	1626
7	1934-35	-	818
8	1935-36	1551	6320
9	1936-37	27188	30340
10	1937-38	17978	11150
11	1938-39	-	-
12	1939-40	-	7557
13	1940-41	-	7051
14	1941-42	-	11829
15	1942-43	-	3043
16	1943-44	-	23610
17	1944-45	-	16113
18	1945-46	-	42490
19	1946-47	-	57234
20	1947-48	82214	11788
21	1948-49	-	-
22	1949-50	-	4349
23	1950-51	22500	8672
24	1951-52	37037	40960
25	1952-53	36404	20431
26	1953-54	8645	11917
27	1954-55	4196	17062

Source: Kanha Tiger Reserve (2019)

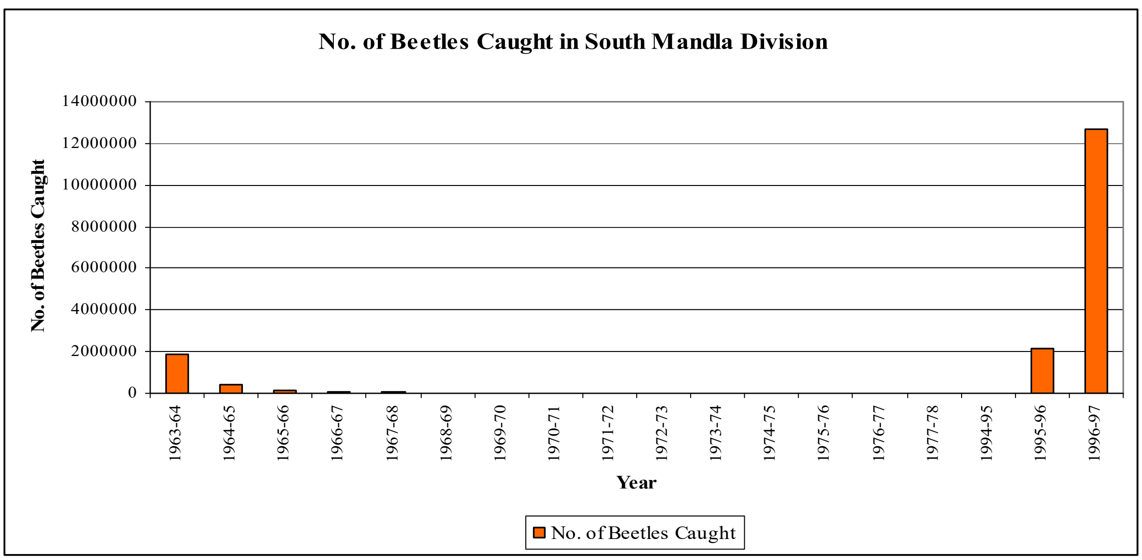


The number of beetles caught in the south Mandla division (1963-64 to 1977-78 & 1994-95 to 1996-97) is presented as under:

Table-41: Beetles Caught in the South Mandla Division (1963-64 to 1977-78 and 1994-95 to 1996-97)

Sl. No.	Year	No. of Beetles Caught
1	2	3
1	1963-64	1865494
2	1964-65	419064
3	1965-66	161221
4	1966-67	93754
5	1967-68	57873
6	1968-69	5977
7	1969-70	31205
8	1970-71	6937
9	1971-72	-
10	1972-73	4074
11	1973-74	2326
12	1974-75	4066
13	1975-76	392
14	1976-77	8685
15	1977-78	7145
16	1994-95	72
17	1995-96	2159739
18	1996-97	12650000

Source: Kanha Tiger Reserve (2019)



4.18.1.2 **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, 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).

4.18.1.3 **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.

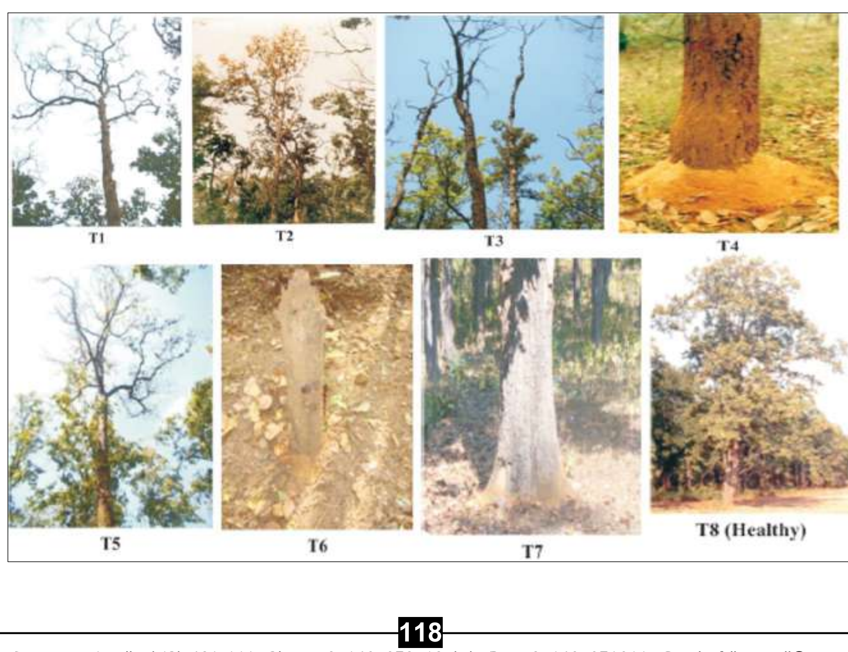
Large open areas in a habitat, as a sequel to insect outbreak, do bring in vegetational changes. Opportunistic species are readily attracted to such clearings. This in turn, eliminates the habitat of vertebrate/invertebrate canopy dwellers. Such habitat changes usually do not affect the small, ground 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.

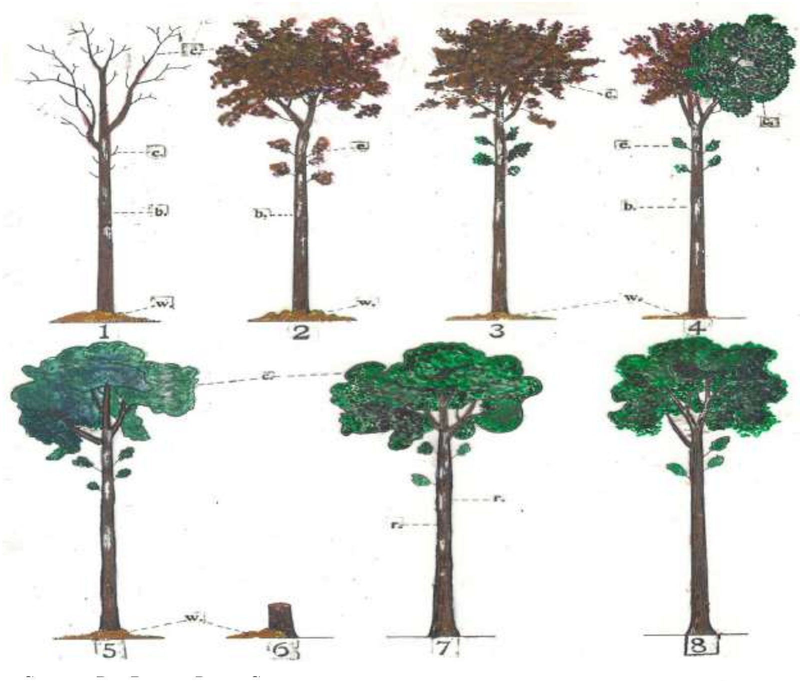
The mosaic of shrubs, herbs, woody vegetation and gaps create a patchy environment. This enhances the edge effect, thereby fostering animal diversity.

4.18.1.4 **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 Kanha management decided to take it up as an 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 (increase)/ regression (decrease) of the disease. Resource persons also visited the core zone to assess the infestation and suggest control measures. The category seven through one was considered as the progression of infestation, whereas the reverse (one through seven) as regression.

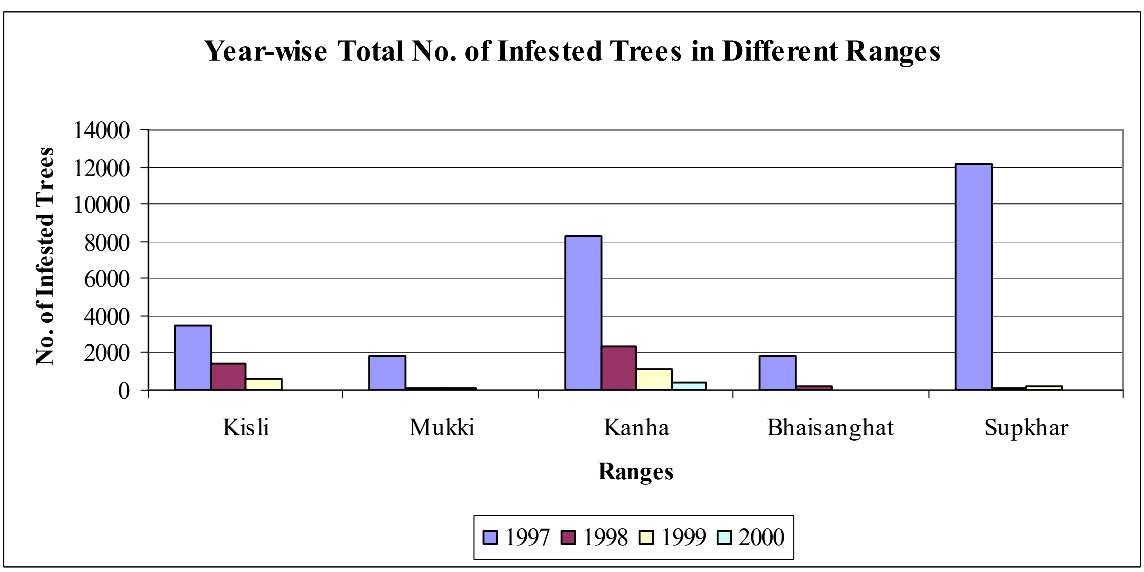
4.18.1.5 **Intensity of Infestation:** Considering the intensity of the sal borer infestation, the following eight revised categories have now been identified. Presently, these categories are being applied for the study of sal borer infestation:

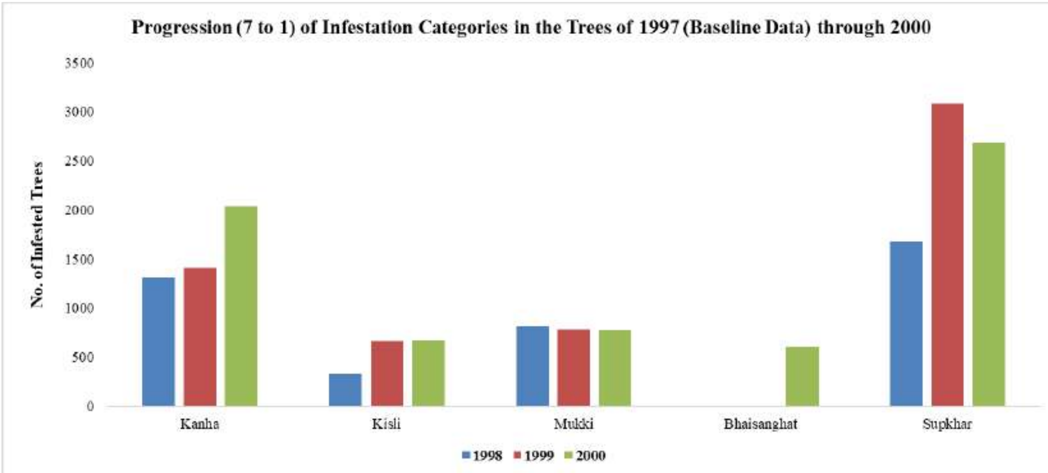
1. Crown leafless and dead; stem and epicormic branches leafless, large heap of dust below the tree.
2. Crown dried and brown; leaves dried and brown; epicormic branches either dead or brown, large heap of dust below the tree.
3. Crown dead or brown, epicormic branches dead in the upper part but alive in the lower part, large quantity of dust over 7 cm. below the tree.
4. Crown alive and green, epicormic branches green, large heap of dust over 7 cm. below the tree.
5. Crown partially alive and green, partially dead, brown; epicormic branches green; dust heap less than 7 cm. high and scattered.
6. Stump with a large heap of dust.
7. Crown alive, green; epicormic branches green and alive; with or without resin; dust scattered or very little.
8. Healthy tree.

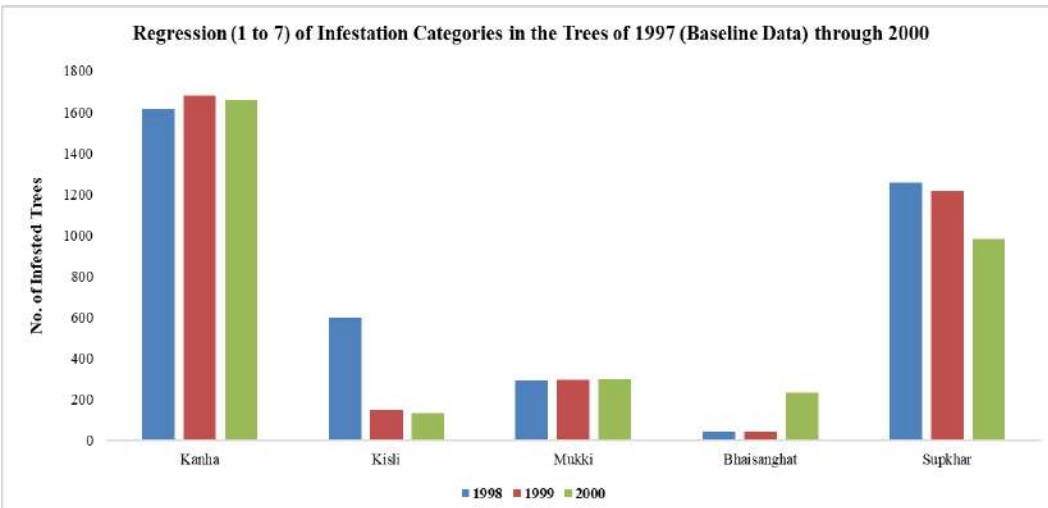


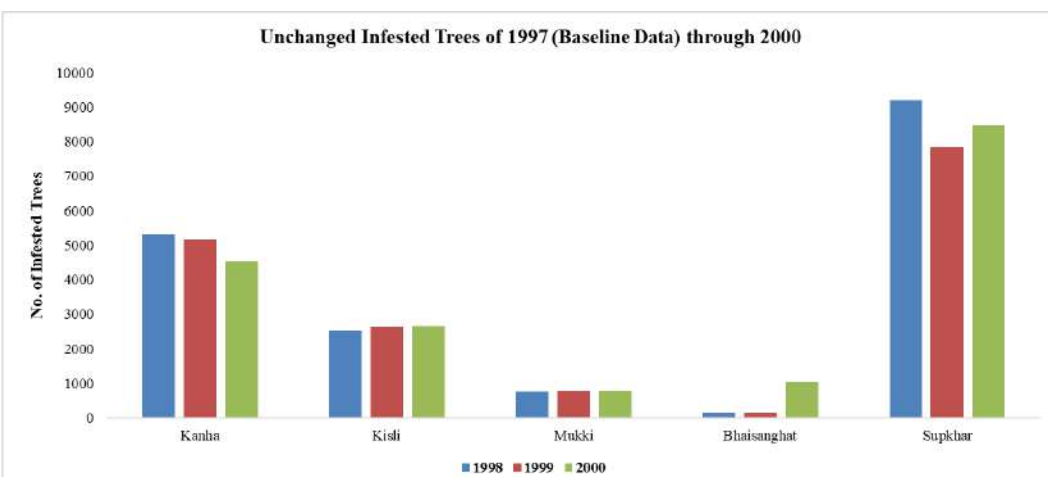


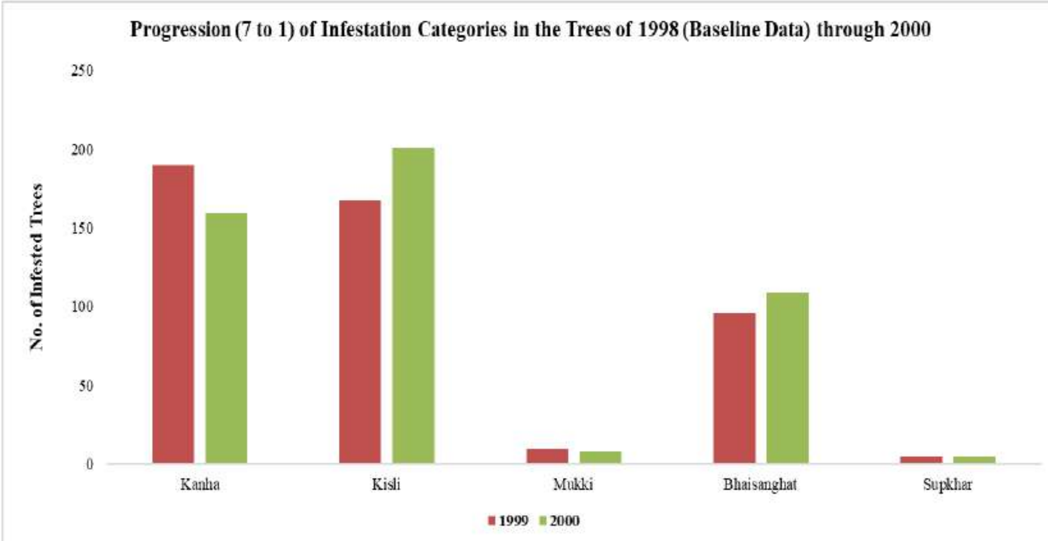
4.18.1.6 **Inferential Generalizations:** The observations relating to the sal borer infestation during 1997 to 2000 in the core zone has been graphically presented as under:

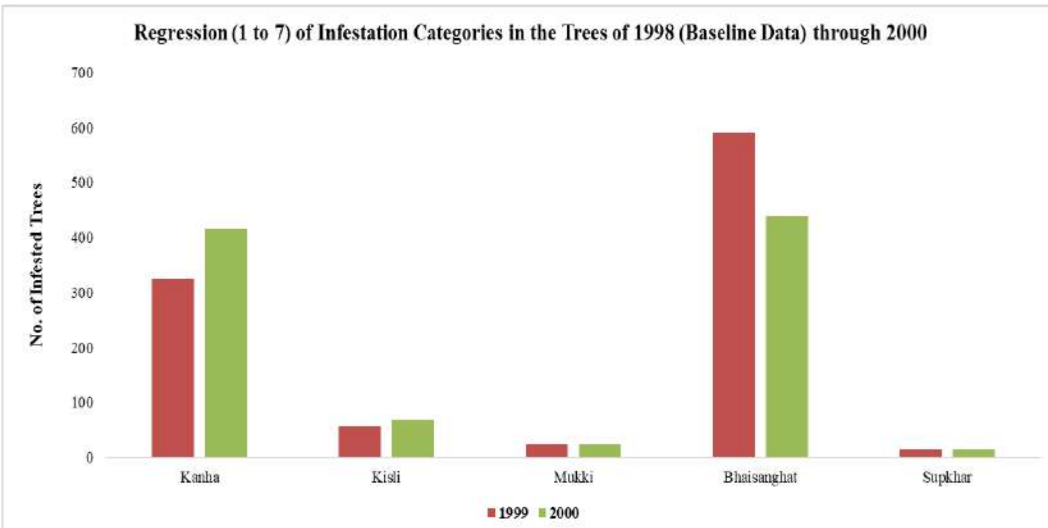


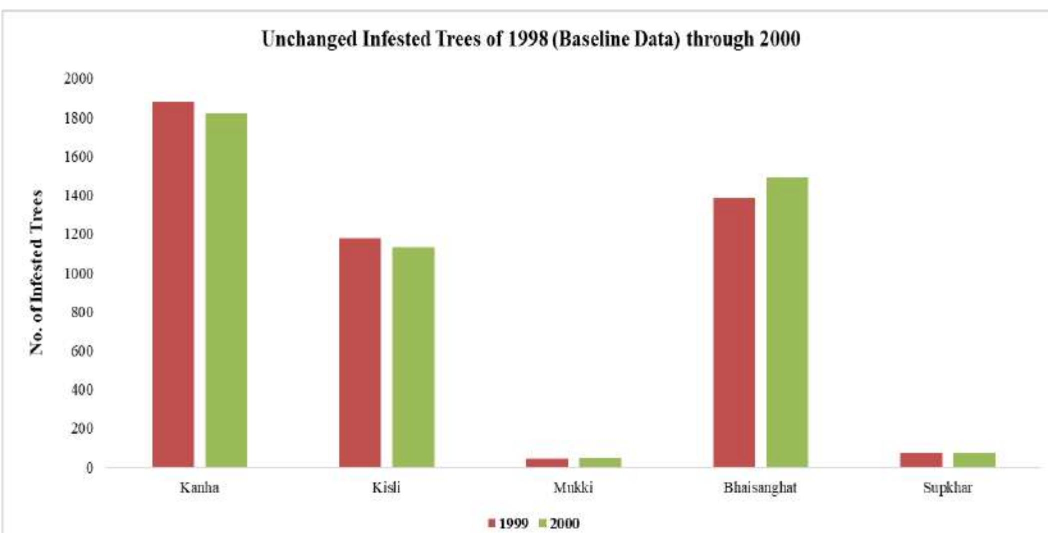

Progression (7 to 1) of Infestation Categories in the Trees of 1997 (Baseline Data) through 2000
No. of Infested Trees
3500
3000
2500
2000
1500
1000
500
0
Kanha
Kisli
Mukki
Bhaisanghat
Supkhar
1998
1999
2000


Regression (1 to 7) of Infestation Categories in the Trees of 1997 (Baseline Data) through 2000
No. of Infested Trees
1800
1600
1400
1200
1000
800
600
400
200
0
Kanha
Kisli
Mukki
Bhaisanghat
Supkhar
1998
1999
2000


Unchanged Infested Trees of 1997 (Baseline Data) through 2000
No. of Infested Trees
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Kanha
Kisli
Mukki
Bhaisanghat
Supkhar
1998
1999
2000


Progression (7 to 1) of Infestation Categories in the Trees of 1998 (Baseline Data) through 2000
No. of Infested Trees
250
200
150
100
50
0
Kanha
Kisli
Mukki
Bhaisanghat
Supkhar
1999
2000


Regression (1 to 7) of Infestation Categories in the Trees of 1998 (Baseline Data) through 2000
No. of Infested Trees
700
600
500
400
300
200
100
0
Kanha
Kisli
Mukki
Bhaisanghat
Supkhar
1999
2000


Unchanged Infested Trees of 1998 (Baseline Data) through 2000
No. of Infested Trees
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Kanha
Kisli
Mukki
Bhaisanghat
Supkhar
1999
2000

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 dynamic 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 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.

4.18.1.7 **Sal Defoliation at Kanha:** Scientists of the Tropical Forest Research Institute, Jabalpur collected insect larvae from the tiger reserve and identified them as under:

Table-42: Name of Insects and their Family

Sl. No.	Name of Insect	Order	Family
1	**2**	**3**	**4**
1	*Trabala Vishnu* Lef.	Lepidoptera	Lasiocampidae
2	*Hyposidra talaca* Walk	Lepidoptera	Geometridae
3	*Trypanophora semihyalina* Koll*	Lepidoptera	Zygaenidae
4	*Caviria seicea* Moore*	Lepidoptera	Lymntridae

* New record. ***Source: Kanha Tiger Reserve (2021)***

Several forests of Madhya Pradesh were reported to have been affected by lymantrid species of defoliators in 1909. The presence of the hairy caterpillar of lymantrid, *Lymantria mathura* feeding on sal leaves was recorded from the east Mandla division in the years 1998-2000. Besides, the naked caterpillar of *Paectes subapicalis* was also recorded in the Karanjia range of Dindori forest division during 2000-2001. The infestation, however, remained below the economic threshold. In the year 2008, the localized sudden outbreak of *Ascotis selenaria* accompanied by the naked caterpillars of *Anua triphaenoides* Walk., *Ophiusa* (*Achaea*) *Janata* Linn., *Paectes subapicalis*, was recorded from the Umaria forest division.

4.18.1.8 Effect of Defoliation: Insect defoliation is reported to affect trees by reducing photosynthesis, interfering with transpiration and translocation of food within. While low defoliation normally has very little effect on trees, moderate to severe defoliation not only reduces the growth but also increases their susceptibility to the attack of secondary insects and diseases. Destroying of buds and young shoots lead to forking of leading shoots or epicormics branching resulting bushy appearance of affected trees.

The study revealed a large number of larvae of four species defoliating sal trees of different age group together and a number of trees became leafless. Besides, the defoliation was reported to reduce the annual growth, making them more susceptible to the attack of various diseases and insect pests. In some compartments, however, the sprouting of new leaves appeared and thereafter the defoliation was moderate and sporadic in some trees.

The study concluded the presence of the above four insect pests, which are the causative agents for the epidemic defoliation of sal forests in the Kanha tiger reserve. The incidence of sal defoliators was sporadic and in patches even within the compartments. It was observed that the defoliation started during the rainy season, based on the known behavior of the defoliating larvae proven by the declining population of the larvae, even in the severe area of infestations. It was also assumed that the incidence might subside in the due course by winter. The study also suggested future surveillance and monitoring to prevent its further spread into newer adjoining areas.

4.18.1.9 Sal Borer Monitoring: As per instructions received from the Principal Chief Conservator of Forests (Development), Madhya Pradesh in 2013, sal borer monitoring was again started in the tiger reserve. The monitoring was carried out from the month of November under a prescribed proforma. The result of the enumeration of sal borer infested trees for the past some years are as under:

Table-43: Results of Enumeration Sal Borer Infested Trees (2013)

Sl. No.	Range	Forest Area	Sal Area	No. of Affected Trees	Affected Trees/ Ha. (Sal Area)
1	2	3	4	5	6
1	Kisli	13895.58	4022.16	809	0.20
2	Kanha	12166.83	4495.65	2900	0.65
3	Sarhi	13830.88	1952.55	931	0.48
4	Mukki	13021.40	7304.16	6957	0.95
5	Bhaisanghat	15570.55	3228.21	5828	1.81
6	Supkhar	21266.37	11866.71	3104	0.26
	Total:	**89751.61**	**32869.44**	**20529**	

Source: Kanha Tiger Reserve (2021)

Table-44: Girth-wise Sal Borer Infested Trees (2013)

Sl. No.	Range	*Girth-wise Sal Borer Affected Trees*							
		31/45	46/60	61/90	91/120	121/150	151/180	> 180	Total
1	2	3	4	5	6	7	8	9	10
1	Kisli	123	67	135	106	119	36	223	**809**
2	Kanha	0	33	329	636	711	578	613	**2900**
3	Sarhi	110	86	192	257	37	17	232	**931**
4	Bhaisanghat	1216	598	844	707	725	147	1591	**5828**
5	Supkhar	717	482	323	298	525	124	635	**3104**
6	Mukki	2010	1069	948	648	688	268	1326	**6957**
	Total:	**4176**	**2335**	**2771**	**2652**	**2805**	**1170**	**4620**	**20529**

Source: Kanha Tiger Reserve (2021)

Kanha Tiger Reserve, Mandla (MP) 481 661, Phone: 07642-250760 (O), Fax: 07642-251266, Email: fdknp.mdl@mp.gov.in

Table-45: Results of Enumeration Sal Borer Infested Trees (2014)

Sl. No.	Range	Forest Area	Sal Area	No. of Affected Trees	Affected Trees /Ha. (Sal Area)
1	**2**	**3**	**4**	**5**	**6**
1	Kisli	13895.58	4022.16	1441	0.36
2	Kanha	12166.83	4495.65	4902	1.09
3	Sarhi	13830.88	1952.55	2061	1.06
4	Mukki	13021.4	7304.16	8721	1.19
5	Bhaisanghat	15570.55	3228.21	8227	2.55
6	Supkhar	21266.37	11866.70	5801	0.49
	Total:	**89751.61**	**32869.43**	**31153**	

Source: Kanha Tiger Reserve (2021)

Table-46: Girth-wise Sal Borer Infested Trees (2014)

Sl. No.	Range	***Girth-wise Sal Borer Affected Trees***							
		31/45	**46/60**	**61/90**	**91/120**	**121/150**	**151/180**	**> 180**	**Total**
1	Kisli	179	156	140	198	308	132	328	**1441**
2	Kanha	788	703	1363	256	791	74	927	**4902**
3	Sarhi	253	358	396	215	311	41	487	**2061**
4	Bhaisanghat	1356	737	1119	1050	1550	301	2114	**8227**
5	Supkhar	1311	697	821	697	797	398	1080	**5801**
6	Mukki	1472	1084	1282	936	1228	223	2496	**8721**
	Total:	**5359**	**3735**	**5121**	**3352**	**4985**	**1169**	**7432**	**31153**

Source: Kanha Tiger Reserve (2021)

Table-47: Results of Enumeration Sal Borer Infested Trees (2015)

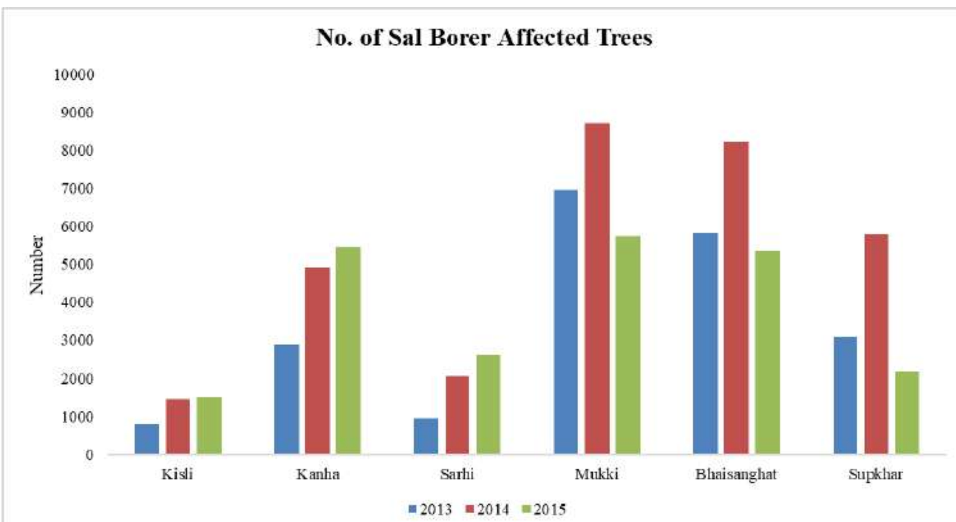
Sl. No.	Range	Forest Area	Sal Area	No. of Affected Trees	Affected Trees /Ha. (Sal Area)
1	**2**	**3**	**4**	**5**	**6**
1	Kisli	13895.58	4022.16	1503	0.37
2	Kanha	12166.83	4495.65	5453	1.21
3	Sarhi	13830.88	1952.55	2619	1.34
4	Mukki	13021.4	7304.16	5758	0.79
5	Bhaisanghat	15570.55	3228.21	5342	1.66
6	Supkhar	21266.37	11866.71	2160	0.18
	Total:	**89751.61**	**32869.44**	**22835**	

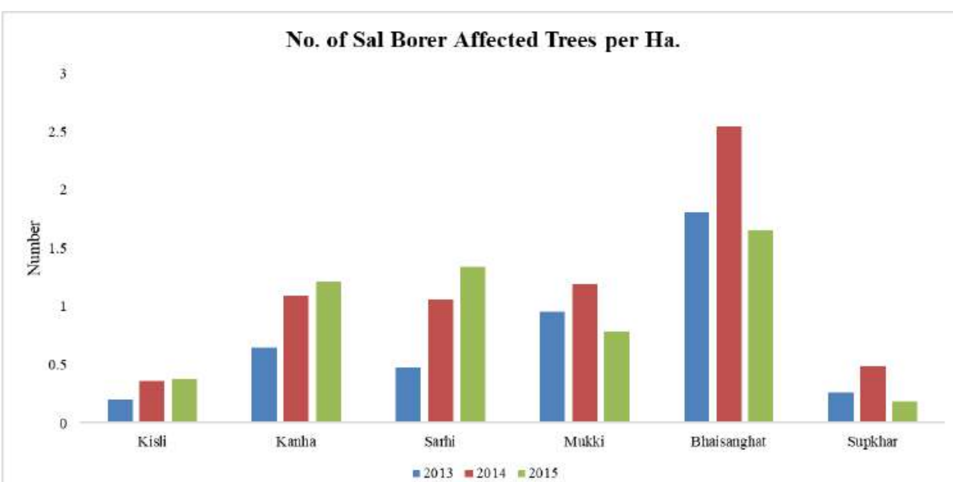
Source: Kanha Tiger Reserve (2021)

Table-48: Girth-wise Sal Borer Infested Trees (2015)

Sl. No.	Range	*Girth-wise Sal Borer Affected Trees*								No. of Last Year's Affected Trees Now Alive	No. of New Trees Affected this Year
		31/ 45	46/ 60	61/ 90	91/ 120	121/ 150	151/ 180	> 180	Total		
1	2	3	4	5	6	7	8	9	10	11	12
1	Kisli	191	172	194	165	234	206	341	**1503**	683	1291
2	Kanha	538	384	853	621	989	123	1945	**5453**	1604	-
3	Sarhi	347	192	242	288	291	109	1150	**2619**	-	-
4	Bhaisanghat	817	498	879	429	948	206	1565	**5342**	-	-
5	Supkhar	342	254	268	247	331	150	568	**2160**	2537	-
6	Mukki	795	483	761	629	806	216	2068	**5758**	2133	5758
	Total:	**3030**	**1983**	**3197**	**2379**	**3599**	**1010**	**7637**	**22835**	**6957**	**7049**

Source: Kanha Tiger Reserve (2021)





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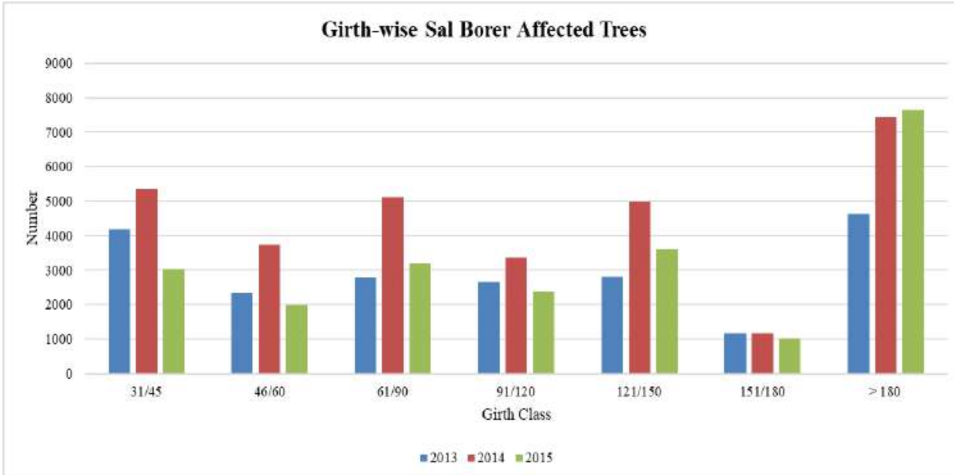

As per available information, the epidemic level of sal borer infestation has been fixed at 2.5 trees per ha. by entomologists. As infestation at Kanha was found below the epidemic level, no prevention measures needed to be taken.

4.18.2 **Other Pathological Problems:** Though in the recent decades, no serious epidemic affecting wildlife has been reported in and around the protected area, history does reveal some serious outbreaks. Mehta (1949-50) has referred to old documents and mentioned ill-fed and unhygienically kept cattle causing rinderpest and foot-and-mouth disease, with the consequent heavy mortality of forest animals. He has also written about a virulent epidemic of rinderpest that occurred in the Banjar range in 1925-26, killing large herds of bison and barasingha.

The disease again broke out in the protected area in 1976, and killed 52 gaur, 8 sambar and 35 chital. (Parihar and Kotwal, 1989; Gopal and Shukla, 2001). The small population of barasingha, confined only to several small habitat-pockets, however, remained unaffected. Rinderpest has now been eradicated completely from both livestock and wildlife in the world (WOAH, 2011).

Brander (1923) has noted that the barasingha are far more immune and suffer less casualties from rinderpest and foot and mouth disease than do sambar or bison.

Schaller (1967) has attributed low fawning rate to abortion of fetuses due to brucellosis, a bacterial disease. It was, however, later proven wrong (Panwar, 1991). Schaller (1967) has also pointed out that the drastic decline in the barasingha population might have caused by disease and predation. He has mentioned two species of pathogenic trematode parasites (*Paramphistomum gotoi* Fukui, and *Gastrothylax crumenifer* Creplin) in the rumen of the deer. These pathogens are responsible for causing paramphistomiasis and acute anaemia, serious diseases, in cattle.

Martin (1978) has, however, recorded that diseases were not really relevant to the decline in hard ground barasingha population, and external abnormalities were seldom discernible. The current management practices and the cervids' response to them has now established that no disease but only poaching and habitat loss were responsible for population decline. On the other hand, a lack of viable habitat, human interference, cattle influx, lack of fawning sites and the like contributed much to the population decline in the past. Gopal (1995) has pointed out that the presence of ectoparasites (*Haemaphysalis bispinosa* and *Lipoptena axis*) and endoparasites (Amphistome group) in the body of this species, as indicated earlier, may further aggravate the body condition of debilitated animals.

Several diseases/ infections have been reported in barasingha. Veterinarians suggest that infectious and parasitic diseases may also become one of the major factors for decline in its population. The occurrence of *Sarcocystis* spp., causing abortion in animals, has been reported in barasingha (Shrivastav et al., 1997).

Many post-mortem examinations of different barasingha carcasses have been conducted by the wildlife veterinarian, veterinary surgeons of the state veterinary department and Wildlife Disease Diagnostics and Research Centre, Jabalpur. These examinations have revealed moderate to severe ecto and endoparasitic infestations in all the carcasses. Amphistomes were found attached to the inside wall of rumen mucosa, and other parasites like *Haemonchus contortus* on the abomasum wall of barasingha stomach. The infestation of ectoparasite like fleas, ticks, and mites were also reported more or less in all barasingha carcasses. The symptoms of moderate to severe anaemia, weakness, slow movement, rough body coat, alopecia, were reported specially in the sick animals of the barasingha enclosure at Kanha in the past. The enclosure population was found more susceptible to parasitic load as compared to free-ranging population.

Faecal samples of different barasingha populations in the protected area were also collected and examined. They revealed different types of parasitic infestations more or less in all populations. This is very important to conduct epidemiological study of different bacterial, viral and mycotic infections for long term conservation, and to understand ecological interaction between barasingha population and pathogenic agents. It is also important to conduct a complete health investigation profile which should include complete haematology, serology and immunology for randomly selected animals from different populations. No case of mass mortality has ever been reported so far. Only sporadic cases of mortality have been reported in old barasingha due to chronic parasitic infestation leading to immune suppression, anaemia and death.

Cases of tiger predation and infighting between two dominant males have been reported in free-ranging barasingha population. In such cases, post-mortem examinations have shown different types of lesions, suggesting carnivore predation and perforation injury caused by antlers of dominant males during infighting. The post-mortems of new-borns revealed starvation due to separation from mother. Such small fawns had empty stomachs and intestine, with lesions, more or less congestion, and haemorrhages in vital organs.

Tiwari et al. (2007) conducted a study on parasite prevalence in the Kanha tiger reserve and reported parasitic load of strongyles group of nematodes, amphistomes, strongyloides, trichuris, *Moniezia expansa*, coccidia and *Moniezia benedeni* in the hard ground barasingha.

Wildlife health monitoring and disease diagnosis is an essential component of conservation of wild fauna. Since wildlife health management is a new discipline in our country, not much work has been carried out on health management of this species. Therefore, the establishment of a database for forecasting the diseases by performing epizootiological studies throughout the year in and around protected areas is the need of the hour.

4.19 Management Effectiveness Evaluation of Kanha:

The Management Effectiveness Evaluation (MEE) process is a framework to evaluate the performance of protected areas. This is the assessment of how well protected areas such as national parks, wildlife sanctuaries, conservation reserves, community reserves and tiger reserves are being managed and their effectiveness in conserving target flora and fauna. Under this evaluation each tiger reserve is evaluated on the basis of a number of assessment criteria. The tiger reserve management has to respond to each of this criteria in a prescribed written format. Later, a team consisting of several senior forest officers, scientists and NGIs visit the tiger reserve and discuss responses in detail with the management and make inspections in the field. Kanha has also been evaluated in four cycles and its MEE ratings are as under:

Table-49: Four Cycles MEE Ratings

Sl. No.	Kanha Tiger Reserve	2006	2010	2014	2018
1	**2**	**3**	**4**	**5**	**6**
1	Rating	Very good	Very good	Very good	Very good
2	Score Percentage	89.73%	85.00%	87.90%	92.97%

Source: NTCA, New Delhi (2021)

4.19.1 **Actions on the MEE Report:** The Kanha management has already taken initiatives on the recommendations (actionable points) of the MEE, 2018. The action taken is as under:

- The recommended sniffer dog squad has been setup at Khatia.
- Presently, there are no serious gaps in the positions of mid-level officers.
- Most of the recommendations of the security audit have been implemented.
- The Kanha management has been persistent in ensuring effective coordination with the electricity department and district administrations for the protection of wild animals.
- The corridor plan is already in place, and the required management practices are being carried out through concerned territorial divisions depending upon budget allocations. Several NGOs have also collaborated with the Kanha management to take up select initiatives in the corridor areas.
- Matters relating to proliferation of resorts around the core zone have been discussed at meetings of LAC, and presently there is control over the building of new resorts.
- The use of fuel-wood by resorts is strictly restricted.
- Ecodevelopment interventions have been strengthened in the buffer zone.
- The ESZ notification relating to Kanha National Park and Phen Wildlife Sanctuary has been issued by the Govt. of India.
- Efforts are made to ensure timely release of funds from state treasury for implementation of managerial activities.

4.20 Conservation Assured Tiger Standards CA|TS of Kanha:

Under the IUCN (International Union for Conservation of Nature and Natural Resources, Switzerland) Green List Concept, tiger experts evolved CA|TS or Conservation Assured |Tiger Standards a few years back. This has now become an important conservation tool setting minimum standards for evaluation of management of tigers. This evaluation concept is based on the fact that presently only a very few tiger conservation areas are effective safe havens for tigers, and there has been progressive decline in tiger populations in most of the tiger range-countries. The Conservation Assured | Tiger Standards (CA|TS) evaluation scheme provides an incentive to those responsible for tiger

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conservation areas in the 13 tiger range countries to improve the effectiveness of management.

The Global Tiger Forum-India, New Delhi and WWF-India are working closely with the IUCN Green List of PAs to evaluate protected areas for these minimum standards of tiger conservation and to implement measures for long-term effective conservation. The CA|TS is a set of 7 pillars and 17 criteria that help assess tiger areas to ascertain if the current management will lead to successful tiger conservation. It is not a new management effectiveness system or a ranking of tiger conservation areas; but rather provides the means to tell if a particular area attains the minimum standards needed to conserve tigers. Tiger conservation areas taking part in the system will be recorded as either Registered (but standard not yet attained) or as Approved (achieving the standards as verified through an assessment and independent review process); excellence would be expressed in terms of highlighting specific best practices. Whether tiger conservation areas meet the criteria is based on a process which starts with self-assessment, progresses through a system of national assessment and is finally approved by an international committee, which ensures equivalence across tiger range countries.

CA|TS provides an opportunity for individual tiger conservation areas to demonstrate their commitment to, and success in, protecting tigers. It is a voluntary, independent scheme for any area involved in tiger conservation. CA|TS has been extensively field-tested and subjected to expert peer review. It is expected that the CA|TS will be reviewed every few years as best practice standards evolve and are refined.

In the year 2021, Kanha tiger reserve was also among a number of protected areas in India evaluated under this system, and was approved as meeting all the requirements of the CA|TS standards.

4.21 Research & Training:

4.21.1 **Research:** Effective decisions about resource use and manipulation depend upon the results of quality research. There is now growing acceptance that ignorance of science, like ignorance of law is, an unjustifiable excuse for environmental abuse.

A strong research arm of wildlife wing is necessary for guiding a programme of scientific, rational wildlife resource management. Research is one of the major issues in the plan outline of the Project Tiger document, 1972, and is recognized as one of the most important components. The Document envisaged that the scientific staff of the reserves would undertake basic research programmes aimed at evaluating systematic factors and influences, for devising pragmatic management practices to cover specific populations and the entire ecosystems. Research based wildlife management is crucial for the success of any tiger reserve.

Research and monitoring programs can provide essential information that will allow conservation objectives to be accomplished. Wildlife research is essential to the understanding of an ecosystem and its components. Responsible decisions, required in the backdrop of current biotic pressure and general degradation of habitat, depend upon the results of quality research. Research functions only when its results/ findings are brought together into the decision-making processes. This is, actually, an idea, a process and a programme, and it cannot provide solutions overnight, nor can it be conducted on personal whims. At present, when there are so many limiting and adverse factors affecting our wilds, species and site-specific and eco-system specific researches have become all the more relevant and a very reliable aspect for effective decision making on issues of conservation.

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 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”.

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 management. As a follow-up of the recommendations of the Tiger Task Force constituted in 2006, the govt. of India also set up a committee to formulate guidelines for scientific research in tiger reserves.

The protected area has gradually progressed into a study centre for national and international wildlife researchers, and has 9 Ph.Ds. 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 (1963-1965):** Ecology of the Tiger and Ungulate Species.
- **Claude Martin (1971-1973):** Status and Ecology of the Barasingha in Kanha National Park.
- **RK Pandey (1980-1982):** Ecological Studies on Grasslands of Kanha National Park with Reference to Wildlife Management.
- **Paul Newton (1980-1983):** Ecology and Social Organization of Hanuman Langurs in Kanha Tiger Reserve, Central Indian Highlands.
- **PC Kotwal (1985-1987):** Ecological Studies on Evaluation of Certain Wildlife Habitats & their Utilization by Major Mammals in Kanha National Park.
- **Rajesh Gopal (1993-95):** Biology & Ecology of the Hard Ground Barasingha in Kanha National Park.
- **HS Negi (2001-2003):** 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 (2005-2007):** Evaluation of Habitat for Conserving the Barasingha 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 appendicular 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-11)**.
- 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).
- 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.

4.21.2 **Training:** As 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 old employees 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 Kanha 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–12)**.

4.22 **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-13)**.

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.

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

4.22.2 **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 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, February, 2010, January, 2014; and February, 2018, 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.

Presently, Phase-IV monitoring in high winter and summer, camera trapping, and the traditional block count censes for ungulates in the 1st/ 2nd week of July are conducted for estimating wildlife population in the core zone.

4.23 Administrative Setup:

As stated above, the core zone and the buffer zone are under the unified control of the Field Director. The core zone along with the national park is in charge of a Deputy 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 core zone are appended **(Appendix-14)**.

4.24 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 consistently making efforts to develop a very effective communication network. Presently, this network consists of a sufficient number of fixed and mobile wireless sets, and Android mobiles. While fixed and mobile wireless sets are installed all over the core zone, mobile SIMs (Closed User Group) have been allotted to all the officers and some select frontline personnel. Besides, Android mobiles have been allotted to beat guards. The Kanha 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. Furthermore, 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-15),** the strength of communication network is as under:

Table-50: Strength of Communication Network

Sl. No.	Type of Wireless Set	No.
1	**2**	**3**
1	Fixed Set (Base Station)	110
2	Hand Set (Walky-Talky)	254
3	Mobile (Vehicle)	15
	Total:	**379**

Source: Kanha Tiger Reserve (2021)

Table-51: Android Mobile & Mobile SIM Information

Sl. No.	Particulars	No.
1	Android Mobile for M-STrIPES Patrolling	185
2	Android Mobile for Tourism	80
3	Mobile SIM	63
	Total:	**328**

Source: Kanha Tiger Reserve (2021)

4.25 General Issues & Problems:

The 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 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:

4.25.1 **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.

4.25.2 **Relocation History:** While the last relocations of Jholar, Sukdi and Linga forest villages from the core zone were carried out under Option-I, and was totally transparent and hassle-free, people of forest villages relocated in the past, specially before 2010, nurture animosity towards the Kanha management. When these forest villages were relocated, there was no such option for any monetary incentive. Therefore, now these villagers feel that they were short-changed and moved out of the core zone. This relocation history also requires tremendous efforts on the part of the Kanha management for credibility building.

4.25.3 **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.

4.25.4 **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 Kanha management will do everything for wildlife at their expense.

4.25.5 **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.

4.25.6 **Human Population & Growth:** There are still 8 forest villages in the national park (technically outside the core zone), and the populations also affect the core zone to some extent. Besides, there are many forest and revenue villages in the buffer zone just outside the core zone, forming a significant impact zone. This population also undergoes the typical Indian decadal demographic growth.

4.25.7 **Livestock Population & Growth:** There are around 3,900 cattle heads in the national park showing the usual population growth and defective animal husbandry practices.

CHAPTER – 5

LAND USE PATTERNS & CONSERVATION MANAGEMENT ISSUES

5.1 Land Use in a Protected Area:

In a protected area, land cover generally refers to all classes of physical material/ substance covering the ground surface. These observed physical cover include human constructions, man-made water resources, agricultural fields, natural and planted vegetation, bare ground and rocks etc. The cover can also be observed and classified through remote sensing.

Land use in a larger context may also refer to the economic objective for which a particular land area is systematically manipulated. In this way, a notified protected area, or for that matter an outdoor recreational area, is also an example of a land use. Agriculture and grassland for given objectives are also such examples. There could also, however, be several land uses within a protected area itself. These land uses are actually a series of a wide range of operations on land, carried out by the Kanha management with the intention to obtain certain objectives through the use of land resources.

Land use classification, with Kanha as a case in point, is actually a systematic categorization providing information on land cover, and the types of human activity involved in land use. Land use classification in this context can be defined as the arrangements, activities and inputs the Kanha management undertakes in a certain land cover type to produce, change or maintain it. In this way, land cover and land use are related but different terms, and the definition of land use establishes a direct link between land cover and the activities of the Kanha management in the 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 forests, grasslands and water constitute the major natural 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. While currently there is no forest village/ human settlement inside the core zone, artificial water bodies **(Appendix-16)** and natural rivers and streams **(Appendix-17)** along with all types of government buildings **(Appendix-18)** may also be technically classified as land use classes in the core zone.

Experts believe that land use change in protected areas can also affect their effective size and limit their ability to conserve biodiversity, as land use change alters ecological processes and the ability of organisms to move freely even within a protected area itself. Though the core zone supports a number of land use classes, they are directly or indirectly support biodiversity conservation in general and tiger conservation in particular.

In this way, the entire landscape of the core zone can be classified into the following land use classes:

- **Forest:** Mainly sal and mixed forests are distributed under several vegetal cover types over different physiographic features of the core zone.

- **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.

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

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

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

- **Forest Roads:** The core zone has a large network of forest roads to facilitate regular vehicular patrolling, tourism and general vehicular activity for management purposes.

- **Forest Villages:** The settlements of 8 forest villages, located outside the CTH but within the national park, consist of houses, cowsheds, barns and other temporary structures.

  Presently, these forest villages are located just outside the notified critical tiger habitat but inside the national park. As per the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, the critical tiger habitat needs to be determined and notified as Critical Wildlife Habitat (CWH), an inviolate area for the purpose of wildlife conservation, on the basis of scientific and objective criteria. The majority of the villagers (almost 92%) belong to the Scheduled Tribe, mainly the Gond and the Baiga. Given the background and constraints of these forest villages, they are all socially backward and 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 Madhya Pradesh Forest Village Rules of 1977, for marginal cultivation as their main livelihood. All these cultivable lands depend essentially on rains and produce marginal crops. In spite of basic irrigation facilities, a failed monsoon or erratic rains, however, 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 Kanha management has no plan to relocate these villages located at the periphery of the CTH. The information on the forest villages of Kanha national park is as under:

Table-52: Information on the Forest Villages

Sl. No.	Range	Forest Village	No. of Families	Total Population	Cattle Population	Land (In ha.)
1	**2**	**3**	**4**	**5**	**6**	**7**
1	Sarhi	Bhilwani Cluster	523	2267	1678	562.010
2	Sarhi	Jhapul	63	411	372	294.611
3	Bhaisanghat	Dhaniajhor	66	295	369	195.612
4	Bhaisanghat	Kadla	91	545	291	185.747
5	Supkhar	Patua	143	920	597	281.969
6	Supkhar	Chhatarpur	117	578	357	143.662
7	Supkhar	Janglikheda	42	263	186	53.002
8	Mukki	Mukki	137	816	679	277.612
	Total:		**1182**	**6095**	**4529**	**1994.225**

Source: Kanha Tiger Reserve (2021)

- **Resource Dependence of Villages:** The last village was relocated from the CTH in 2016. Until then, the presence of forest villages, with the typical anthropogenic components of humans, cattle, agriculture, and a number of human induced activity, also formed a land use class in the protected area. Now, with no forest village inside the CTH, this land use form has technically ceased to exists therein.

The national park with 8 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 Kanha 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 produce, including mahua, aonla, tendu and mahul leaves, and 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 peripheral 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, at least near the periphery areas of the core zone.

5.3 Human-Wildlife Conflicts:

Human-animal conflicts do occur in the tiger reserve. While the number of such cases in the core zone are naturally not high during the past years, it is an issue the Kanha management never disregards, and takes swift action to control situations arising out of such incidents. As stated above, villages in the tiger reserve 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 prey, 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 retaliatory killings of wildlife by poisoning, snaring and trapping etc.

The Kanha management ensures to caution villagers repeatedly through ecodevelopment committees, public announcements (*munadis*) and frontline staff not to venture into the protected area for grazing, fuel wood and MFP collection, as the core zone is inviolable under the Wildlife (Protection) Act, 1972. They are also advised to exercise utmost precautions while going inside the forests of the buffer zone. The Kanha management also ensures to spread awareness to this effect through distribution of pamphlets in the villages so that such instances of man-animal conflicts may be kept at minimum.

The Kanha management has also constituted a well-equipped wildlife rescue squad to handle problematic animals in and around villages to reduce human-animal conflicts. An Assistant Conservator of Forests heads this Squad, with the wildlife veterinarian and some other field personnel as members. The wildlife rescue squad has been trained by resource persons/ professionals at the Van Vihar national park, Bhopal. The Squad is well-equipped with all the necessary vehicles, rescue instruments, medicines, cages and other required accessories. The Kanha management has acquired so much experience over the years that other states also request to train their staff in this discipline. A few years back, the Kanha management also conducted a Training-Cum-Workshop on the Restraining, Capture & Rehabilitation of Wild Animals for the Odisha Forest Department Officials.

Though the Kanha management has to face the ire of villagers and local public representatives whenever any such human-animal conflict occurs, it tries to mollify the aggrieved family/ injured persons by getting them treated in hospitals and paying them prescribed compensations as soon as possible. These payments are monitored under the Madhya Pradesh Public Service Guarantee Act, 2010. Besides, some prominent NGOs such as WWF-India and The Corbett Foundation also sometimes partially compensate for cattle kills so that the same are not disturbed/ poisoned.

The Kanha management has always been on good terms with the revenue and police departments of the Mandla and Balaghat districts, but so far no human-animal conflict has created any unmanageable/ uncontrollable problem for the management.

5.4 Assessments of Inputs of Line Agencies/ Other Departments:

The Kanha 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:

- **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 Kanha management also work in close cooperation during the visits of state guests and VIPs.
- **Police Department:** The police also lend full support at the request of the Kanha 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 Kanha management and police department.
- **District Rural Development Agency (DRDA):** Sometimes the Kanha management 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. The core zone also received funds from the DRDA, Mandla in

the past for wildlife and fire protection under the Mahatma Gandhi National Rural Employment Guarantee Act.

- **Health Department:** The core zone has remotely located patrolling camps with staff and eight forest villages with a population of 6095 people. The Kanha management also regards itself responsible for dealing with health related issues of its staff and villagers. At the request of the Kanha management, the Mandla and Balaghat district health departments have to play an important role to organize health camps in various places to treat staff and villagers. Besides, they 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 all the personnel deployed in the field.
- **Veterinary Department:** The Mandla and Balaghat district veterinary departments play an important role in the vaccination/ immunization of the cattle of the forest villages located outside and close to the periphery of the protected area. Besides, in emergencies, the veterinarians also conduct postmortems on wild animals. District veterinarians support the Kanha management at the time of the outbreak of any infectious disease in the livestock of any forest village around the protected area.

5.5 Conservation Management Issues:

Having been a notified protected area since 1955, and been managed as a national park/ core zone since 1973, Kanha has had to deal with several major conservation management issues over all these years. Experience, gradual professional expertise and planning, and adequate fund flows, however, have helped the Kanha management settle most of these issues to a large extent. As a protected area can never reach a fully secure and issueless status in the typical Indian scenario of biotic pressure surrounding it, Kanha still has the following conservation management issues:

- Barasingha conservation
- Tiger conservation
- Habitat management

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CHAPTER – 6

GRASSLAND HABITAT

6.1 Background:

Grasslands, regarded as highly dynamic ecosystems, include almost all semi-natural pasturelands, large clearings, and steppe or unforested grassy expanses dominated and co-dominated by graminoid vegetation i.e. grass and grass like plants of the family Poacae, including sedges of Cyperaceae and rushes of Juncaceae. Grasslands are said to have co-evolved with grazing ungulates, and provide a wide range of ecosystem services. Although grasses possess a wide ecological amplitude and a number of adaptations to withstand nature's vagaries, these plants also have to severely compete with woody species for light and nutrients.

Unlike natural grasslands such as the steppes of eastern Europe and central Asia, Pampas of south America, the prairies of north America, the savannahs/ velds of South Africa, and the Puszta of Hungary, which are "climatic climax", with grass species as their climax vegetation, the Kanha grasslands, and for that matter most grasslands in India, are "plagioclimax", with human-induced stage of arrested ecological succession, and are regarded as anthropogenic.

Bor (1960) stated that the climate of India is either a forest-climate or a desert-climate. He pointed out that Indian grasslands can be controlled under the influence of fire and grazing and the term biotic-climax can be safely applied for them. Many experts have concluded that grasslands of India are man-made, distributed in extensive patches all through the country. Such grasslands are controlled by biotic factors and represent dis-climax of the area.

There are, however, the Bugyal, or alpine grasslands, of Uttarakhand, the Terai belt of grassland, the Banni of Gujarat and the Shola of south India, which are considered semi-natural, all grasslands in the country are man-made. Rangnathan (1938) believes that the grasslands of the Nilgiri plateau are the climatic climax of community of the region.

6.2 Grasslands & Forest Edges:

Grasslands form around 11% of the total area of the core zone. This is the most important habitat type, as far as the survival of barasingha and thousands of ungulates of different species are concerned. Most prime grasslands of Kanha are actually sites of relocate villages. Relocated villages and abandoned agriculture fields, reintegrated as grasslands into surrounding wildlife habitats, are generally nutrient rich sites. They are, however, specially prone to invasion by brushwood species and easily transform into woodlands with unpalatable shrubs and herbs. As already stated, Kanha’s grasslands are anthropogenic in nature, and some clearings within woodlands are basically frost hollows. In this sense, Kanha’s grasslands are a case in point.

Some of the main anthropogenic activities in Indian context are lopping, burning, grazing, and farming etc. Besides, climatic conditions, including low rainfall, droughts and thin soils, that govern a natural grassland ecosystem are markedly different from those that control artificial or man-made grasslands in the country. Coupland (1979), however, defined semi-natural grasslands as deforested areas in regions of forest climate that are held in relatively stable condition by various natural and man-induced means, such as flooding, mowing, grazing and other treatments that prevent reinvasion of natural forests.

The tiger reserve lies in a dry deciduous zone, and until around the 1950s of the last century, the protected area used to receive a typical average annual rainfall of those times. The heterogeneous grasslands had a good moisture regime and they also supported tall grass species. The Kanha national park, though had a small area, was already existent with initial basic protection measures. The ungulate population was not large, and grazing pressure on grasslands within the park was low. The barasingha population was declining, and these grasslands formed the mainstay of ungulate species, including the hard ground barasingha for whose fawning and ultimate survival, tall grass played a very important role.

From the management point of view, the grasslands of the core zone can be classified into: **Hygrophilous:** wet savannahs adapted to wet soils. They include low-lying wet grasslands, semi-aquatic areas with sedge meadows, with some important species such as *Saccharum spontaneum*, *Themeda triandra*, and *Bothrichloa odorata* etc; **Mesophilous:** extensive grassy plains or grassy flats. These are the valleys and slopes (wooded grasslands with moderate humidity) away from streams, with species like *Eragrostis uniloides*, *Ischaemum indicum*, *Rottboelia perforata*, and *Saccharum spontaneum* etc; **Mesic:** with good supply of moisture. They are generally valley grasslands, including some relocated village sites, with *Saccharum spontaneum*, *Themeda triandra*, and *Heteropogon contortus* etc.; and **Plateau:** with shallow soil and sparse tree growth, with *Heteropogon contortus*, *Themeda triandra*, *Dimeria ornithopoda*, and *Themeda quadrivalvis* etc. All these grasslands differ in composition, geo-hydrological requirements and successional trends.

In the past, these grasslands were mainly managed under "fire protection" measures to minimize fire hazards in the summer. As an accepted norm, prescribed by the forest department, the grasslands were regularly cool-burnt in December-January. The already frost-dried grass burnt well in winter, and the soil had enough moisture to help the rhizomes produce green shoots soon after cool burns. Besides, frequent wanton fires also gave rise to this phenomenon. This resulted in grasslands attracting a large number of ungulates, and the grazing pressure on these burnt grasslands continued until the next rains. This protracted grazing resulted in sapped rhizome vigour due to nonstop production of green shoots without allowing them to grow fully and rebuild the rhizome through photosynthesis. Eventually, this fire protection practice gradually caused the more palatable perennials to disappear from the central meadows under the heavy 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 (Panwar, 1973; Negi and Shukla, 2011).

While the barasingha population was reviving under special conservation measures in the early Seventies, the national park was also included in Project Tiger during this time. During the late Seventies and early Eighties, grassland management was essentially guided by the sole objectives of increasing and propagating barasingha population and building a good prey base for tigers and co-predators. Gradual strengthening of protection measures also ensured an increase in ungulate population, which in turn increased grazing pressure on these meadows. All the above factors had a cumulative negative effect on grasslands, and regression and degradation gradually set in. Besides, erratic annual average rainfalls in later years and grazing pressure of increasing ungulate population, coupled with low moisture regime, only added to this situation. Further, the barasingha and chital are sympatric cervids, and compete for the overlapping food resources in open grasslands. In sympatry, the difference between closely related species usually increase (diverge) when they occur together, in process called character displacement, which may be morphological or ecological (Allaby, 1985). Chital, because of a large population, outcompeted barasingha, which is stenoecious with a narrow niche. By this time the barasingha, who preferred tall grass for its parturition, and avoided sympatric competition with the chital, had abandoned the central grasslands of Kanha for more conducive ones, specially Sonf.

It is now common knowledge that overgrazing is responsible for grassland degradation. In the initial stages of grazing pressure, the more palatable plant species, annuals and perennials, are reduced or eliminated, and are replaced by less palatable species. Besides, invasive and hardy species from adjoining ecosystems also encroach into grasslands. Dry areas, however, bear most of the grazing pressures in low rainfall years, with palatable perennials prone to being 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 almost nothing. Low rainfall also affects the soil surface, once protected by perennial grass, exposing it to erosion. Degradation continues in this way, with less plant growth, increasing grazing pressure and signs of erosion.

Anthropogenic history, successional intricacies, old burning practices and chronic grazing pressure, and climatic changes have all contributed to the degradation of grasslands. Many prime grasslands have turned regressive over the years. Large chunks of once fine grasslands have been invaded by *Desmostachya bipinnata*, locally known as *Kush* grass, with serrated leaves and low palatability. A very hardy species, and a great survivor, its roots may go very deep to meet the sub-soil water. Some *Aristida* species have also infested large areas of the central meadows. An indicator of degraded soil and fire prone areas, the dwarf palm, *Phoenix acaulis*, has also encroached into many parts of important grasslands and forest edges. Many forest edges have also been colonized by *Colebrookia oppositifolia* and *Pogostemon benghalensis*. The latter is also encroaching into several grasslands. Needless to add, such colonization reduces forest edges and replaces more favourable species for wildlife. 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.

Understandably, many annual and perennial weed and unpalatable species also occur in these grasslands. *Lantana camara*, *Cassia tora*, *Parthenium hysterophorus*, *Ageratum conyzoides*, *Desmodium heterocarpon*, *Vernonia divergens*, *Petalidum barleriodies*, *Plactranthus incanus*, *Achyranthes aspera*, *Acanthospermum hispidum*, *Sida spinosa, Corchorus trilocularis*, *Argemone mexicana*, *Pogostemon plactenthroides* and *Bidense bidermata* etc. are only a few of them.

Further, the Kanha meadows are also under an arrested stage of ecological succession due to past anthropogenic interventions such as felling, fire and grazing etc. Consequently, gregarious hardy woody species such as *Butea monosperma*, *Lagerstroemia parviflora, Bombax ceiba, Cassia fistula, Cordia myxa,* and *Diospyros melanoxylon* and *Flemingia spp.* etc. also encroach upon these grasslands. The seedlings of these woodland species appear in the grasslands as small patches, and gradually grow in size and area to create favourable conditions for other species to invade the grasslands. Brander (1923) described some areas of the present core zone as grasslands with large herds of barasingha. They have, however, now disappeared because of woody species. 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 and needs to be taken care of.

Pandey (1982) identified 16 vegetation communities in these grasslands. Later studies suggested about structural changes in these grasslands (Pandey, 1982; Gopal and Shukla, 2001; Pandey and Hardaha, 2007). The above studies suggest that burning and grazing in the grassland habitat were 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. Regressive trends 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.

6.3 Assessment of Range Conditions:

In the winter of 2011, the Kanha management organized an international workshop on grassland management. As a precursory exercise for this event, a rapid and broad assessment was made to interpret range conditions by grouping some of the main grass and herbaceous species into ecological categories or classes (Chauhan and Shukla, 2011). These vegetal species are classified into three groups, as follows:

Decreaser Species (D): Grass & herbaceous species that decrease when grassland is under or overgrazed:

Acrocephalus indicus, Alysicarpus bupleurifolius, Apluda mutica, Apluda varia, Arthraxon quartinianus, Bothriochloa glabra, Bothriochloa odorata, Bothriochloa pertusa, Cassia pumila, Chrysopogon fulvus, Cynodon dactylon, Desmodium triflorum, Dichanthium annualatum, Digitaria abludens, Digitaria stricta, Echinochloa colonum, *Flemingia bracteata, Heteropogon contortus, Iseilema laxum, Panicum montanum, Themeda quadrivalvis, Themeda triandra.*

Increaser I Species (I): Grass & herbaceous species that increase when grassland is under or selectively grazed:

When the grasslands in the national park are under or selectively grazed, some of the main increaser species (I) encountered are as under:

Arthraxon lancifolius, Arthraxon quartinianus, Bothriochloa odorata, Bothriochloa pertusa, *Cyperus pilosus, Cyperus iria, Dimeria ornithopoda, Dichanthium annulatum*, *Heteropogon contortus, Imperata cylindrica, Kyllinga triceps, Sacciolepis indica, Setaria glauca, Themeda triandra, Ageratum conyzoides, Smithia conferta, Coix lacryma, Eragrostris viscose, Hemarthria compressa, Sorghum nitidum, Ageratum conyzoides, Justicia simplex, Lepidagathis cristata, Phyllanthus amarus, Swertia angustifolia, Saccharum spontaneum, Ziziphus nummularia.*

Increaser II Species (II): Grass & herbaceous species that increase when grassland is overgrazed.

When the grasslands in the national park are overgrazed, some of the main increaser species (II) encountered are as under:

Achyranthes aspera, Ageratum conyzoides, Aristida adscensionis, Aristida setacea, Biophytum sensitivum, Cassia tora, Desmostachya bipinnata, Desmodium gangeticum, Desmodium heterocarpon, Dimeria connivens, Dimeria ornithopoda, Elephantopus scaber, Euphorbia hirta, Euphorbia heterophylla, Eragrostis tenella, Imperata cylindrica, Kyllinga monocephala, Pennisetum hohenackeri, Pseudosorghum fasciculare, Lantana camara, Pogostemon benghalensis, Plactranthes incanus, Setaria glauca, Sida cordata, Sida alba, Sida acuta, Sida spinosa.

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6.4 Reclaimed Grassland Habitat:

Until the Sixties of the last century, the core zone used to be a typical part of the physiography of the central Indian highlands, with rolling slopes, undulations and plains, was forested with excellent sal and miscellaneous woodlands along with densely foliaged large bamboo clumps as understory, and thick herbaceous and shrubby undergrowth. The woodlands were also interspersed with heterogeneous grassy plains and large clearings, with occasional tree groves. Nestled in this primeval, pristine landscape were also several forest villages. These habitations, with an aboriginal, harmonious, and nature-friendly way of living, perfectly blended with the wilderness. And little seemed environmentally amiss at that time.

Gradually, however, villagers' access to the nearby forests for their needs and demands of grass, fuel wood, timber and a wide range of miner forest produce grew substantial. The hunting of wild animals in the tract became 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. The hard ground barasingha was the species that suffered most in this background and its population declined sharply in its habitats.

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 (Panwar, 1991). 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 tranquil zone for the protection and propagation of wildlife. Acting upon this guideline, the Kanha 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 villages. Under a comprehensive relocation plan, 12 villages were moved out of the national park by June, 1976 (Panwar, 1991). Village relocation continued, and more and more abandoned village land got integrated into the surrounding wildlife habitat, and by

1982, a total of 26 forest villages had been moved out. The relocation programme, however, slowed down, and between 1983 and 1996 no village was relocated. Kanha forest village, located in the heart of the core zone, was moved out as the 27th village in 1997-1998. While relocation discontinued again for several years, the remaining ten villages of the core zone moved out between 2009 and 2017, technically making the core zone completely inviolate.

So far, by relocating 37 villages since 1969, the Kanha management has reclaimed good chunks of around 80.52 sq. km. of flat land. The recently abandoned village sites are developing into excellent grasslands. Specially, the Sukdi-Ajanpur-Jholar composite is going to play a very important role in barasingha conservation in the near future. Barasingha have started exploring these new grasslands.

6.5 Structural Changes on Grasslands:

An ecological study on the grasslands of 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 on 38 grasslands of the national park, 16 plant communities were identified. Gopal & Shukla (2001) took up the phytosociological study of 10 select grasslands of the Kanha national park during the revision of the Management Plan. Though a detailed study of the grasslands was beyond the scope of this Management Plan, efforts were made to assess the current status of some of the grasslands and compare them with the benchmark study (Pandey, 1982) to study the trends and suggest prescriptions for grassland management in the national park. The comparison of the two studies elucidates that the total number of grass/ sedge, legume, forb and woody species are higher in the current sampling than in the earlier study. The phytosociological success of other annual grass species such as *Themeda*, *Eragrostis* and *Dimeria ornithopoda*, as observed in some grasslands, indicates a clear progression towards a change in the benchmark grass associations in these grasslands. Besides, *Heteropogon contortus*, which was earlier a dominant species in some meadows, has either been relegated to the co-dominant status, or followed very closely by other species such as *Dichanthium annulatum* and *Themeda quadrivalvis*. Other annual species such as

Bothriochloa odorata, *Cynodon dactylon*, *Imperata cylindrica* and some species of *Eragrostis* have also been recorded in almost all the grasslands, contradicting the earlier status of the grasslands to some extent. List of existing grasslands is appended **(Appendix-19).** On the basis of the phytosociological sampling the following plant communities have been ascertained on different grasslands:

Table-53: Plant Communities on Different Grasslands

Sl. No.	Grassland	Plant Community (1982)	Plant Community (2007)
1	2	3	4
1	Sonf	*Heteropogon contortus - Saccharum spontaneum*	*Saccharum spontaneum - Themeda quadrivalvis - Eragrostis unioloides*
2	Kanha	*Saccharum spontaneum - Eragrostis unioloides*	*Heteropogon contortus - Themeda triandra - Saccharum spontaneum*
3	Ronda	*Heteropogon contortus - Saccharum spontaneum*	*Heteropogon contortus - Saccharum spontaneum - Themeda triandra*
4	Mundidadar	*Heteropogon contortus – Themeda triandra*	*Themeda triandra - Heteropogon contortus*
5	Bisanpura	*Heteropogon contortus – Themeda triandra*	*Themeda triandra - Heteropogon contortus*
6	Sondar	*Heteropogon contortus – Themeda triandra*	*Themeda triandra - Heteropogon contortus*
7	Kahwajhardadar	*Dichanthium annulatum – Dimeria ornithopoda*	*Dichanthium annulatum - Dimeria ornithopoda*
8	Deoridadar	*Dichanthium annulatum – Dimeria ornithopoda*	*Dichanthium annulatum - Dimeria ornithopoda*
9	Piperwada	*Dichanthium annulatum - Themeda triandra*	*Themeda triandra - Heteropogon contortus*
10	Supkhar	*Heteropogon contortus - Dichanthium annulatum*	*Heteropogon contortus - Dichanthium annulatum*

Source: Kanha Tiger Reserve (2021)

The same detailed study was repeated in several prime 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-20)**:

Table-54: The Comparative Status of Plant Community

Sl. No.	Plant Community (1982)	Plant Community (2007)
1	**2**	**3**
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*
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*

Source: Kanha Tiger Reserve (2021)

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 led to secondary succession in the form of changed community types on these grasslands. Regressive trends 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.

6.6 Workshop on Grassland Management:

Chronic biotic pressure of a large number of ungulates, frequent occurrences of fire and the cool burning practice in the meadows until 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 Kanha management, and the Principal Chief Conservator of Forests (Wildlife), instructed the Kanha management to avail of this opportunity to organize workshops 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, two workshops on grassland management were organized at Khatia Eco-centre, Kanha tiger reserve on 25 & 26 October, 2010 and 23 & 24 November, 2012. These workshops, chaired by the Principal Chief Conservator of Forests (Wildlife), Bhopal, consisted of indoor technical sessions and field visits inside the core zone. At the first workshop Mr. Francois De Wet, Range Ecologist, South Africa was also invited to assess the condition of these grasslands and interact with forest officers and scientists to form his opinion about management. The proceeding of this workshop is appended **(Appendix-21)**.

At the second workshop on grassland management, among the invitees was also Dr. Winston SW Trollope, who was a senior range ecologist, working on Fire International, Nelspruit, South Africa. He also spent a few days at Kanha, inspecting these grasslands, examining various grass species on different grasslands, and interacting with forest officers and scientists. He also likened these savannah type grasslands, to a large extent, with those occurring in South Africa. Speaking broadly, he was in favour of systematic burning of these grasslands, as they do in South Africa.

Dr. Trollope later recommended **(Appendix-22)** that these grasslands were dominated by Increaser I grass species in the form of *Aristida setacea, Desmostachys bipinnata, Pennisetum hohenackeri, Narenga poophyrocoma* and *Themeda quadrivalvis*, and to a lesser extent by Decreaser species like *Themeda triandra* and *Heteropogon contortus*. Generally, the grass sward in the different grassland areas and the grass dominated forest areas including the keyhole grasslands, was in a highly moribund and unpalatable condition urgently requiring burning to provide young nutritious regrowth for the grazing ungulate species like gaur, barasingha and chital. He suggested that as an interim measure the recommended fire regime for prescribed burning presented in his detailed report be used as a guideline for initiating an integrated fire management plan. He firmly believed that this would significantly improve the quality of the grazing resulting in an increase in animal numbers thereby providing a greater prey base for the tigers and therefore increasing their numbers. He also recommended to formulate an integrated fire management on the basis of his detailed report as a matter of priority for the tiger reserve.

6.7 General Observations on Grasslands:

Some empirical observations of the Kanha management as well as those of wildlifers and scientists who frequently visit the core zone are as under:

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 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 these 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 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, fire lines 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.

CHAPTER – 7

BARASINGHA CONSERVATION

7.1 The Indian Swamp Deer:

The swamp deer or barasingha (*Cervus duvauceli* G Cuvier, 1823), meaning a species having twelve distinct points or twelve-tined in its antler configuration, is regarded as one of the world's endangered large mammals. As per zoological nomenclature, separation into subspecies has required to retain the originally described population of this deer as nominotypical or nominate subspecies. All the three subspecies of the swamp deer are endangered in India and are listed in Schedule I (part I: Mammals) of the Wildlife (Protection) Act, 1972 (amended subsequently). These subspecies have also been categorized as vulnerable as per the IUCN Red List of Threatened Species Version 2010.2.

The swamp deer is confined exclusively to India and Nepal. It is reported extinct in Pakistan and Bangladesh (Duckworth et al., 2015). Mukherjee (1974) has described the past distribution of the deer species from the marshy tracts of terai and duars of northern part of the upper Gangetic plain to Assam, eastern Sunderbans and central India. In the early part of last century, the species was also extremely common in Pachmari (Central India). The species has now disappeared from the swamps of the Sunderbans.

The deer is native to the northern and central parts of the Indian subcontinent and Nepal and has declined drastically in the past decades due to poaching, loss of habitat and other pressures exerted by an ever-increasing human population (Jerdon, 1874; Blanford, 1888-91; Inglis, 1892; Lydekker, 1898; and Ellerman and Morrison-Scot, 1951). Forsyth (1889) has written about the killing of barasingha in great numbers in areas now under the Chhattisgarh state. A drastic decline in the barasingha numbers was recorded, rendering its continued existence in the wild state unassured. As per Schaller (1967), the range of distribution had shrunk to a few limited places in Nepal, Uttar Pradesh, West Bengal, Assam and Madhya Pradesh. The poaching of this cervid was an important decimating factor for the overall decline of the deer population. Schaff (1977) has

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recommended elimination of poaching and grazing from the Suklaphanta reserve as quickly and completely as possible. Martin (1977) has pointed out that while no poaching was detected during his study period in the Kanha national park, some cases of poaching and trapping were recorded outside and it was assumed that in the 1960s poaching must still have been an important factor in the park. Singh (1977) has observed that in the sub-Himalayan forests of the Kheri region, rampant encroachment, habitat destruction and trophy hunting were cited as responsible for sheer reduction of the deer's population. Mukherjee (1974) has opined that the size of barasingha range represents about 4.4% of the historical extent at the beginning of the present century.

Panwar (1977) has noted that barasingha breeding, food and conservation are inevitably linked with open areas that also support human activity. Therefore, the rapid decline of the barasingha since the turn of the century is due to progressive shrinking of habitat and eliminative pressures. Qureshi et al. (1995) have studied the ecology and behaviour of the northern species in the Dudhwa national park, and given recommendations for effective conservation. Gopal (1995) has studied the biology and ecology of the cervid with special reference to the Kanha national park.

7.2 The Three Sub-Species:

Over the years, two subspecies/ races of the nominotypical species have also been identified on the basis of some morphological peculiarities/ geographical variations. Currently there are three subspecies as distinguished on the basis of morphological features:

7.2.1 **Northern swamp deer (*R d duvaucelii* Cuvier, 1823):** Named after Mr. Alfred Duvaucel, the species has splayed and spongy hooves and is adapted to the flooded tall grassland habitat in the Indo-Gangetic plain (Pocock, 1943). Nasal short, relative to the snout length; antlers long, slender, and not compressed or palmated; little or no sexual dimorphism in size, tail relatively long and slim, with prominent white hair on the underside; ears very large and rounded, with thick white hair on the inside; in moult the white spots in the dorsal region very prominent. Feet splayed, with bare "heels".

Midha and Mathur (2010) has written that there are around 1200-1400 animals of this sub-species in the Dudhwa tiger reserve (UP), and 2000 animals in the Suklaphanta wildlife reserve and Bardia national park in Nepal. A total population of 3040 of swamp deer, probably the largest number of the subspecies in the world, has been estimated in Uttar Pradesh, with more than 1200 swamp deer in Jhaadi Taal, which is the single largest population of swamp deer, in the world (Anon., n.d.). In this way, small populations of the deer species are distributed in the Hastinapur wildlife sanctuary, Bijnor forest division, Pilibhit forest division, Kisanpur wildlife sanctuary, Dudhwa tiger reserve and Katerniaghat wildlife sanctuary in Uttar Pradesh (Mondol et al., n.d.).

Tewari and Rawat (2013) have written about a small population of 320 swamp deer, recently rediscovered in 2005 at Jhilmil Jheel in the Chidiyapur range of the Haridwar Division, Uttarakhand.

7.2.2 **Southern swamp deer (*R d branderi* Pocock, 1943):** Named after the British forest officer AA Dunabr Brander, its hooves are adapted to hard ground conditions in open sal forest with a grass understory. Free ranging populations occur only in the Kanha tiger reserve, where there are 956 animals. There are, however, also some reintroduced animals in an *in-situ* enclosure in the Satpura tiger reserve (Present study). Distinguished from *R duaucelii and R ranjitsinhi* by the "well-knit" feet, with hairy pasterns. Size smaller; nasals long; snout short; but the nose not deep; antlers more as in *R duvucelii*, but extremely long, many branched, with a long brow tine; branching high up the beam; anterior branch specially long.

7.2.3 **Eastern swamp deer (*R d ranjitsinhi* Groves, 1982):** Named after Dr. MK Ranjitsinh, instrumental in facilitating comparative study of several skulls of the deer sub-species, it is only found in Assam. Elongated nasals; snout short; deep, antlers short, thick, branching low down, with a specially shortened anterior branch; antlers somewhat compressed, tending to be palmated. Heavily built, females notably smaller than the males, ears small, pointed, with very little white hair on the inside; tails short, in moult, the white spot in dorsal region less prominent. Feet splayed, with bare "heels".

Currently, a large population of the eastern species is more or less restricted to the Kaziranga national park (WTI, 2016), and as per the latest population estimation there are 1148 barasingha in the protected area (ToI, 2016). As far as the Manas tiger reserve is concerned, around 500 animals were estimated in 1987, however, almost the entire population was later wiped out by poachers during the civil unrest (Telegraph, 2013). Currently, however, there are 83 animals in two surveyed ranges of the Manas national park (Sarma, 2016).

7.3 The Hard Ground Barasingha:

The resurrection of the central Indian or hard-ground barasingha at Kanha is by far one of the most inspiring successes in the history of wildlife conservation in the country. Though the species has adapted to hard ground conditions of central India over a very long period of time, the cervid still shows evolutionary affinity for water and swampy areas.

7.3.1 **Distribution and Status:** The historical range of this cervid once covered several districts of the present states of Madhya Pradesh, Chhattisgarh, Maharashtra, Orissa and Andhra Pradesh, is now endemic only to the Kanha tiger reserve, Madhya Pradesh, and forms the only world population.

Forsyth (1889), writes that the species was found widely distributed from Hoshangabad in the west to Chhindwara, Seoni, Balaghat, Mandla (Kanha national park, Motinala and Karanjia ranges) districts of Madhya Pradesh, Durg, Bilaspur, Raipur and Baster (Kutru in Toynar and Bhairamgarh ranges) districts of Chhattisgarh, Bhandara and Chanda Districts of Maharashtra and several areas in Bihar and Orissa contiguous with bordering tracts in state of Chhattisgarh. Nelson (1909) has recorded that the swamp deer was found throughout the sal area of the Raipur district (CG), to the south in Sihawa and in the Government forests of Lawan in the north-east. The belief that the greater number of the animals in these parts were a cross between the sambar and real swamp deer might be quite true as the length and thickness of horns and the colour of the animal were slightly different to those of the ordinary swamp deer of the Terai. Nelson (1910) has also written about the distribution of swamp deer in open sal forests and grass glades in the Bilaspur district (CG). He further adds that the rut took place in December-January when the stags were very noisy and pugnacious, the whole forest ringing with their most peculiar call. Brander (1923) reports 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 Maharashtra. Mehta (1949-50) has specifically written about the occurrence of the species in the Jagmandal and Khudrahi forest blocks of the Mandla forest division. But the distribution of the subspecies must also have extended into the States of Bihar and Orissa. Randhawa et al. (1969) have reported the presence of fossils of *Cervus duvauceli* Cuvier (allied to the modern barasingha), in the Narmada valley between Hoshangabad and Narsinhpur.

Mr. Ravikiran Govekar (*in litt*., 13.10.16) has mentioned that in a Marathi book there was an unconfirmed cross reference of famous official hunter turned conservationist Mr. Madhavrao Dongarwar who had killed 10-12 barasingha at a place called Bodarai in Navegaon national park between 1950 and 1952. This moist, somewhat swampy area is presently part of the Navegaon-Nagzira tiger reserve. This region is also known for the past distribution of wild buffalo. He further adds that Mr. Maruti Chitampalli, a retired forest officer, had given the above reference in one of his marathi books. Mr. Govekar also spoke to Mr. Dongarwar's relatives.

In the Kanha eco-region, encompassing surrounding forest areas, the barasingha roamed the grasslands in large numbers, and had safe and unobstructed access to most of its habitats for 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. Schaller (1967) writes that in 1938, a census of this deer population was conducted in and around the present Kanha national park which indicated that there were 3023 animals.

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 found a barasingha antler in the Bastar district in 1970 (Gopal, 1995). Yet today it is very unlikely, that barasingha survive outside the Kanha national park in central India.

7.3.2 **Brief Specific Attributes:** Barasingha are sexually dimorphic, with males larger than females. The hard ground barasingha is a large specialized deer, and an adult male is smaller than an adult sambar, the largest deer in the south-east Asia, but much larger than a chital. 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 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 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.

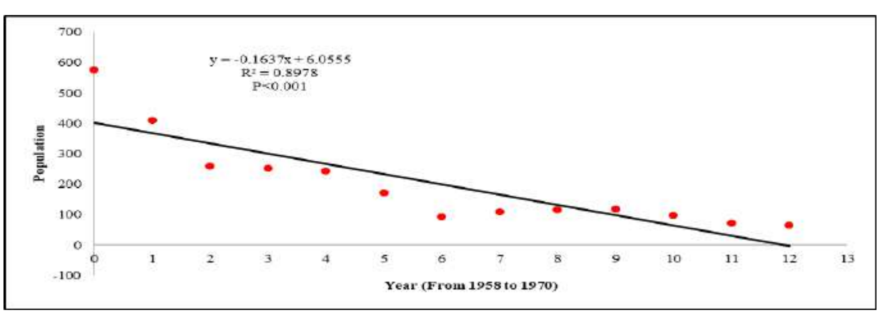
As stated earlier, the animal has been conclusively studied by several workers to be a graminivore, feeding preferably on *Saccharum spontaneum* throughout the year. However, the seasonal diet comprises of many common grasses found in the habitat. The cervid shows seasonal movements within the habitat. 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.

7.3.3 **Population Decline:** The cervid population had recorded a progressive decline before 1970. Forsyth (1889) writes that a large number of barasingha used to be killed by the Gond and Baiga in September and October when large herds were formed on the plateaus at Matin to the east of Pendra (now in CG). Much later, 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, especially the Baiga, 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, destruction was getting more and more mechanized and efficient.

The hard ground barasingha bore the brunt of this onslaught. The deer were continually hunted by villagers for its meat and occasionally for sale as trophies. By 1951, though the population of undivided Madhya Pradesh was only around nineteen million, barasingha habitats had already started to seriously succumb to agriculture and settlements. Poaching and biotic pressures including timber felling, encroachment and cattle grazing had tattered the forest, with grave consequences. Large chunks of forest and vast meadows were replaced by marginal crops (Shukla, 2009).

Progressive Decline of Barasingha Population to the Critical 66 in 1970

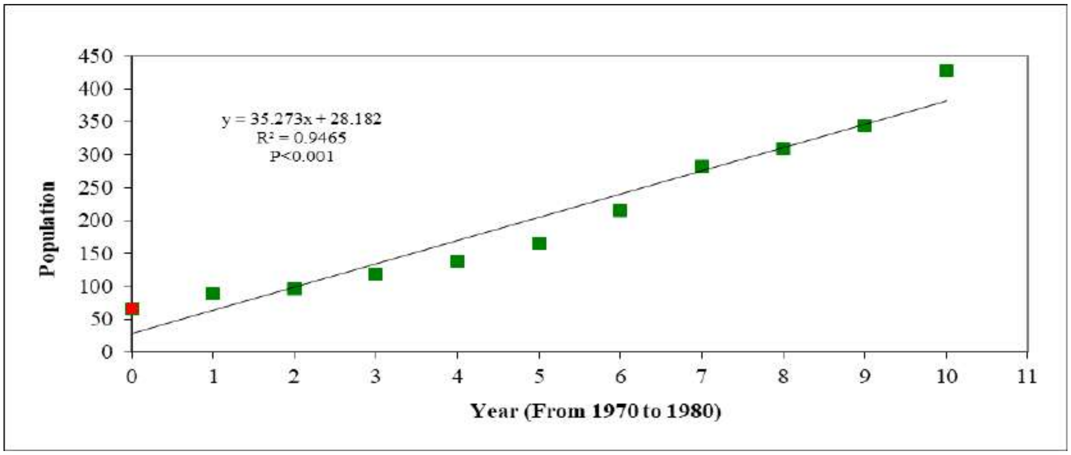


The barasingha never had an easy time of it. Wildlife classics on the natural history of the region are replete with references of how the deer were snared, poisoned and shot. Martin (1977) has written that the migratory habits of this cervid, due to central Indian environment, and herd instability and consequent dispersal outside the national park led to its decline. Panwar (1991) has mentioned that the situation became so serious that the MP govt. had to put a ban on barasingha hunting in 1954. The Supkhar area, which was part of the north Balaghat forest division, also lost all the animals by the late Fifties. In 1964, baiting in the Kanha meadows also attracted and confined several tigers to a small area. These tigers also killed barasingha to further decrease this population. While some good steps were taken, they were too late to be effective, and poaching continued unabated, recording a gradual decline in barasingha population from 3023 in 1938 through 577 in 1958, 98 in 1968, and 66 in 1970 (Binney et al., 1969; Panwar, 1973, 1991). The critical number was restricted only to the central meadows of the Kanha national park. The deer was now on the brink of sub-species extinction.

7.3.4 **Revival Years:** The decline of this deer population brought it into sharp national and international focus. The situation was regarded so serious that the IUCN (International Union for Conservation of Nature and Natural Resources, or now World Conservation Union) dispatched a team of internationally renowned experts/ conservationists to study the barasingha problem at Kanha and submit recommendations. The study team visited Kanha between 17 and 22 November, 1969, and submitted a joint report to the Eleventh Technical Meeting of IUCN organized between 25 and 28 November, 1969 in New Delhi (Binney et al., 1969).

What immediately followed within the forest department, however, were short term systematic conservation initiatives and swift action in the field to protect this species and its habitats. The population responded extremely well to these measures, and gradually started increasing and expanding. Some animals traversed through the Kanha meadow, Koyalabhatta meadow, Number nine, Botalbehra and reached Sonf in 1971. Panwar (1991) writes that these animals started using this abandoned village site for grazing and fawning. Fawning, however, remained restricted to Sonf because of good chunks of tall grass for parturition.

Progressive Increase of Barasingha Population in the 1970s



Until around 1992, no barasingha was seen in the central meadows of the Kanha range. The entire population was restricted to the Sonf meadow and its surroundings, and almost no animal movement was recorded between Sonf and the Kanha central meadows. During this time habitat improvement works were also being taken up in the Kanha range. Gradual improvement in habitat resulted in the first barasingha fawning in 2003 in the Kanha range after such a long gap. (Negi and Shukla, 2011). In the initial years, the fawning took place in the Desinala meadow, Ghaterokhero meadow, close to Phootatal, and in the Menharnala area.

Dispersals from 1975 onwards also took a few animals to the Bishanpura and Sondar meadows in the Mukki range. Mr. Abdul Gafoor Khan (*in litt.*, 8.7. 2016) points out that he sighted two females near the Khadari nala in 1976, and again recorded two different females, around a month later, in the Junnakhet meadow in the Mukki range. Mr. Khan encountered 6 animals near the Sondar tank in Ferbruary-March of 1977, and a large herd of around 18 animals in the Junnakhet meadow in March, 1978. Most animals are supposed to have followed the 9 km.

long Chital Line through the Kanha meadow, Chuhri, Benipat, Lakargadda area, Nair Ghat, and Tatkapani. In 1981, however, 41 animals were counted in the Mukki range (Anon., 1981). A few animals from Sonf are also supposed to have traversed through the Naktighati area and along the Chital Line to reach Bishanpura and Sondar.

The population rose to 88 in 1971, 96 in 1972, 138 in 1974, and crossed the 200-mark in 1976 in the national park (Panwar, 1991). Now these populations were establishing themselves in several grasslands of the Kanha range. The Sonf and Ronda grasslands (now in the Sarhi range), parts of the Kanha range, were later to become prime habitats of the deer, with relatively large populations. The construction of predation-proof barasingha enclosure was also completed at Kanha, and seven barasingha along with a few chital and blackbucks were kept therein for safe multiplication in 1972. This small barasingha population recorded total growth of around 129% and rose to 16 in 1976.

Due to non-negotiable physiographic barriers for the deer, managerial interventions were made to reintroduce some animals into the Supkhar range, the upper Halon valley part of the national park and a former distribution range of barasingha. Three attempts were made between 1981 and 1990 to chemically immobilize, capture and translocate a total of 24 animals from Kanha to Supkhar, (Kotwal, 1993). While several animals died during the operations, the remaining deer struggled to survive and gradually grew into a small population, and now there are around 70 animals.

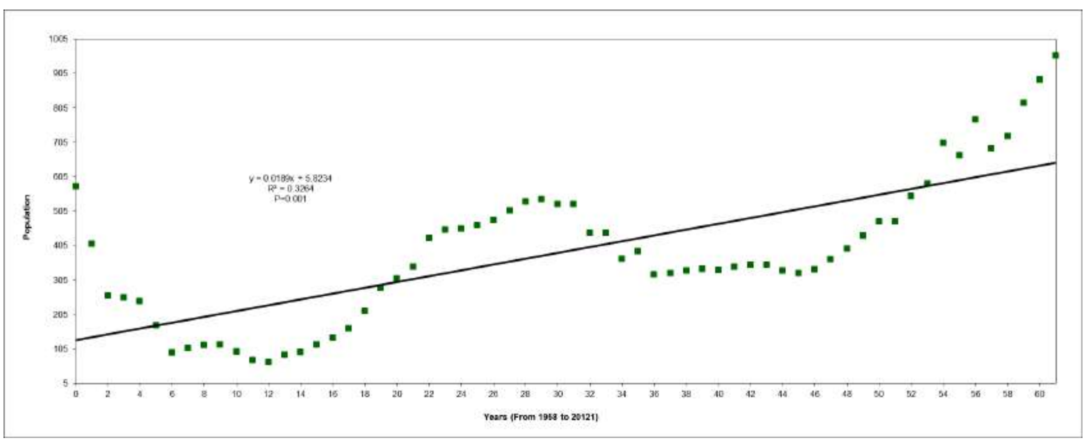
There has also been frequent movements of some animals from Kanha to Kisli and back, since 1992. The numbers at Kisli generally varied from 15 to 53 animals. In some years, however, the number also came down to as low as even zero to 8 animals. These are the breakaway animals from the Kanha population. Some animals leave Sonf and reach the Kisli tank area via Siliyari, Umarpani, Bade Ghat and Sajanala. A few animals are also seen taking the Kanha-Kisli main route over the Kanha Ghat to reach Kisli. Some animals take the Kanha-

Kopedabri-fireline-Chimta passage to reach Indri. Still others follow the Sonf-Rondagarh-Digdola course to reach Sondar (Kisli).

In 2005, a few animals splintered off the Supkhar population and reached Lanjhiabehra, near the Balda patrolling camp, and the Ronda clearings of the Bhaisanghat range (Negi and Shukla, 2011). Initially, the animals kept rejoining the Supkhar population and coming back, later, however, new fawns, and new arrivals from Supkhar, formed a small population that temporarily split and rebuilt at Lanjhiabehra, Dudhania and Adwar dadar.

While Kotwal (1987) observes that the barasingha had negative correlation with steep slopes and plateau, occasional presence of these animals was recorded at Bamhani dadar in the Kanha range. A few animals broke away from the Sondar (Mukki range) population and traversed through Ghorela, Jokpani, Khamerpani and reached the plateau. The presence of barasingha has regularly been observed at Bamhnidadar particularly during the monsoon.

Overall Year-wise Barasingha Population Trajectory



Growing population and consequent competition for specialized habitats, and habitat improvement in the core zone, could well be the reasons for dispersals to these places once regarded as so incongruous for these cervids. In this way, the deer has now dispersed over several habitat-pockets in all the six forest ranges. Currently, there are 956 barasingha in the core zone. The build-up of this population from the critical 66 in 1970 has taken around 45 years.

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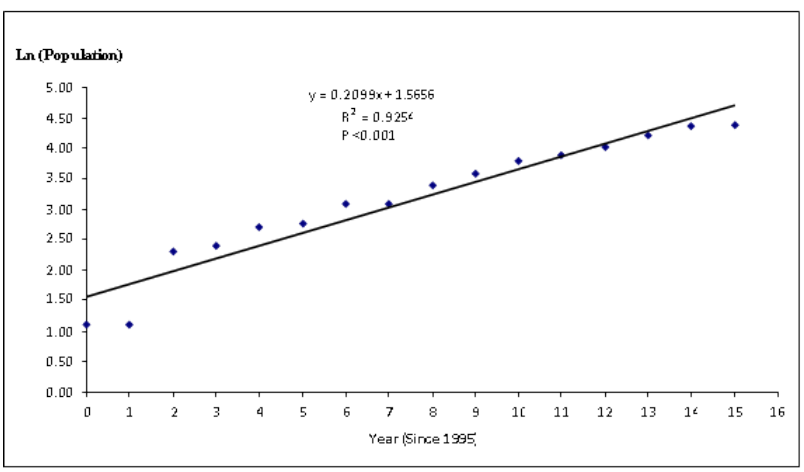
7.4 The Kanha Enclosure:

The 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 three animals, one male and two 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. All the animals were later released into the wild. This enclosure has proved an effective instrument for the safe multiplication of barasingha. Currently, there are 38 barasingha in the enclosure. This is also used to capture animals through the boma method for translocation. A part of the enclosure has also been set aside for a small population of reintroduced blackbucks.

Barasingha Population Growth in Predation Proof Enclosure



7.5 Small Population:

The conservation of hard ground barasingha needs to be practiced under the concept of small population management. The deer is a food specialist and the female is monoestrous and monotocous with a relatively long gestation period. The deer population has also survived sub-species extinction, and has grown out of only 66 animals. The hard ground barasingha is not only an endangered deer species, its being the only world population endemic to Kanha also makes it a very significant conservational cause in India and the world as well. This challenge requires 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 protected area.

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

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achieving so is to identify those factors that can potentially cause serious reverses or even extinction.

Ballou (1995) has pointed out that whatever the trend of a small population - increasing, decreasing or stable - its fate is uncertain. These 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 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.

Macdonald and Willis (2013) have opined that the concept of a minimum viable population rests on two separated but linked ideas, one derived from genetics and the other form population dynamics, both agreeing that small populations are always at a much greater risk of extinction than larger ones. They have further quoted Franklin (2005) that as a general rule at least 50 breeding individuals are needed to stave off inbreeding depression, and 500 for long term security against genetic drift, and total populations need to be larger. Frankham (2005) has pointed out that breeding groups on islands are usually more inbred than their mainland relatives. Mills (2013) argues that the number has also received serious scrutiny by population geneticists, with arguments to increase it to as large as 5000 or more. He adds that there is little doubt that the actual population size as opposed to the genetic effective population size necessary to maintain evolutionary potential for the long term should be thousands of individuals and not hundreds.

Experts now believe that population size of a species is extremely important in the evaluation of conservation priorities, and small populations can go extinct because of demographic stochasticity and genetic drift. Harmon and Braude (2016) have emphasized that estimating the appropriate effective population size is crucial in conservation biology; in most (but not all) cases, effective population size will be smaller than the actual number of organisms in the population. A conservative rule of thumb used by some biologists is that the effective population size is usually about one-fifth of the total population size once existed. Using such a rough estimate is risky because this size can be larger than the census size of the population, depending on the history of the population and the particular effective population size under consideration.

7.6 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:

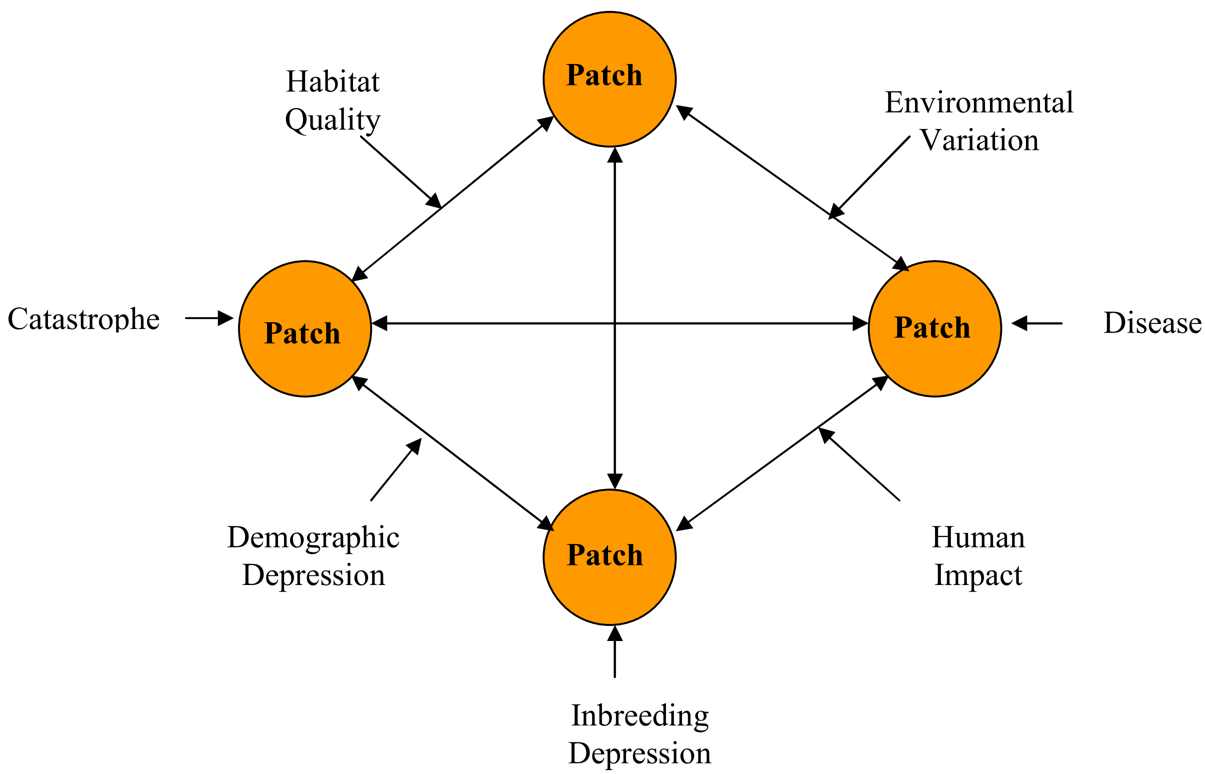
Kanha-Sarhi	
1	Phootatal
2	Menharnala
3	Phataknala
4	Kanha Anicut
5	Koylabhatta
6	Parsatola
7	Ghaterakhero
8	Shravantal
9	Sonf-I
10	Ronda
11	Urnakhera
12	Matigahan
13	Silpura

Mukki	
1	Sondar
2	Bisanpura
3	Orai
4	Ghorella

Supkhar-Bhaisanghat	
1	Ladua
2	Baspehra
3	Katrakhol
4	Piperwada
5	Bithli
6	Adwar
7	Dudhania
8	Sukdi
9	Ajanpur
10	Ronda
11	Jholar

As the overall population of the barasingha in the Kanha core zone is relatively small, a proper understanding of the dynamics of these three indicative metapopulations has become 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 indicative 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).

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 indicative metapopulations and their patches are not prone to same kind of threats.

While all the three indicative metapopulations of barasingha do not follow the typical model strictly, the sub-populations are dynamic, moving from one site to another. The Kanha 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 this metapopulation structure. As the metapopulations are monitored daily, the Kanha 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.

Some promising connectivity routes for barasingha in the Sarhi range are as under:

Table-55: Connectivity Routes for Barasingha in the Sarhi Range

Sl. No.	Corridor Routes in the Sarhi Range
1	Ronda Meadow to Kalorbehra Meadow
2	Kalorbehra Meadow to Natwaware Meadow
3	Natwaware Meadow to Nagoreware Meadow
4	Nagoreware Meadow to Ronda-Mahuadabari Forest Road Meadow
5	Ronda-Mahuadabari Meadow to Harraware Meadow
6	Harraware Meadow to Gadabehra Meadow
7	Phasitanga Meadow to Udnakhero-Karahidabra Meadow
8	Udnakhero Meadow to Ghurghundi Meadow
9	Ghurghundi Meadow to Khutapathar-Baraware Meadow
10	Bijatake-Semarkhero Meadow to Piperware Meadow
11	Harraware Meadow to Kallekachar Meadow-Neelware-Kariwah Meadow
12	Udnakhero-Palasware Meadow to Silpura Meadow

Source: Kanha Tiger Reserve (2021)

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

7.7 Population Expansion:

Commendable protection and special habitat improvement measures for the barasingha in the past so many years have also held a bearing on its distribution within the core zone. Until 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, Sondar 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, until only a few years back, never supported barasingha, and no animal used to be reported from this range. Now animals have also been reported from Sukdi, Ajanpur, Jholar, Adwar, and Lanjhiabehra, 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.

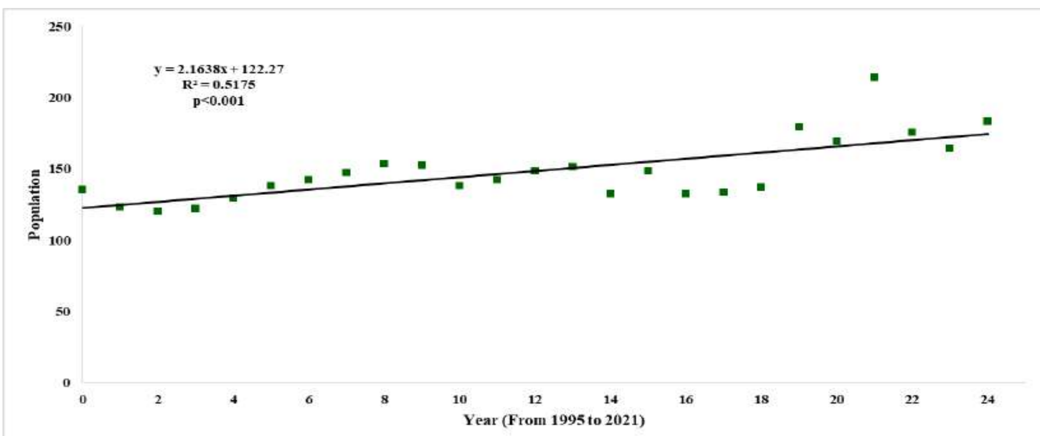
The barasingha population is slowly increasing and expanding in the protected area. The newly abandoned forest village areas are expected to develop into good grasslands, and may in future support another around 300 animals. The populations of predators and co-predators, however, are also increasing. Currently, there are 118 tigers (Phase-IV tiger monitoring, 2019), a clear increase in populations over 60 in 2010 and 80 in 2014 (both Phase-I estimation). The tiger density in the core ranges from 4.82 ± 0.33 to 5.21 ± 0.55 per 100 sq. km. between 2013 to 2018. Besides, the protected area also supported leopard densities from 6.63 ± 0.71 to 8.64 ± 0.75 per 100 sq. km. between 2013 and 2016 (Jhala et al., 2019). There is also a good population of jackals. Under this predation, we can only expect the deer population to record any relatively low growth rate in the future, as predation would also offset the increase. The population, however, will go on increasing at a low rate. Therefore, to offset the hazards faced by this single population of around 819 animals at Kanha, barasingha were also shifted to the Satpura tiger reserve. The regular augmentation of this population from Kanha tiger reserve, until the Satpura population reaches demographic viability, is most vital for the long-term survival of barasingha at Satpura. It will also ensure the overall growth of both populations.

7.8 Population Growth:

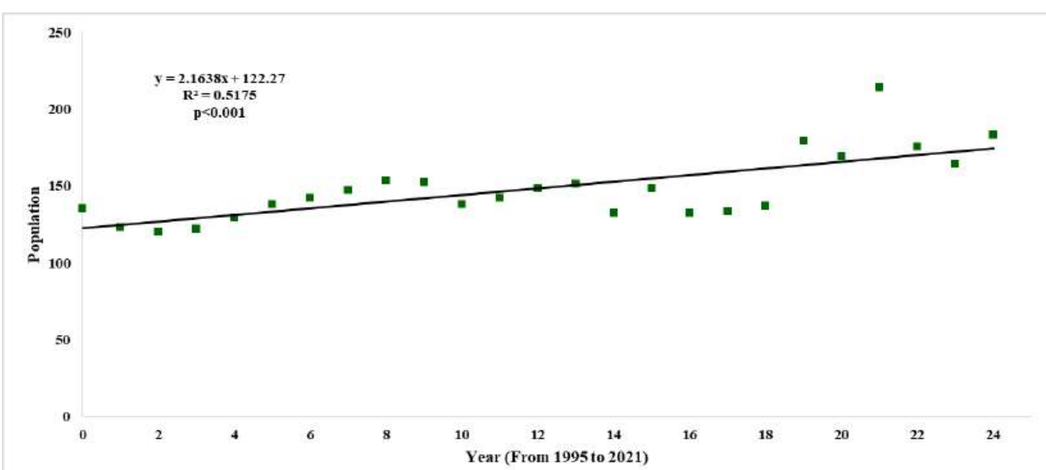
Increase in barasingha population in the core zone has been slow for the past several years. There is no abnormality in this trend, and is also a characteristic of a small population. There are, however, several views and perspectives on this plateau population. There are opinions that the prime habitats of the barasingha have deteriorated over the years and the 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 consequently shows low growth rate in the wild.

The regression analysis (1995 to 2021) of the free-ranging populations of the Kanha-Sarhi, Mukki and Supkhar-Bhaisanghat ranges are as under.

Population Trajectory of Free Ranging Population of Kanha-Sarhi Ranges



Population Trajectory of Free Ranging Population of Mukki Range



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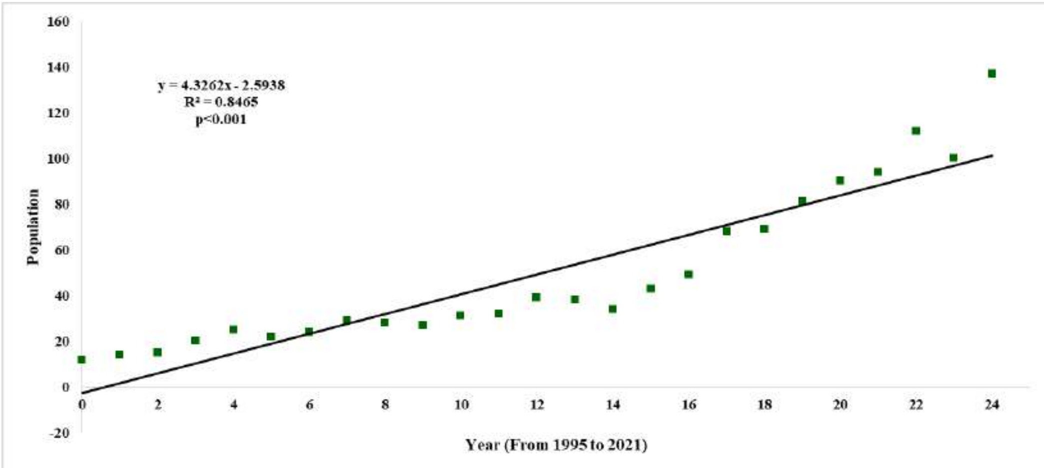
Population Trajectory of Free Ranging Population of Supkhar-Bhaisanghat Ranges



7.9 Reintroduction Programme:

Barasingha were confined to the Kanha tiger reserve for around for almost 45 years, and for long-term conservation, it was important to safeguard population by finding suitable sites for reestablishment of new populations.

In spite of successful conservation and literal resurrection of the deer, the sub-species was still regarded at risk of extinction. The small number, susceptibilities to diseases, and any large-scale natural calamity, which may impact the population were reasons for establishing a geographically separated population outside Kanha and somewhere in the deer's former range of distribution. The first such historic habitat that readily came to mind was certain areas of the Satpura tiger reserve. Until around 100 years ago, a small population of the hard ground barasingha was also found in this area.

Forsyth (1889) and Brander (1923) have reported the occurrence of the hard ground barasingha in, what is now known as the Satpura tiger reserve, in the Pachmari region. There is, however, no record suggesting its presence after the 1940s. No probable cause other than biotic pressure resulting in habitat loss and hunting/ poaching and the consequent extinction of the population has ever come to light. The same causes were also responsible for its abrupt decline in the Kanha area (Forsyth, 1889; Brander, 1923; Schaller, 1967; Panwar, 1977, 1991; Gopal & Shukla, 2001).

This small population was regarded as prone to sudden outbreak of epidemic and facing large mortality. Besides, the genetic makeup also suggested that it could also be an inbred-based population with its characteristic weaknesses and susceptibilities. In this background, the reintroduction of a founder population of the cervid into another protected area of its historic distribution range had been under serious discussion for some years.

Considering all the pros and cons involved in this project, it was decided that 7 barasingha should first be introduced into the Van Vihar national park. This exercise would help understand the response and behaviour of these animals during capture, translocation and captivity. Besides, it would also help familiarize with actual problems involved in the reintroduction programme. On the basis of this attempt, next field exercises, preparations, capture and translocation could be refined to further satisfaction. The Van Vihar national park had excellent ex-situ facilities to conserve a small number of these ungulates and spread conservation awareness.

7.10 Practical Considerations:

As species conservation also needs a practical approach to effective management, some more justifications and managerial reasoning were put forward for ensuring second homes/ alternative sites for the species.

- The Kanha population has grown from only 60–70 animals in 1970-71, and could safely be considered as inbred. Geneticists suggest that the genetic health of a population or its ability to adapt to environmental conditions depend solely upon the maintenance of genetic diversity within the population, and a loss of genetic diversity may have extremely harmful effects on the existence of this population. The Kanha population is vulnerable to extinction solely on this count, in the long run, despite excellent management and protection.

- The barasingha population in Kanha national park is clearly predation regulated, with a large number of different carnivore species. This is also an important factor for relative slow growth of this population over around four decades. In the Satpura national park, a relatively small density of carnivore species and congenial habitat conditions seem to be suitable for the growth of the barasingha population to establish itself in the wild.
- The grasslands occupied by the barasingha population have a long pastoral history in Kanha tiger reserve. Some of the causative factors of pastoral diseases are known to remain dormant for many years before recurring again as epidemics (Gopal & Shukla, 2001). Besides, on the basis of the epidemiology of the surrounding areas of the Kanha national park (Negi & Shukla, 2011), mutual disease transmission through inter and intra-specific contact due to intermingling with village cattle at the periphery of the national park cannot be ruled out.
- The Van Vihar national park is an excellent protected area, with a host of in-situ and ex-situ conservation practices and facilities. The protected area is already very famous for attracting a large number of tourists every year. Easy and well-interpreted sightings of this handsome deer in the park will only add to conservation awareness in public. Besides, the long term conservation breeding programme will also ensure a new blood line for the species.
- As the philosophy of conservation lies in the maintenance of biodiversity and prevention of species extinction, it is a tremendous opportunity to restore the hard ground barasingha to its historical distribution range of Pachmari and Bori, harbouring tropical moist deciduous teak forests- 3B/C1(b), slightly moist deciduous teak -3 B/C(c) and dry peninsular sal (high level sal)-5B/C1c (iv) forests in the Bori valley of the Satpura hills.
- The creation of another geographically separated home for the hard ground barasingha will further add to the conservation of this population in future. Besides the Bori meadow, three new meadows have already been created by relocation of Dhain, Sakot and Khakrapura villages in the recent past, while several more villages have also been relocated. Moreover, vast grasslands (approximately 1000-1200 ha.) are available in the drawdown areas of the Tawa reservoir for most part of the year.

As a result of the relocation of several villages in the Bori wildlife sanctuary and the Satpura national park, new and potential barasingha habitat has been created (Pandey & Prakash, 2012). Thus, there is a possibility of the species dispersing onto a significant plain part of the Satpura conservation area and establishing a viable population, at least as large as the Kanha population.

Under this reintroduction programmes 7 barasingha were translocated to the Van Vihar national park, Bhopal, and 78 to the Satpura tiger reserve.

7.11 Threats to the Barasingha Population:

The barasingha populations in Kanha core zone face the following threats to their survival:

7.11.1 **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 Kanha 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 manages 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 fourth 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.

7.11.2 **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 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.

7.11.3 **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 37229 (D=40.58). 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.

7.11.4 **Specialized Niche:** The branderi barasingha is a food specialist and has a 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.

7.11.5 **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.

7.11.6 **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.

7.11.7 **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". 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.

7.11.8 **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 fatal 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.

7.12 Timeline in Barasingha Conservation:

Barasingha at Kanha is also a fine example of single species conservation, whose chief objective has been to reduce or delay the risk of the extinction of the target population. Initially, it looked like fighting a losing battle, later, however, the wide range of all conceivable conservation practices and innovative steps ensured to take the population to a much safer status. Amid all these conservation practices and animal/ population responses, some events/ milestones have emerged distinctly in a span of around half a century to chronicle the entire barasingha conservation in the protected area. Some of these are as under:

Table-56: Some Events/ Milestones in Barasingha Conservation

1954	Considering the plight of the barasingha, the MP Govt. imposed a ban on barasingha hunting in the state
1955	The Banjar wildlife sanctuary was declared the Kanha national park
1964	Study on the ecology of tiger and ungulate species in the national park (1964-1965) by Dr. George Schaller concluded
1967	Publication of the wildlife classic "The Deer and the Tiger" by Dr. George Schaller
1969	Relocation of Sonf forest village for additional habitat, and cattle grazing stopped in several grasslands Tiger baiting site in the Kanha meadows shifted in favour of the barasingha

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	IUCN sent a team of international experts to Kanha to study the barasingha problem
1970	The barasingha population declined to an all-time low of a mere 66 animals, restricted to the Kanha meadows The construction of an *in-situ* enclosure started for the safe multiplication of this cervid
1971	First arrivals sighted in the Sonf meadow, previously part of the Kanha range
1972	7 barasingha were kept the *in-situ* enclosure for multiplication
1973	The Kanha national park notified as a tiger reserve A five-year management plan for Kanha national park prepared with special emphasis on habitat improvement by Mr. HS Panwar Study on the status and ecology of barasingha by Dr. Claude Martin (1971-73) concluded
1974	Supkhar range declared a wildlife sanctuary and merged with the national park The barasingha population crossed the 100-mark
1976	First dispersers sighted in the Mukki range
1981	Reintroduction of eight barasingha into the Supkhar range, one of them later died
1982	Translocation of eight barasingha into the Supkhar range, 4 of them died a few days later
1990	Translocation of eight barasingha into the Supkhar range, 2 of them died during the operation
1992	Barasingha sighted in the Kisli range
1993	Daily monitoring strengthened
1995	Study on the biology and ecology of the hard ground barasingha (1992-1994) by Dr. Rajesh Gopal concluded
1999	Comprehensive monitoring of the species under a prescribed format started in the national park
2003	Barasingha fawning recorded in the Kanha meadows after a long gap of several years
2005	Some animals sighted in the Bhaisanghat range, they built a small population
2007	The Kanha *in-situ* enclosure expanded to around 50 hectares. Study on the ecology of the hard ground barasingha (2004-2006) by Dr. K Nayak concluded
2010	Strengthening the monitoring of 81 barasingha released from the Kanha enclosure, and extensive habitat improvement undertaken inside by Dr. HS Negi Relocation of Jami forest village from the Supkhar range

2011-2014	After the relocation of seven forest villages, the core zone is free of forest villages
2015 (January and March)	Translocation of seven barasingha to the Van Vihar national park, and 16 to the Satpuda tiger reserve by the boma and non-invasive capture method
2016 (January)	Translocation of six barasingha to the Satpura tiger reserve by the boma and non-invasive capture method
2016 (July)	Barasingha sightings recorded in the Sukdi and Ajanpur relocated grasslands
2017 (January)	11 barasingha (2 males, 7 females and 2 fawns) translocated to the Satpura tiger reserve
2020 (February)	13 barasingha (2 males and 11 females) translocated to the Satpura tiger reserve
2021 (February)	12 barasingha (2 males and 10 females) translocated to the Satpura tiger reserve

Source: Kanha Tiger Reserve (2021)

CHAPTER – 8

TRANSLCOATION AND REINTRODUCTION OF WILDLIFE

8.1 Active Management:

Though there is no specific definition for "active management" in the context of wildlife conservation, it can be explained as just opposite of the "reactive" approach of the management of any protected area to routine or day-to-day issues. The active approach appeals to the "important" rather than the "urgent". This approach is futuristic and looks beyond the routine, and encompasses deep thinking and the knowledge of the wildlife ecosystem, team efforts, serious deliberations, systematic planning and preparations, and collective responsibility to achieve goals that seemed to many rather atypical and non-conforming. Practitioners of active management also have to step out of the comfort zone of dealing with the routine and the mundane. Understandably, the approach also carries some risk that may question the professionalism of conservation practitioners in the end, if the desired goal is not achieved, or the achievement does not fare well in the typical cost-benefit analysis. Actually, the more ambitious the goal, the higher the risk involved.

While around a quarter of the total area of the core zone had already been declared a national park in 1955 and upgraded to a tiger reserve in 1973, the status of the present protected area has remained as such since 1976. The past almost five decades have been a proud witness to excellent management for expanding and developing the area, restoring and improving major wildlife habitat types, considerably neutralizing/ minimizing threats and challenges to conservation, and, of course, consequently increasing wildlife populations to more or less the protected area's carrying capacity. Clear vision, goal-oriented strategies, and outstanding professionalism have helped the management achieve the present status for Kanha.

Now, with the protected area counted among some of the finest in the country, the Kanha management had enough time and experience to think beyond the usual and the mundane, and plan for several unimplemented ideas, unrealized aspirations, and innovations that could not be attempted earlier due to routine preoccupations, inexperience and sheer hesitancy. These undertakings related to the reintroduction of some species into other protected areas and also into Kanha; capture, translocation and release of tigers inside and outside Kanha, and capture of chital from high density areas and their release into low density areas within the protected area. Some senior officers of the wildlife wing also wholeheartedly supported and got personally involved in some of these initiatives.

All these programmes involved multi-disciplinary expertise, and senior forest officers of the wildlife wing, officers of Kanha, and scientists of the Wildlife Institute of India, Dehradun played their respective important roles. In the gaur reintroduction programme, several veterinarians and wildlife managers of South Africa were also involved. Prior to the field implementation of these programmes, all laid down procedures were meticulously followed, which included necessary permissions from the state government as well as the NTCA, New Delhi; detailed protocols, meetings on protocols, procurement of specially designed vehicles, veterinary drugs, equipment, and cages; assembling of bomas/ capture enclosures, training of staff, and mock exercises etc.

All these programmes resulted in the reintroduction and translocation of different wildlife species from and into Kanha as under:

8.2 Tiger Translocations:

8.2.1 **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.

8.2.2 **Tiger to Van Vihar National Park:** As already mentioned above, this tiger was one of the three orphaned cubs. This animal was kept in a small quarantine house of Ghorella enclosure due to unavailability of large enclosure which was engaged for the rewilding of two tigresses of the same litter. As the animal was not exposed to wild conditions, it was decided to keep this animal in captivity. The tiger was translocated to the Van Vihar national park by road on 15th May, 2008. The animal is doing well there.

8.2.3 **Tigresses to the Panna Tiger Reserve:** Two tigresses kept in the *in-situ* enclosure was translocated to the Panna tiger reserve by road on the 26th March, 2011 and the 12th November, 2011 respectively. This animal spent almost 2-3 years in the large enclosure of Ghorella and predated almost 265 chital. This animal was reared with its sister and both together predated the live chital in the enclosure. The animal was found suitable for the ongoing tiger translocation programme of Panna tiger reserve. This animal given birth to two litters of cubs which later on survived well in Panna tiger reserve.

8.2.4 **Radio-Collared Tigers Released into Kanha:** These two orphaned tiger and tigress were reared and trained in the Ghorella enclosure. Later, they were released into low tiger density areas of the Kanha core zone on the 25th October, 2013 and 26th October, 2013 respectively. The animals were continuously monitored by a dedicated team of staff. The tiger at first sustained injuries in infighting with a dominant tiger of the tiger reserve. Later, however, he had a serious infighting that ultimately caused his death. The tigress also explored the core as well as the buffer zone. She was immobilized in the Bamhni range of the west Mandla (T) division and again released into the core zone.

8.2.5 **Tiger to Van Vihar National Park:** This tiger was translocated on the 27th March, 2014. The animal was actually shifted from the Panna tiger reserve for rewilding. The tiger, however, did not show satisfactory wild instincts due to too much human imprinting during initial stages. It was decided to keep this animal in captivity at Van Vihar national park.

8.2.6 **Tigress to the Satpura Tiger Reserve:** This animal was translocated to the Satpura tiger reserve on the 23rd March, 2015. She was released into a low tiger density area to avoid infighting with existing tigers. This tigress was successfully monitored for about two years at Satpura tiger reserve.

8.2.7 **Tigress to Noradehi WLS:** This animal was translocated on the 17th April, 2018. The tigress also later gave birth to some cubs in June, 2019. At present, this tigress is doing well with the cubs.

8.2.8 **Tiger to Satkosia Tiger Reserve:** The tiger was translocated on the 20th June, 2018. This was the first inter-state tiger translocation operation jointly carried out by the Wildlife Institute of India, Dehradun and the Odisha forest department with the support of the Madhya Pradesh forest department. The animal was released into an enclosure at Satkosia tiger reserve. Later, the animal was released into the wild.

8.2.9 **Tiger to Sanjay Tiger Reserve:** The tiger was translocated on the 10th December, 2018. He was released into a low tiger density area to avoid the infighting with other tigers. At present, this animal is being monitored by a dedicated team of the Sanjay tiger reserve and the Wildlife Institute of India, Dehradun.

8.2.10 **Tiger to Satpura Tiger Reserve:** This animal was rescued from the Sarni area of the Betul forest division and shifted to the Ghorella enclosure of Kanha for monitoring. He was later translocated to a low tiger density area of the Satpura tiger reserve on the 31st January, 2019. The animal, however, again entered the buffer area of the Satpura tiger reserve, and moved on into the same area of Sarni under the Betul forest division. The animal was again rescued and shifted to the Ghorella enclosure at Kanha. Now the animal has been translocated to Van Vihar national park, Bhopal on 05-06-2020.

Kanha Tiger Reserve, Mandla (MP) 481 661, Phone: 07642-250760 (O), Fax: 07642-251266, Email: fdknp.mdl@mp.gov.in

8.2.11 **Tiger to Van Vihar National Park:** On the 23rd October, 2019 a tiger was translocated to the national park.

8.2.12 **Tigress to the Mukundpur Zoo:** A tigress was sent to the Mukundpur Zoo on the 2nd November, 2019.

8.2.13 **Tigers to Van Vihar National Park:** Two tigers were translocated to Van Vihar National Park on the 5th June, 2020 and the 17th December, 2020 respectively.

8.2.14 **Tiger Released at Kanha:** On the 6th February, 2020, a tiger was released into the tiger reserve itself.

8.3 Gaur Reintroduction:

The Bandhavgarh tiger reserve is one of the most beautiful protected areas of the state, and harbours lush forests of sal, bamboo and miscellaneous species. Until around 25 years back, the protected area also supported a small population of the Indian gaur (*Bos gaurus gaurus*), regarded as the largest species of wild cattle. 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. The local extinction of this species was a blow to conservation and caused serious concerns. No major managerial intervention in protected areas at that time was possible due to various financial and infrastructural inadequacies and limitations, and this beautiful national park carried on without the gaur. The Kanha management and old watchers however, had been feeling twinges of sadness over such sudden departure of this species.

It had already been decided that in future the gaur population in the protected area would be restocked. In South Africa, the translocation of large mammals is very common, and such undertakings need multi-disciplinary involvement. Accordingly, a lot of experts of different disciplines in India and South Africa were contacted. Ideas and modalities were discussed, mutually agreed terms and conditions of actual field operations finalized, and all concerned were encouraged to discuss the same among them for preparations. Nothing was left to chance. This colossal undertaking resulted in receiving remarkable cooperation from wildlife managers and veterinarians of & Beyond Africa, Ezemvelo KZN Wildlife, naturalists of Taj Safaris, experts from the Wildlife Institute of India, Dehradun, wildlife veterinarians of the Centre for Wildlife Forensics and Health, Jabalpur, Kanha, Pench and Panna tiger reserves, and the management of Kanha and Bandhavgarh tiger reserves.

These actual field operations involved a wide range of preparations, including finalizing a detailed protocol, procurement of all sorts of veterinary drugs and equipment, the making of specially designed large recovery and transportation vehicles and holding boma (large steel cages used in South Africa) and training of field personnel for discharging assigned duties and ensuring mutual understanding/ coordination etc. As the tiger reserve had a sizeable population of the Indian gaur, and the management had modest exposure to such teamwork in the past, it was naturally the first choice for these operations. Eventually, in January, 2011 and March, 2012, field operations were carried out to capture, restrain, load and translocate a total of 50 gaur to the Bandhavgarh tiger reserve. This was a remarkable reintroduction undertaking and received profuse accolades from all quarters. These animals are currently doing well.

8.4 Barasingha Reintroduction:

Amid national and international applause, the successful conservation of the hard ground barasingha had slowly but steadily increased its population at Kanha. This only single and small population of the endangered deer species was, however, regarded as being prone to sudden epidemic and ultimately getting wiped out. Besides, the genetic makeup also suggested, at least theoretically, that it could also be an inbred- based population with its characteristic weaknesses and susceptibilities. In this background, the reintroduction of a founder population of the cervid into another protected area of its historic distribution range had been under serious discussion for some years. More populations at geographically different places are always considered better and safer than one population restricted to only one place.

Considering all the pros and cons involved in this project, it was decided that a few barasingha should first be introduced into the Van Vihar national park by a non-invasive capture method without using drugs/ chemicals. This exercise would help understand the response and behaviour of these animals during capture, translocation and captivity. Besides, it would also help familiarize with actual hitches and problems involved in this colossal undertaking. On the basis of this attempt, next field exercises, preparations, capture and translocation could be refined to further satisfaction.

The Satpura tiger reserve, the select site for the reintroduction, had until several decades back, also supported a small population of this sub-species, and still had good habitat. There was, however, some anxiety about the success of this venture due to past failures of reintroduction resulting in several mortalities of these animals. It was already an endemic and Schedule-I animal, and its being the state animal of Madhya Pradesh only added to the unease and concern.

When the majority of decision makers was agreed to take this calculated risk, a comprehensive capture, transportation and release protocol was prepared to the minutest details and nothing was left to chance. This covered a wide range of reintroduction aspects from objectives, feasibility studies to installation of capture boma, veterinary interventions, capture method, translocation and release etc. As already stated above, a non-invasive capture method was to be employed. Specially designed in-situ enclosures with improved barasingha specific habitat were erected at Van Vihar and Satpura.

Inspired by the South African capture and translocation technique, already used successfully for the translocation of several Indian gaur, the boma method was employed to capture barasingha in the barasingha enclosure itself at Kanha. It consisted of a wide funnel tapering into an animal selection-cum-loading chute. The main structure of the boma was made of steel sections but the wings of the funnel were extended with the help of chain-link fence supported with the grass mats to make it opaque for animals. Besides, a large transportation truck was also customized to carry around 15-20 captured barasingha comfortably. The truck container was also fitted with CCTV cameras to monitor the animals in the driver cabin during transportation.

The transportation truck was closely fitted to a ramp camouflaged with plastered soil and grass to make it look natural to the animals. In this way, the transportation truck, the ramp and the chute of boma became one composite structure at the capture site. This structure had been installed several days before the actual capture operation in the field so that the animals might get habituated to its presence and could freely enter and exit it.

A total of nine capture operations, the first operation for sending animals to the Van Vihar national park, and the next eight for the Satpura tiger reserve, were carried out between January, 2015 and February, 2022 (6^{th} January, 3^{rd} and 15^{th} March, 2015; 14^{th} January, 2016, 27^{th} January, 2017, 16^{th} February, 2020, 25^{th} February, 2021, 4^{th} February, 2022 and 10^{th} February, 2022). These nine operations resulted in the successful capture and translocation of 7, 8, 8, 6, 11, 13, 12, 8 and 12 barasingha respectively. All these procedures were undertaken during the cool hours to prevent the target animals from overheating and exhaustion.

This is a generalized account of all the four capture operations, incorporating minor hitches/ problems faced by the team and their instant solutions during these field operations themselves. As the non-invasive capture using the boma technique was new to the Kanha staff, there was always some improvisation or the last minute departure from the original planning in all these four operations. Each operation slightly varied from the other in terms of timings, number of team members, and attempts to trap the required number of animals in the truck. Gradually, however, these capture operations became less difficult because of better coordination among the team members, their well anticipated moves, and a better understanding of the animal behavior.

Rigorous mock drills were conducted in the field and long sessions were held to discuss every eventuality and assign specific duties to the staff before each capture operation. Several crews of the capture team entered the barasingha enclosure from the direction exact opposite to the boma structure. They were equipped with helmets, wore padded jackets and carried very handy makeshift reflectors. The crews moved towards the grazing and now slightly uncomfortable animals to drive them gently towards the boma and into the chute. These reflectors were used to further dazzle and confuse the animals. Utmost care was taken not to make the animals panicky and each attempt was made in a leisurely way. As and when the animals entered the narrow selection chute, sliding gates were closed one by one to hold and further push them into the truck. Over the years, the Kanha team has learnt the art of capturing barasingha safely without much difficulty, and the procedure has now been standardized.

The transportation convoy included, besides the truck, three more vehicles carrying senior officers, wildlife veterinarians with emergency drugs and equipment and support staff. The animals were monitored from time to time during the journey, and it took almost 17 and 12 hours to cover around 450 km. and 350 km. to reach the destination enclosures at Van Vihar and Satpura tiger reserve respectively. While 7 animals to Van Vihar were transported in a single trip, 22 animals were sent to the Satpura tiger reserve in three trips, and there was not a single mortality! All these animals are doing well in their respective new home-enclosures.

8.5 Blackbuck Reintroduction:

One of the common antelopes, blackbucks (*Antelope cervicapra*) were once distributed on plateaus to the east of the Banjar river passing through the Baihar tehsil, and in several valley villages on the Kanha landscape. Until a few years back, even the core zone also supported a small population of the antelope. The population, however, declined steadily since 1975, and the last animal was seen in 2004. The small population was confined only to the Kanha meadows. Some founders were also kept in an enclosure for safe multiplication, they, however, fell prey to pythons. Blackbucks are animals of open country/ plains, and dense and tall grass growth and thick ground vegetation may also have resulted in the weakening of anti-predator strategy of the blackbuck, rendering it vulnerable to predation. The local extinction of the blackbuck from Kanha was regarded as a blow to biodiversity, and the Kanha management decided to give it a try and reintroduce some animals into extensive areas of short grass with low density of shrub and woody species, which would serve as good rehabilitation sites for the blackbuck in the core. Some of these sites are: Matigahan, Yusufdadar, Silpura, Mundidadar, Deoridadar, Adwardadar and Dulhadadar.

The Kanha management planned the entire capture operation with Mr. Thulsi Rao, a retired forest officer from Andhra Pradesh, credited with successful translocations of about 7000 blackbucks in his State. The task of capturing the blackbucks was assigned to Mr. Rao's team of 14 persons from Andhra Pradesh who were trained for this job and had much needed experience of capturing blackbucks in Andhra Pradesh. Besides, the select field staff of the tiger reserve was also trained for the entire operation of capture and translocation. Special wooden crates were made to safely shut individual animals for transportation. In November 2011, the entire operation was carried out in agricultural fields close to Seoni town.

Instead of releasing the blackbucks straight into the wild, they were kept in an enclosure at Kanha. The idea was to keep them under observation/ monitoring for any health eventuality and also to let them get acclimatized to the new environs. In this case the basic objective of this translocation exercise was to build up a population in Kanha and not just to translocate the crop raiding animals. To achieve this objective, the released animals needed to be monitored on a daily basis and this was possible only in an enclosure. The in-situ enclosure was specially erected and developed for the multiplication of barasingha. The release site was also prepared for the blackbucks well before the actual release. In the past also, this enclosure had already supported a small population of blackbuck for some years. The area of the enclosure was around 50 ha. and it harboured typical grassland habitats of the core with a range of grass species. Most of the enclosure area supported short to medium height grass species. The first mortalities occurred within 3-4 days of release of these 50 animals, and several animals were lost. Inferences drawn from the first several postmortems suggested that the blackbucks had died due to capture myopathy. Some visceral samples were also collected and sent for histo-pathological examinations. The reports confirmed the cause of death due to capture myopathy. The population is now thriving and will be released into the wild shortly.

8.6 Chital Reintroduction:

The chital is the most numerous of ungulate species and forms the main prey base of tigers in the Kanha tiger reserve. Ever since the village relocation programme was started in the late Sixties of the last century, these abandoned village sites have been the main focal points for habitat/ wildlife management. As a result of priority based intervention and excellent management, the Banjar valley gradually registered a steady increase of chital. Village relocation was also started in the Halon valley in the mid-Seventies of the last century. The abandoned village sites in this valley, however, did not show such remarkable increase in chital population. Tall grass, absence of mega herbivores and lack of similar intensive grassland management practices in this valley could be the cause of this relatively small increase in the ungulate population. Consequently, the low prey base population has also affected the number of carnivores, including tigers, in the valley. As several villages have been relocated over the recent past, and the abandoned sites are gradually getting integrated into natural grassland ecosystem, the release of several hundred chital at these sites will accelerate an early build-up of ungulate population. Several select sites for the release of chital in a phased manner are: Bithli, Benda, Rol, Ajanpur, Jholar, Linga, Sukdi, Jami and Sajalagan. The Kanha management has obtained permission from the competent authority to translocate 1500 chital from the Banjar valley to the above evacuated village sites. This proactive management practice will not only allow the evacuated sites to recover faster, but will also provide enough prey to carnivore population. In several operations over the past years, chital were captured using the capture boma methodology and driven into specially designed transportation trucks for translocation and release into select areas of the tiger reserve. In this methodology, chital were not chemically immobilized. So far, 1426 chital have been shifted to the Phen/ Halon valley sites.

8.7 Reintroduction of Wild Buffalo:

The Kanha management has collaborated with the Wildlife Institute of India, Dehradun to reintroduce a small founding population of the wild water buffalo (*Bubalus arnee*), also known as the Asiatic buffalo. The Supkhar tract is known to have supported this species until several decades back. The current Tiger Conservation Plan also envisaged the reintroduction of this species into Supkhar. Over around 100 years back, Kanha tiger reserve once supported the wild buffalo population in the Banjar valley areas of the Mandla district and the east and north-east of the Balaghat district. These populations are locally exterminated and now only found in three sub-populations in Indravati national park, Pamed and Udanti wildlife sanctuaries in Chhattisgarh. The wild buffalo (*Bubalus arnee*) population of Central India is one such example whose local existence is gravely threatened, the central India population now has its last bastions in some pockets of Chhattisgarh-Maharashtra states of India. This reintroduction project has often been discussed in the recent past. Several forest officers/ scientists are also in favour of this reintroduction programme. Several years back, a team constituted by the Wildlife Institute of India, Dehradun to conduct a field survey for the assessment of the status of the wild buffalo in undivided Madhya Pradesh, also recommended the reintroduction of a small breeding group into the Kanha Tiger Reserve.

The vegetation and habitat conditions of some areas of the Supkhar forest range are suitable for a small founder population of the wild buffalo. Besides moist and grassy glades, there are also several swampy/ marshy water bodies facilitating, at present, the habitat requirements of the gaur. The wild buffalo is primarily a graminivore as well as folivore, and a water loving animal that likes wallowing. The free-ranging population of this animal will also reduce congestion in the grassland habitat for lesser ungulates. The introduction of around 5-10 wild buffalo in the Supkhar range would not pose any problem in the initial stages, and may, in future, build a viable population. The wild buffalo may initially be maintained only in an *in-situ* enclosure and be released into the wild after acclimatization.

The researchers of the WII, Dehradun have already conducted preliminary phytosociological study of grasslands in several parts of core zone, including the Supkhar forest range.

As per the feasibility report on the study of wild buffalo reintroduction in Kanha tiger reserve submitted by the Wildlife Institute of India, Dehradun (Jhala et al., 2022), the Assam population with over 3000 animals could be considered as the source for selecting founders **(Appendix-23)**. The work, however, is underway at the Wildlife Institute of India, Dehradun to validate the inference that the north-east wild buffalo population does not differ significantly from the Chhattisgarh population.

CHAPTER – 9

VILLAGE RELOCATION

9.1 Background:

The Kanha of the bygone era typified, to a large extent, the physiography of the central Indian highlands, with rolling slopes, undulations and plains. These large tracts with primary or low biotic impact vegetation were forested with excellent sal and its associates, and miscellaneous woodlands along with densely foliaged large bamboo clumps as understory, and thick herbaceous and shrubby undergrowth. The woodlands were also interspersed with heterogeneous grassy expanses and large clearings, with tree groves. The land was rich in the typical flora of the central Indian highlands, which could be attributed to a number of beneficial factors including combinations of landforms, soil types and moisture regimes. Various topographic features of the protected area commanded special vegetative characteristics. The sal forests on the lower slopes and in the valleys, the mixed forests on the upper slopes and hilltops, and the grasslands in valleys and on plateaus. A number of seasonal and perennial streams also crisscrossed this landscape, which also supported the origin of some of them. Natural depressions with suitable soils dotted the forested tract, and also retained waters for most of the year.

Amid this relatively intact wilderness, all the combinations of the above vegetational, physiographic, interspersional, structural features, and natural resources also resulted in diverse habitat types to suit niches of a large number of wildlife species, including several major ungulate species. This also included the hard ground barasingha, which was later to become endangered and catch the world attention for conservation. In this congenial environment, all these animal species occupied their respective niches and performed different life functions such as feeding, breeding, parturition, and rearing the young etc. On this prey base of ungulates depended a number of predators, including tigers, and co-predators and small predators, also occupying different niches and performing vital life functions such as predation, loafing, breeding, and raising the young etc. Besides, wildlife also found rest, cover, and shelter in these habitats from weather inclemency.

However, nestled on this primeval, pristine landscape were also many small villages showing typical Indian decadal demographical growth rate. The same was also true of the cattle populations with the most defective animal husbandry practices and their consequent dependence on the bio-resources of Kanha.

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. At that time, the idea of relocating a village from a national park to restore a wildlife species was unconventional and ahead of its time. The relocation of Sonf village was probably the first such venture in Independent India. The idea was nascent, and there were no clear govt. guidelines for such evacuation. Consequently, the provision of cash compensation to villagers for relocation was also not under consideration. As human sentiment was also involved in the undertaking, the Kanha management understood its sensitiveness, and dealt with this very cautiously. They wanted the relocation to be a mutually agreeable and participatory process, and also exemplary for subsequent relocation of more villages in future.

The expanding village had sheltered populations of several generations, and the existing villagers cherished very fond memories of their ancestors and their own lives. They were, however, faced with day-to-day problems, and were deprived of a normal living their counterparts enjoyed outside the national park. Living under stringent rules and regulations of forest and wildlife conservation also added to their plight. Besides, they also found themselves appallingly helpless and uncompensated, and sometimes deeply resentful, when their standing crops were destroyed by wildlife and their livestock killed by carnivores. Whatever problems and deprivations, these villagers felt emotionally attached to the land, and leaving the village for an unknown place and an uncertain future was far from their minds.

The farsighted Kanha management, however, had started working on different aspects of this relocation programme. Taking the district administration and higher offices at Bhopal into confidence, the management started treading extremely carefully and sensitively. They started feeling the pulse of the village as regards their aspirations, expectations from relocation through some local confidants and elderly people. The villagers were desultorily made aware of all the benefits, mainly education for children and employment opportunities, of joining the national mainstream of progress outside the park. They were also told about more stringent rules and regulations they might have to face in future, making their lives very difficult. The management knew that such villages in the national park were doomed to become islands, unfortunately, far away from the rapid development of other villages located near the mainstream of progress. Besides, various Conservation Acts and Rules would also discourage any development activities that would otherwise be very important for the upliftment of these villages. In the meantime, the management was also preparing a blueprint for relocation side by side, taking into considerations all that needed to be transported, prepared or delivered at the new relocated site to minimize the impact of this social and cultural severance.

Eventually, the management’s persuasion and villagers’ wisdom prevailed over a few naysayers, and the consensus was built on the relocation of Sonf village to a mutually agreed site at Bhanpurkheda outside the national park. Broadly, as promised by the Kanha management, each family was given around 2.5 ha. of ready land for cultivation. All the families were also given village style houses along with sheds for livestock. All their household materials and belongings along with cattle and fuel wood were also transported to the new site. The new village was also provided with a well or two for drinking water along with an anicut/ earthen tank for cattle, irrigation etc. The village was also given handholding support for some time to ensure hassle-free settlement.

9.2 Need for Village Relocation:

The village life had a touch of aboriginality as the majority of populations in these villages belonged to the Scheduled Tribes, mainly the Gond and the Baiga. Agriculture consisted of a mosaic of cultivation fields and fallow lands. Depending upon the soil, minor and major rain-fed *kharif* and *rabi* crops were grown. These habitations, with an aboriginal, harmonious, and nature-friendly way of living, more or less blended with the wilderness**.**

The villagers enjoyed considerable access to the nearby forests for their *bona fide* livelihood needs and demands of grass, fuel wood, timber and a wide range of miner forest produces. Initially, this setting looked innocuous, and the biotic impact on natural resources was not perceptible. Later, however, signs of dependence on natural resources started showing clearly. Illicit felling, lopping, illicit grazing, and hunting of smaller mammals and ungulates for sustenance became noticeable with disturbing frequency. Shifting cultivation through the slash and burn practice gradually became rampant among the tribals. Agricultural fires spreading across wildlife habitats incurring heavy ecologically losses year after year became common. And so were fires ignited to clear the ground for easy mahua collection. The Baiga were mostly hunter-gatherers, and could inflict massive ecological losses annually. Uncontrolled anthropogenic ways in the wilds and laxity in the enforcement of the existing Acts/ Rules relating to wildlife conservation only added to the destruction of natural resources.

Kanha was also gradually expanding, with its status undergoing change through two wildlife sanctuaries – Banjar and Halon–and a national park, to finally a tiger reserve. Kanha had also displayed tremendous scope to become a world class protected area, provided timely managerial inputs were given for improvement of wildlife habitats and propagation of wildlife. This gradual change in the status of Kanha, with better protection and law enforcement, also improved and stabilized the situation. However, it was now abundantly clear that the current situation strongly pointed straight to the incompatibility of land uses for effective wildlife conservation. And that the villages needed to be relocated outside the national park and abandoned land reclaimed for integration into the surrounding wildlife habitats to enhance ungulate populations, a key determinant of the abundance of tigers and co-predators in any nature reserve.

In the meantime, the hard ground barasingha, whose population was on a progressive decline, had almost reached the brink of extinction in the late Sixties, with only less than 100 animals restricted to the Kanha meadows. This handsome cervid, made endangered by poaching and habitat destruction at and around Kanha, urgently required new safe habitats with minimum disturbance for fawning. Sonf village, located to the north of the Kanha meadows, with past distribution of barasingha population, was deemed an appropriate choice for relocation and restoration of barasingha.

9.3 Further Relocations:

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 tranquil zone for the protection and propagation of wildlife. Acting upon this guideline, the Kanha 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 villages to reclaim potential areas for wildlife. Under a comprehensive relocation plan, 12 villages were moved out of the national park by June, 1976. Village relocation continued, and more and more abandoned village land got integrated into the surrounding wildlife habitat, and by 1982, a total of 26 forest villages had been moved out. The relocation programme, however, slowed down, and between 1983 and 1996 no village was relocated. Kanha forest village, located in the heart of the core zone, was moved out as the 27th village in 1997-1998.

Village relocation 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. 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 **(Appendix-24)**. Later, however, the NTCA introduced its own policy, making provision for monetary compensation/ land support to relocated families. This policy was applied at Kanha for the relocation of Jami forest village in 2010.

The relocation of first 27 forest villages from the core zone and the 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 Kanha 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 Kanha managements. It is very important to note that 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.

9.4 NTCA Relocation Policy:

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). Subsection-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 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 monetary package of Rs. 10 lakh in this policy was, however, revised in April, 2021. As per the latest directive from the National Tiger Conservation Authority, New Delhi this package has been enhanced to Rs. 15 lakh per family.

The proposed package has two options:

9.4.1 **Option-I:** Payment of the entire package amount (Rs. 15 lakh per family) to the family in case the family opts so, without involving any rehabilitation / relocation process by the forest department.

9.4.2 **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. 15 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
(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

Table-57: Details of Villages Relocated During the Plan Period (2011-12 to 2021-22)

Sl. No.	Name of Villages	Range	No. of Families	Reclaimed Area (Ha.)	Year
1	2	3	4	5	6
1	Rol	Supkhar	78	85.660	2011-12
2	Benda	Supkhar	70	80.937	2012-13
3	Bithli	Supkhar	101	128.940	2012-13
4	Ajanpur	Bhaisanghat	259	574.650	2012-13
5	Jholar	Bhaisanghat	209	312.010	2014-15
6	Linga	Supkhar	135	243.621	2014-15
7	Kariwah	Sarhi	57	75.270	2015-16
8	Sukdi	Bhaisanghat	201	568.178	2016-17
9	Ranwahi	Supkhar	224	187.703	2016-17
	Total:		**1334**	**2256.969**	

Source: Kanha Tiger Reserve (2021)

9.5 Relocation of Sukdi Village:

Sukdi forest village, established in May, 1932, was one of the eight forest villages that fell within the core zone of the tiger reserve. The village occupied a very significant wildlife habitat of the Bhaisanghat forest range.

The total area of the village was 568.178 ha. It was located in the southern part of the core zone, and was one of the five forest villages of the Bhaisanghat range. The total population of the village was 523 belonging to 210 families. However, 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., a total of only 201 families were identified and found eligible for the purpose of bank accounts, compensations and monitory benefits etc. relating to the relocation. Of the 201 families, 183 belonged to the Gond and 18 to the Other Backward Castes (OBC).

Sukdi was one of the last forest villages that chose to be relocated under Option-I as prescribed in the new relocation policy. As the village 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.

The Kanha management wanted to make this resettlement a smooth undertaking under the new relocation policy, and to ensure fully transparent, hassle-free, and people-friendly relocation so that some more villages, even outside the core zone, may also be inspired to move out from near the boundary of the core zone. Besides, the staff of the Bhaisanghat range proved to be a tremendous morale booster for the villagers who could now freely talk to them about their doubts, confusions, and problems, and the Kanha management facilitated these families throughout the relocation. The Kanha management received financial allocation from the NTCA for only Sukdi village in the 2016-17 financial year.

The number of the eligible and non-eligible families after verification by the sub-divisional level committee and revenue team was as under:

- Number of families included in the list: 210
- Number of eligible families: 201
- Number of non-eligible families: 9
- Total number of families for relocation: 201

The particulars of the families are listed below:

Table-58: Number of Families (Sukdi Village)

Sl. No.	Particulars	No. of Families
1.	Adult men	163
2.	a. Unmarried women b. Married women	13 0
3.	a. Widow b. Estranged	16 2
4.	Orphan	1
5.	Handicapped	6
	Total:	**201**

Source: Kanha Tiger Reserve (2021)

All the 201 relocated families have settled down outside the core zone in difference places. The current status is as under:

Table-59: Relocated Families Outside the Core Zone (Sukdi Village)

District	Tehsil	Police Station	Name of Village	No. of Relocated Families
Balaghat	Birsa	Birsa	Chichgaon	07
			Bijatola	02
			Basinkhar	04
			Borkheda	04
			Boda	06
			Kendatola	06
			Katangi	04
			Thuremeta	02
			Harrabhat	05
			Parsatola	02
			Ramghadi	04
			Sayal	04
			Dongaria	04
			Chapla	06
			Devgaon	02
			Chakarwahi	06
			Jagla	18
			Gowari	01
	Balaghat	Balaghat	Kosmi	01
	Baihar	Baihar	Gohara	04
		Garhi	Murenda	01
			Bhalapuri	03
			Pondi	01
			Samaria	01
			Nawalpur	01
			Alna	01
			Garhi	02
			Lapti	01
			Total:	**103**
Kabirdham	Bodla	Rengakhar	Dhamindihi	01
			Barbaspur	02
			Seonikala	02
			Titri	01
			Bhilwatola	02
			Pandaria	20
			Rampur	04

			Samnapur	10
			Dariya	01
			Nandni	01
		Bodla	Kandapara	04
		Chilphi	Akalghariya	01
	Pandariya	Pandariya	Khamhi	21
			Bakela	03
			Gangpur	03
			Total:	**76**
Rajnandgaon	Chuikhadan	Gundai	Garra	05
			Lakhanpur	06
			Total:	**11**
Mandla	Bichiya	Motinala	Manori	01
			Indri	03
			Murkuta	02
		Bichiya	Dhangaon	05
			Total:	**11**
			Grand Total:	**201**

Source: Kanha Tiger Reserve (2021)

9.6 Brief Procedure of Village Relocation:

The salient points of the relocation procedure of a village are as under:

- When the process of relocation is started, the concerned villagers at a meeting of ecodevelopment committee are apprised of the benefits of relocation. They are also made aware of Options-I and II provided by the NTCA, New Delhi.
- Decisions on the time schedules of the publication of survey list of this village, and invitation and disposal of objections are taken at a general meeting on relocation from the core zone is normally held by the concerned district Collector.
- The preliminary survey of families belonging to the forest village is completed, and the survey list sent to the Collector.
- Forest and revenue officers conducts a joint survey to ascertain the number of families and population of the target village for relocation.
- The final list is published by the Collector, announcing the total number of eligible families of the forest village.

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- At a meeting held by the concerned Gram Sabha, the consent of all the people of the target forest village is obtained for relocation under one of the two available Options. To ensure that all eligible family units are partners in the decision of the Gram Sabha and want relocation, individual consent letters are also taken from each eligible family with regard to the use of Rs. 10 lakh to be received under Option-I from the Collector.
- The Collector's relevant order is followed as a guideline to purchase agricultural land and construct houses with the said amount. Besides, negotiations with nationalized banks are also initiated to ensure smooth money transaction for development of private and community resources.
- The Collector reviews the progress of preliminary preparations at a general joint meeting of forest and revenue officials, including the issuance of relevant certificates by the concerned Chief Medical and Health Officer (CMHO) pertaining to 18 years of age.
- The complete list of eligible families, including the widows, divorcees and the orphans is published by the Collector.

- Two bank accounts of each selected beneficiary are opened at a suitable branch of the State Bank of India. The Corporate Liquid Term Deposit (CLTD) account is a joint account of the Collector and the beneficiary, while the second account is that of the personal savings account of the beneficiary from which he/ she would able to withdraw money.
- It is generally decided that Rs. 1.00 lakh would be deposited into the personal savings account of each eligible family, and the remaining amount of Rs. 9.00 lakh into the respective beneficiary's CLTD accounts and the interest would be transferred into their savings account.
- The agreed amount as payment/ compensation is deposited into the bank accounts of each one of these families.
- In order to release money from the beneficiaries' joint accounts, as per their demands from time to time, the validity/ justification of the same is verified by

the concerning range assistant to start the proceeding of releasing the money from the joint account.

- The money is gradually deposited into the accounts of all the rest of the families who agree to be relocated outside.
- Families start moving out of the forest village gradually with all their belongings and cattle. And after a certain period of time the forest village becomes totally abandoned.
- Thereafter, the Kanha management contacts each family to get a prescribed format/ questionnaire filled in regarding the use of money spent so far on a wide range of their needs.

9.7 Success of Relocation:

The park management has successfully relocated as many as 35 forest villages (1905 families) outside the core zone between 1967-69 and 2016-17. The relocation has helped the Kanha management reclaim 7788.78 ha. of wildlife habitat. Two forest villages (282 families), namely Kariwah and Ranwahi were technically relocated from the national park in the year 2015-16 and 2016-17 respectively. The Kanha management reclaimed 262.974 ha. from these two relocations. 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.

At present, the core zone is now completely inviolate. These abandoned sites have been successfully integrated into the surrounding wildlife habitat and become excellent grasslands, specially for the barasingha. In most relocation programmes, new sites were ecologically separated from the national park/ core zone.

These relocated forest villages were resettled outside the core zone. The current status of the resettlement of these villages is as under:

Table-60: Current Status of Relocated Forest Villages

Sl. No.	Name of Relocated Forest Village	Year of Relocation	New Habitation Site	Under Forest Division
1	Sonf	1967-69	1. Bhanpurkheda	East Mandla (T)
2	Ronda	1974-76	1. Premnagar	Kanha National Park
			2. Vijaynagar	Kanha National Park
			3. Kariwah	Kanha National Park
3	Silpura	1974-76	1. Ajaynagar	Kanha National Park
			2. Raniganj	Kanha National Park
4	Matigahan	1977-78	1. Indra	Buffer Zone Division
5	Bamhnidadar	1977-78	1. Hirapur (Balgaon)	Buffer Zone Division
6	Sondar (K)	1986-87	1. Kapotbehra	West Mandla (T)
7	Kisli	1986-87		
8	Indri	1986-87		
9	Bisanpura	1974-76	1. Tatighat	North Balaghat (T)
			2. Jamjhiria	North Balaghat (T)
10	Sondar (M)	1974-76	1. Mukki	Kanha National Park
11	Ghorella	1974-76	1. Mukki	Kanha National Park
			2. Dhaniajhor	Kanha National Park
12	Orai	1974-76	1. Mukki	Kanha National Park
13	Parsakheda (Parsatola)	1974-76	1. Mukki	Kanha National Park
14	Adwar	1975-78	1. Bandhankhero	Buffer Zone Division
			2. Semarkhero	Buffer Zone Division
			3. Juwaritola	Buffer Zone Division
			4. Ghorsibehra	Buffer Zone Division
15	Deoridadar	1976-78	1. Naunadar	East Mandla (T)
16	Chilpura	1975-76	1. Tatma	East Mandla (T)
17	Baspehra	1975-76	1. Chhatarpur	Kanha National Park
18	Jatadabra	1975-76	1. Ghorsibehra	Buffer Zone Division
19	Chakarwah	1975-76	1. Khaksatand	Buffer Zone Division
20	Dudhania	1975-76	1. Bandhankhero	Buffer Zone Division
			2. Murenda	Buffer Zone Division
21	Katoldih	1976-77	1. Hirapur	Buffer Zone Division
22	Ladwa	1976-77	1. Navalpur	Buffer Zone Division
			2. Chhatarpur	Kanha National Park
23	Gaidhar	1976-77	1. Chhatarpur	Kanha National Park
			2. Navalpur	Buffer Zone Division
			3. Khaksatand	Buffer Zone Division
24	Kawajhar	1976-77	1. Navalpur	Buffer Zone Division
			2. Navnadar	Buffer Zone Division
25	Piperwada	1979-81	1. Chimaghundi	East Mandla (T)
26	Supkhar	1980-82	1. Bajghundi	Buffer Zone Division
27	Kanha	1997-98	1. Manegaon	Kanha National Park

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28	Jami	2009-10	1. Mandla	East Mandla (T)
			2. Balaghat	North Balaghat (T)
			3. Kabirdham (CG)	Kabirdham (T)
29	Rol	2011-12	1. Mandla (MP)	East Mandla (T)
			2. Kabirdham (CG)	Kabirdham (T)
			3. Balaghat (MP)	North Balaghat (T)
			4. Durg (CG)	Durg (T)
30	Benda	2012-13	1. Mandla (MP)	East Mandla (T)
			2. Kabirdham (CG)	Kabirdham (T)
			3. Balaghat (MP)	North Balaghat (T)
31	Bithli	2012-13	1. Rajnandgaon (CG)	Rajnandgaon (T)
			2. Kabirdham (CG)	Kabirdham (T)
			3. Balaghat (MP)	North Balaghat (T)
32	Ajanpur	2012-13	1. Kabirdham (CG)	Kabirdham (T)
			2. Balaghat (MP)	North Balaghat (T)
33	Jholar	2014-15	1. Kabirdham (CG)	Kabirdham (T)
			2. Balaghat (MP)	North Balaghat (T)
34	Linga	2014-15	1. Mandla (MP)	East Mandla (T)
			2. Kabirdham (CG)	Kabirdham (T)
			3. Balaghat (MP)	North Balaghat (T)
35	Sukdi	2016-17	1. Mandla (MP)	East Mandla (T)
			2. Kabirdham (CG)	Kabirdham (T)
			3. Balaghat (MP)	North Balaghat (T)
			4. Rajnandgaon (CG)	Rajnandgaon (T)
36	Kariwah	2015-16	1. Mandla (MP)	East Mandla (T)
			2. Kabirdham (CG)	Kabirdham (T)
			3. Balaghat (MP)	North Balaghat (T)
37	Ranwahi	2016-17	1. Mandla (MP)	East Mandla (T)
			2. Kabirdham (CG)	Kabirdham (T)
			3. Balaghat (MP)	North Balaghat (T)
			4. Rajnandgaon (CG)	Rajnandgaon (T)

Source: Kanha Tiger Reserve (2021)

The Kanha management regards the relocation of the 37 forest 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-25)**.

As the sole objective of village relocations was to reclaim and release additional wildlife habitat, the Kanha management strived to expedite the restoration of these abandoned sites by taking up a number of managerial initiatives depending upon budgetary provisions. Besides expanding grassland areas by uprooting invasive shrub and tree species and improving them through the eradication of annual and perennial weeds and other unwanted species and planting palatable grass species, new shallow water bodies with palatable aquatic plants were also developed for the hard ground barasingha.

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CHAPTER – 10

ECOTOURISM

10.1 Nature Tourism:

Of late, ecotourism has gained popularity all over the world, and is also known as nature tourism. It 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 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 at Kanha in the strict sense of its definition, the potential of ecotourism involving local indigenous communities for their economic improvement has been recognized in the protected area. 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.

10.2 Brief History of 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 Kanha 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 Kanha 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 Kanha management experienced enough to understand perfectly well how the negative impacts of tourism can be alleviated significantly by prescribing an effective code of rules and regulations and its stringent observance by tourists.

The present core zone initially had a modest beginning of wildlife tourism in the early 1970s, and until 1975-76 fewer than 5000 tourists used to visit 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.

The Kanha 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 supported an outstanding flat 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 core zone immensely popular in the country.

10.3 Tourism 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 the tourism zone of the national park. The sub-prime areas of the protected area were hardly exploited for tourism. Until 2007, the total area of the tourism zone was 226.59 sq. km. This amounted to around 25% of the total area of the national park. The national park had initially two entry gates, one at Khatia, around 65 km. from Mandla, and the other at Mukki, around 13 km. from Baihar and 80 km. from Balaghat.

The area of tourism zone in the national park was, however, expanded to 372 sq. km., with around 40% of the total area of the core zone. A third gate was also opened at Sarhi in the 2007-08 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 around 3 km. away from the village Chikalha around 10 km. from Orai village situated on the Mandla–Raipur National Highway-30A. Orai is 38 km. from Mandla. The Sarhi gate is around 10 km. from Bichiya, block headquarters.

This tourism zone area was again revised to 347.74 sq. km. in 2009 (around 38% of the core zone). This area was, however, later reduced and currently forms only 20% (184.74 sq. km.) of the total area of core zone as per the NTCA guidelines in 2012. The tourism zone supports around 240 km. of total road length.

10.4 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 Kanha 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.

10.5 The NTCA Guidelines for Tourism:

The Supreme Court of India, while hearing the Special Leave Petition (Civil) 21339 of 2011 Ajay Dubey Vs. National Tiger Conservation Authority & others, had directed the Ministry of Environment & Forests and National Tiger Conservation Authority, Govt. of India to prepare effective guidelines for tourism in and around tiger reserves. Accordingly, the NTCA has duly submitted and notified the comprehensive guidelines vide No./15-31/2012-NTCA dated 15 October, 2012 in the Gazette of India, Extraordinary, Part-III, Section-4. Part-B of the document deals exclusively with tourism in and around tiger reserves (**Appendix-26**).

The guidelines also envisage that the State shall ensure that each tiger reserve prepares a ecotourism plan, as part of the Tiger Conservation Plan vis-à-vis the technical Guidelines of the National Tiger Conservation Authority. The plan shall inter alia, include identification of corridor connectivity and important wildlife habitats and mechanisms to secure them. This site-specific ecotourism plan forming part of the Tiger Conservation Plan shall be approved as per the provisions of the Wildlife (Protection) Act, 1972. Prior to this approval, no new infrastructure for tourism (except for minor alterations in existing modest home stays) shall be allowed to be developed in and around tiger reserves. The ecotourism and interpretation sub-plan contained in this chapter is prescribed in the backdrop of the guidelines issued by the NTCA, New Delhi.

As per the above guidelines, the Kanha management reduced the tourism area to 184.74 sq. km. constituting around 20% of the total area of the core zone,

10.6 Tourism Zonation:

On the basis of the nature of tourism activities, the tourism zone of the core zone is divided into 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.

10.6.1 **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.

10.6.2 **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.

10.6.3 **Sub-Zonation:** Presently, the total area of the tourism zone is 184.74 sq. km. constituting 20% of the core zone. The entire tourism zone has been divided into four sub-zones for the convenience of tourists and the Kanha management. These sub-zones along with their areas and road lengths therein are as under:

Table-61: Tourism Zone Area and Road Lengths

Sl. No.	Sub-Zone	Road Length (km.)	Area (sq. km.)
1	2	3	4
1	Kisli	59.50	66.12
2	Kanha	61.70	40.62
3	Mukki	77.83	40.19
4	Sarhi	40.96	37.81
	Total:	**239.99 or 240.00**	**184.74 or 185.00**

Source: Kanha Tiger Reserve (2021)

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10.7 Carrying Capacity:

No vehicular carrying capacity was enforced until 2007 when no more than 300 (150 in morning and 150 in evening) vehicles were allowed every day. Later, this number was reduced to 140 vehicles (83 in morning and 57 in evening) in 2012 as per the guidelines issued by the NTCA, New Delhi under which the Kanha management was required to determine the vehicular carrying capacity of the tourism zone. Accordingly, as stated above, the carrying capacity of 140 vehicles per day, sub-divided into different sub-zones, was determined at the physical, real and effective and permissible levels. This carrying capacity remained in force until October, 2018. Later, however, in the backdrop of enhanced availability of staff, improved tourism road conditions, and better tourism management and facilities, the Kanha management felt that the carrying capacity needed to be increased to give further impetus to conservation awareness in public. In view of this, a committee of senior forest officers, experienced in wildlife management, was constituted at the state level in 2018 to look into carrying capacities of tourism zones of all the tiger reserves, and to rationalize them vis-à-vis the spirit of the decision of the Hon'ble Supreme Court of India and the resultant NTCA guidelines.

The committee examined the previous computation of the carrying capacity for Kanha vis-à-vis the present improved tourism infrastructure and management capacity, and modified the same by increasing it to 178 vehicles per day. The same has been ratified by the Kanha Local Advisory Committee (LAC) dated 21/06/2019.

Needless to add, the carrying capacity of 178 vehicles per day has been determined for the standard type of vehicles approved by the Kanha management for safari purpose. As there is no provision for tourist visitation involving elephant, boat and foot travel in the core area, no such carrying capacity has been assessed. The detailed calculation of the carrying capacity along with the relevant LAC approval are appended **(Appendices-27 to 28)**.

The Carrying Capacity of 178 vehicles has been further divided for entry in the morning and evening sessions. While ceilings of maximum numbers of vehicles in the morning and evening sessions are fixed at 100 and 78 respectively, this can also be changed as per needs of tourism management. The implementation of this vehicle number in different tourism zones and day sessions has been divided on the basis of written instructions from the Principal Chief Conservator of Forests (Wildlife), Madhya Pradesh. Information on booking is as under:

Table-62: Carrying Capacity in Different Tourism Zones with Basic Information

Sl. No.	Sub-Zone	Total Carrying Capacity/ Day	Carrying Capacity							
			Morning				Evening			
			Online Booking	Single Seat	Current Booking	FD Quota	Online Booking	Single Seat	Current Booking	FD Quota
1	2	3	4	5	6	7	8	9	10	11
1	Kisli	25	9	2	2	2	7	1	1	1
2	Kanha	59	24	4	4	4	17	2	2	2
3	Mukki	58	21	3	3	3	19	3	3	3
4	Sarhi	36	13	2	2	2	11	2	2	2
	Total:	**178**	**67**	**11**	**11**	**11**	**54**	**8**	**8**	**8**

Source: Kanha Tiger Reserve (2021)

Presently, on the basis of these vehicle numbers, a total of 178 vehicles are allowed into the four sub-zones through three entry gates, namely Khatia, Mukki and Sarhi.

Tourism in these sub-zones are managed under the rules laid down by the Kanha 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.

10.8 Tourist Influx:

The 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 eleven years (2010-11 to 2020-21) along with some statistical indicators in the core zone is as under:

Table-63: Month-wise Average Annual Tourist Influx with Some Statistical Indicators

Month	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
October	15306	12208	5286	7670	8480	12155	11031	14935	12428	6836	11875
November	25943	23927	14857	16975	16379	17661	17523	17034	21435	20549	20049
December	24652	24544	15948	16052	15638	18469	18858	18953	22971	22287	23882
January	16030	18037	14592	14477	15099	18060	18099	18650	19390	20189	25833
February	15186	16434	13954	12185	12776	14263	14606	14980	16101	19432	22125
March	18134	20171	18211	15941	15914	16432	17404	18171	20541	11960	20569
April	21199	20317	16374	16219	15743	15229	16582	17071	20132	0	6952
May	24020	29589	18463	19718	20989	20985	21138	20908	23070	0	0
June	14303	17127	12772	14434	16626	14888	16934	18424	22713	0	19059
Sum	174773	182354	130457	133671	137644	148142	152175	159126	178781	101253	150344
Mean	19419.22	20261.56	14495.22	14852.33	15293.78	16460.22	16908.33	17680.67	19864.56	11250.33	16704.89
SD	4588.43	5160.81	3927.52	3385.43	3333.50	2642.47	2821.42	1916.68	3548.34	9713.47	8612.25
SE	1529.48	1720.27	1309.17	1128.48	1111.17	880.82	940.47	638.89	1182.78	3237.82	2870.75
Sample Var.	2.1E+07	2.7E+07	1.5E+07	1.1E+07	1.1E+07	1.7E+06	1.8E+06	1.4E+06	1.3E+07	8.6E+07	8.6E+07
Median	18134.00	20171.00	14857.00	15941.00	15743.00	16432.00	17404.00	18171.00	20541.00	11960.00	20049.00
Max.	25943.00	29589.00	18463.00	19718.00	20989.00	20985.00	21138.00	20908.00	23070.00	22287.00	25833.00
Min.	14303.00	16434.00	12772.00	12185.00	12776.00	14263.00	14606.00	14980.00	16101.00	0.00	0.00
Range	11640.00	17381.00	13177.00	12048.00	12509.00	8830.00	10107.00	5973.00	10642.00	22287.00	25833.00
Count	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00

Source: Kanha Tiger Reserve (2021)

Generally, the core zone remains open for tourism from the 1st October to the 30th June. However, between October 1 and 15, not all sub-zones are opened for tourism on account of damaged roads under repair. From the 16th October onward, all the sub-zones remain opened for tourism.

In 2020, however, as per government instructions, tourism in the protected area was closed due to COVID-19 between 20 March to 14 June, 2020. Wildlife tourism was opened again between the 15th and 30th June, 2020. During these 15 days, some special measures were taken by the Kanha management along guidelines issued by the government:

- Sanitizer tanks of 6’x4’ dimensions were ensured at all the entry gates so that vehicle tires may get sanitized before entering the park.
- The entire vehicles were also sanitized at the entry gates by the park staff.
- Every visitor was checked for fever by thermal screening.
- Cash transaction was kept to the minimum.
- IDs were check digitally.
- Sanitizers were made available at all the entry gates for visitors.
- Social distancing and masking was also ensured.

Past experience has helped the Kanha 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 the New Year vacation. Besides, the 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 relatively low numbers of visitors.

10.9 Tourist Accommodation:

As per the NTCA, New Delhi guidelines, infrastructures belonging to the Madhya Pradesh Tourism Development Corporation at Kisli has now been shifted outside the core zone. Besides, the Kanha management does not rent out FRH accommodations to visitors at Kisli and Mukki in the core zone. Modest accommodations at Khatia in the buffer zone, however, are available for tourists. While the accommodations are not fabulous and stylish, they are comfortable and cozy, located amid perfect natural surroundings. These accommodations include hutments and dormitories, and cater for the visitors of all income groups. The accommodations can be reserved in advance by contacting the office of the Field Director, Kanha tiger reserve located at Mandla **(Appendix-29)**.

Table-64: Tourist Accommodation with Number of Rooms and Beds

Sl. No.	Accommodation Type	Number of Rooms	Number of Beds
1	**2**	**3**	**4**
1	Kisli FRH*	7	14
2	Mukki FRH*	4	8
3	Kanha Jungle Camp (Old), Khatia	18	36
4	Kanha Jungle Camp (New), Khatia	10	20
5	Khatia Dormitory	3	20
	Total:	**42**	**98**

**** Not for visitors*** ***Source: Kanha Tiger Reserve (2021)***

10.10Management of the Kanha Jungle Camps, Khatia:

This facility consists of 10 new rooms and 18 old rooms, and three rooms of dormitories. The Kanha management charges Rs. 2000/- per room per day for the new rooms, and Rs. 1000/- for an old room. Besides, Rs. 200/- is charged for per dormitory bed. As per an earlier decision taken by the Kanha management, the accommodation facility is managed by the Kanha Workers' Society. Sixty percent of the revenue received from this facility goes into the Kanha Vikas Nidhi, while 40% into the Kanha Workers' Society.

10.11Entry & Park Timings:

Visitors enter the core zone for tourism through all the three gates after due registration and payment of prescribed charges for current permits. They are required to fill in an application form, which needs their personal details and ID proof etc. They also have to sign an indemnity bond containing promises and declarations by the visitors. The application form also has rules and regulations regarding park excursion **(Appendices-30A, 30B & 30C)**.

Presently, only gypsies are allowed for jungle excursions. Each tourist vehicle has to be accompanied by a route guide. There is also a provision for advanced online bookings for jungle excursions through www.forest.mponline.gov.in **(Appendix-31)**. 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 Kanha 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 core zone. 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 Kanha management has also prescribed seasonal timings for tourism as under:

<table>
<tr><td>01 October to 31 March</td><td>6.30 am to 11.30 am</td><td>2.30 pm to 5.30 pm</td></tr>
<tr><td>01 April to 30 June</td><td>Sunrise to 11.00 am</td><td>4.00 pm to sunset</td></tr>
<tr><td colspan="3">Entry gates are at Khatia and Sarhi (Mandla District), and Mukki (Balaghat District). Only petrol gypsies, diesel-driven TATA canter (18+1 seater) from MP Tourism State Tourism Development Corporation (MPSTDC), and modified bolero camper/ TATA xenon (7+1 seater) are allowed inside the core zone. All these vehicles are required to be manufactured within the last 10 years from the date of registration.</td></tr>
</table>

Table-65: Total No. of Tourists Visiting in the Park (During the Last 11 Years)

Sl. No.	Year	Indian	Foreigner	Total
1	2010-11	140700	34073	**174773**
2	2011-12	154951	27403	**182354**
3	2012-13	109357	21100	**130457**
4	2013-14	112539	21132	**133671**
5	2014-15	118863	18781	**137644**
6	2015-16	130659	17483	**148142**
7	2016-17	135417	16758	**152175**
8	2017-18	139595	19531	**159126**
9	2018-19	156015	22766	**178781**
10	2019-20	90135	13875	**104010**
11	2020-21	150235	109	**150344**

Source: Kanha Tiger Reserve (2021)

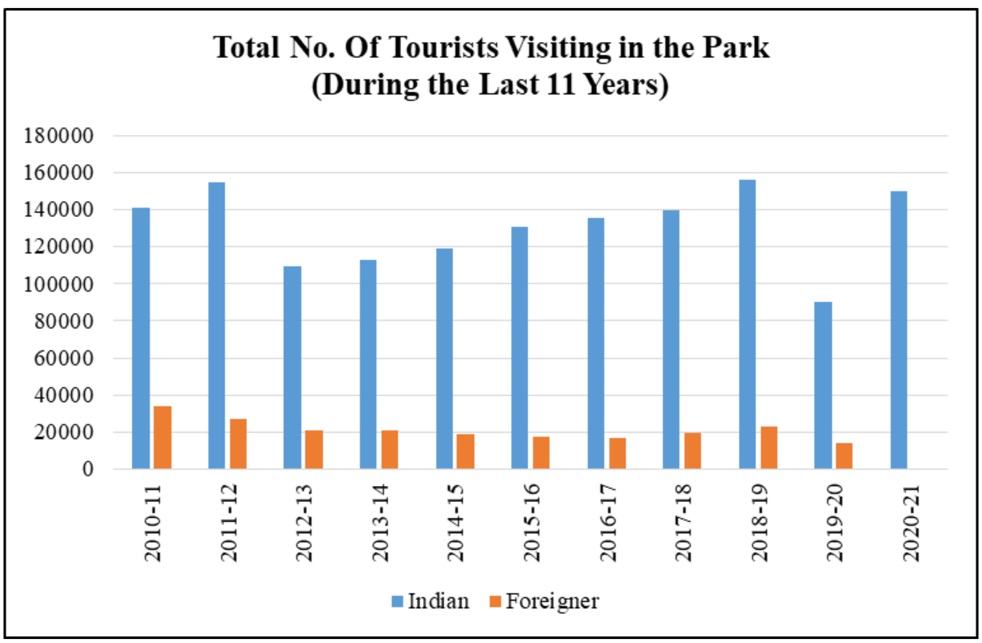

Table-66: Influx of Tourists in the Last 10 Years (2010-11 to 2020-21)

Month	Indian	Foreigner	Total
October	107276	10934	**118210**
November	178405	33927	**212332**
December	203323	18931	**222254**
January	177104	21352	**198456**
February	131494	40548	**172042**
March	146495	46953	**193448**
April	135940	29878	**165818**
May	191174	7706	**198880**
June	167255	2782	**170037**

Source: Kanha Tiger Reserve (2021)

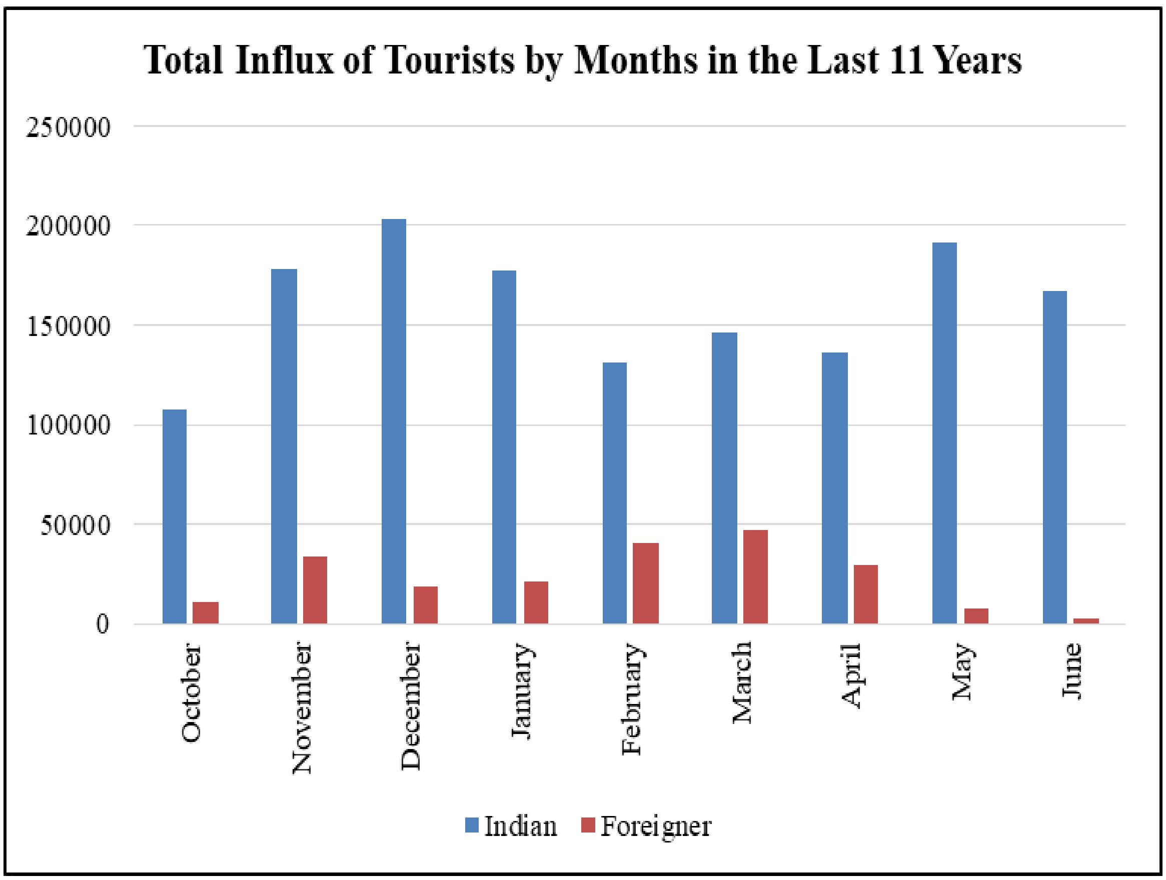

Table-67: Percentage of Indian & Foreign Tourists During the Last 11 Years

Year	Indian	Foreigner
2010-11	80.50	19.50
2011-12	84.97	15.03
2012-13	83.83	16.17
2013-14	84.19	15.81
2014-15	86.36	13.64
2015-16	88.20	11.80
2016-17	88.99	11.01
2017-18	87.73	12.27
2018-19	87.27	12.73
2019-20	86.66	13.34
2020-21	99.93	0.07

Source: Kanha Tiger Reserve (2021)

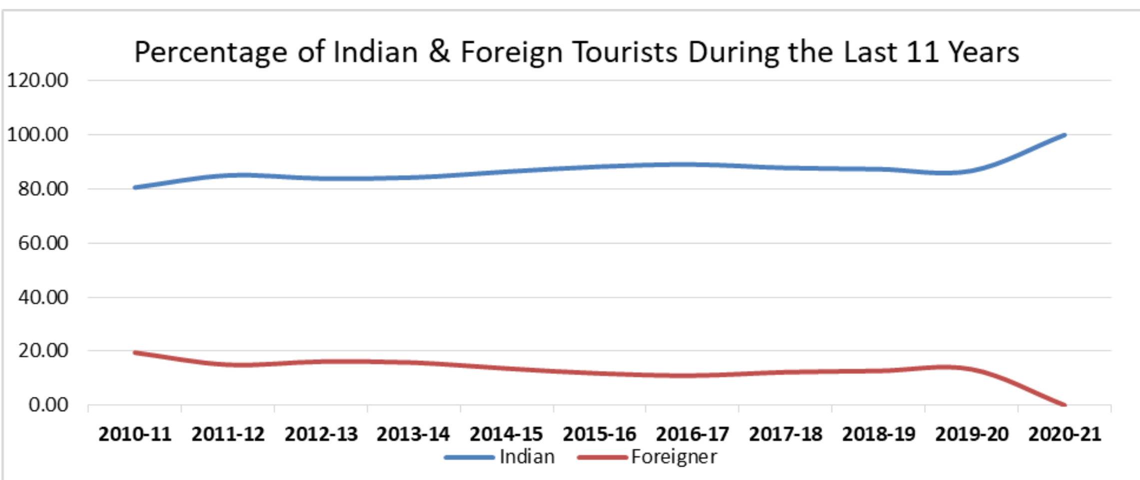

Table-68: Tourists Influx through the Khatia, Mukki and Sarhi Gates

Year	Khatia	Mukki	Sarhi	Total
2010-11	122614	51912	247	**174773**
2011-12	123790	58497	67	**182354**
2012-13	89488	40942	27	**130457**
2013-14	90323	43296	52	**133671**
2014-15	94231	43009	404	**137644**
2015-16	100736	46534	872	**148142**
2016-17	103391	46895	1889	**152175**
2017-18	109959	46961	2206	**159126**
2018-19	118724	56850	3207	**178781**
2019-20	65545	35260	3205	**104010**

Source: Kanha Tiger Reserve (2021)

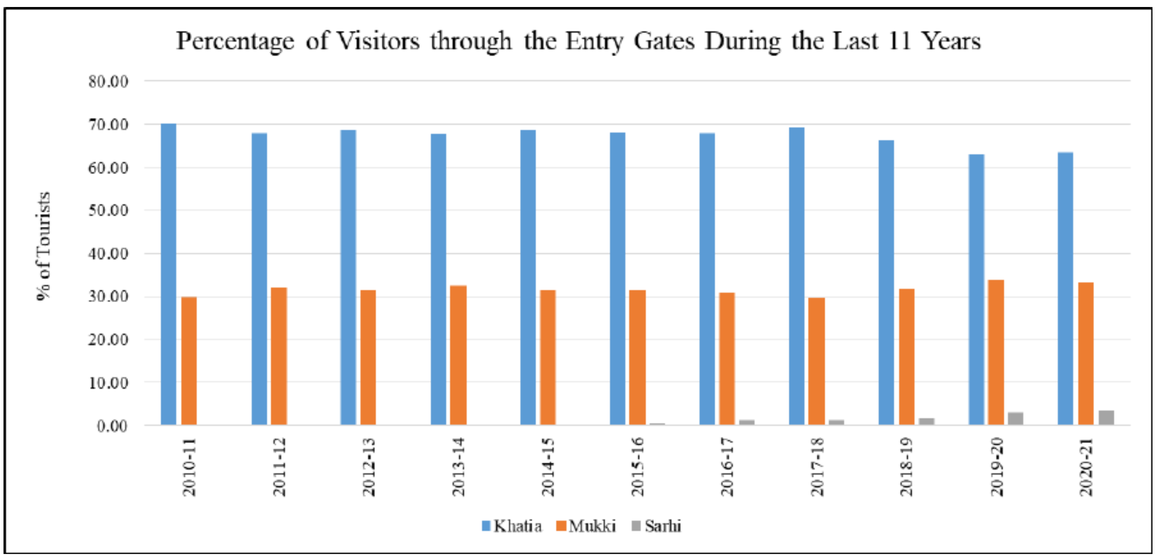

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Table-69: Percentages of Visitors through the Entry Gates & Online Booking

Year	Khatia	Mukki	Sarhi
2010-11	70.16	29.70	0.14
2011-12	67.88	32.08	0.04
2012-13	68.60	31.38	0.02
2013-14	67.57	32.39	0.04
2014-15	68.46	31.25	0.29
2015-16	68.00	31.41	0.59
2016-17	67.94	30.82	1.24
2017-18	69.10	29.51	1.39
2018-19	66.41	31.80	1.79
2019-20	63.02	33.90	3.08

Source: Kanha Tiger Reserve (2021)

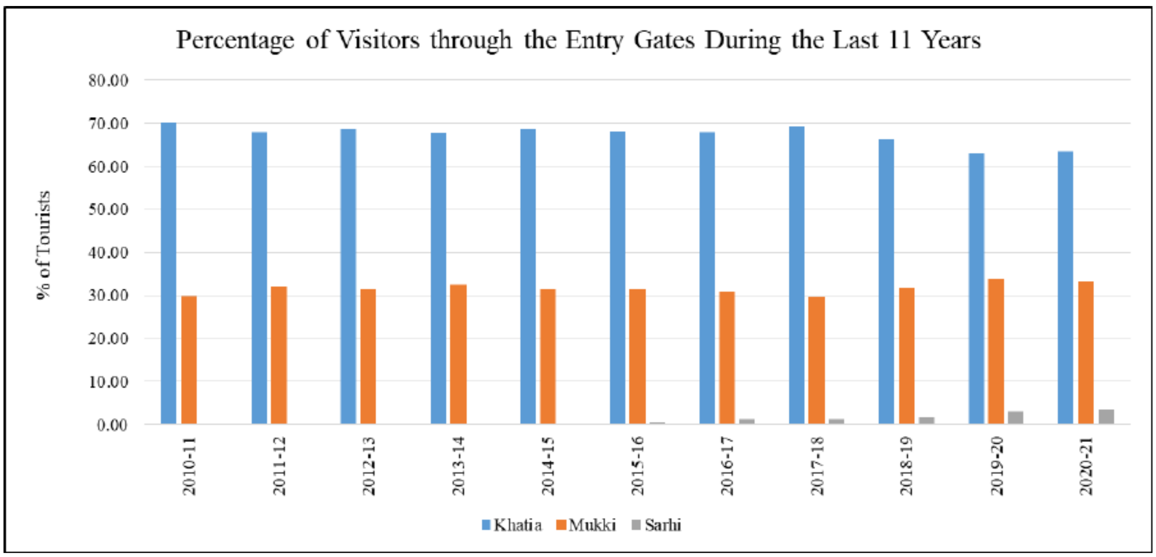

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Table-70: Number of Tourist Permits through the Entry Gates

Year	Khatia	Mukki	Sarhi	Online	Total
2010-11	18436	5689	7	11777	**35909**
2011-12	14316	5547	8	16030	**35901**
2012-13	8613	2362	9	768	**11752**
2013-14	6165	2127	3	19687	**27982**
2014-15	7342	2899	75	18192	**28508**
2015-16	7295	3319	205	19269	**30088**
2016-17	5632	2743	240	28357	**36972**
2017-18	6326	2531	310	31492	**40659**
2018-19	6980	3436	394	35841	**46651**
2019-20	2808	1504	287	19932	**24531**
2020-21	3859	2609	551	26107	**33126**

Source: Kanha Tiger Reserve (2021)

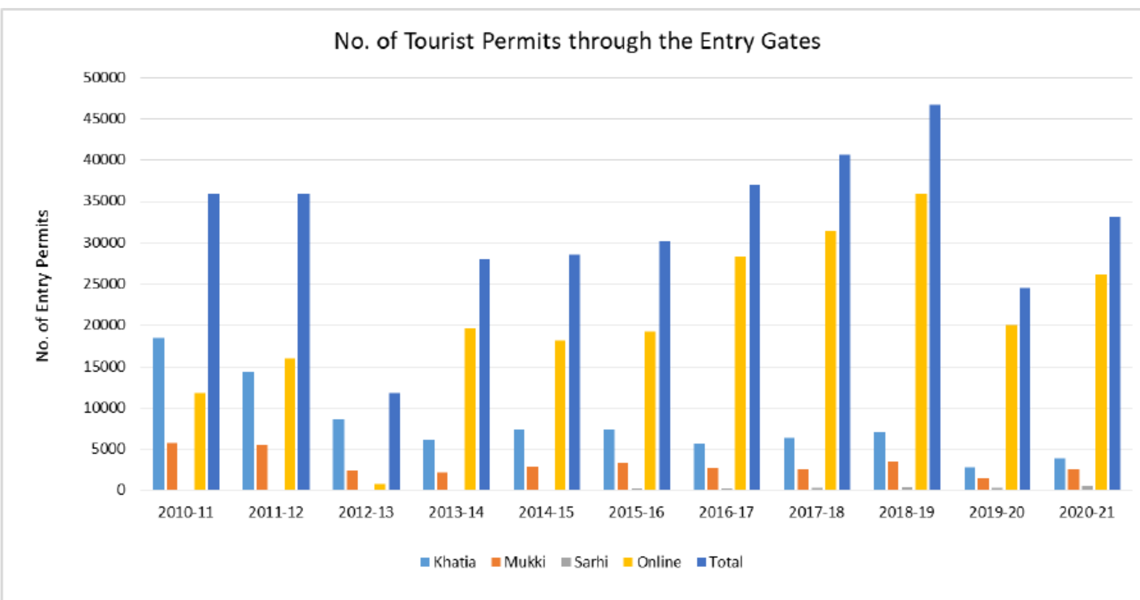

Table-71: Growth % of Tourists with Respect to the Base Year

Year	Tourism Year	Indian	Foreigner	Total	Growth %
0	2000-01	45557	2570	48127	0.00
1	2001-02	53521	1784	55305	14.91
2	2002-03	53498	1977	55475	15.27
3	2003-04	61576	2970	64546	34.12
4	2004-05	67971	3811	71782	49.15
5	2005-06	76774	6490	83264	73.01
6	2006-07	95646	10651	106297	120.87
7	2007-08	113928	18673	132601	175.52
8	2008-09	118002	19293	137295	185.28
9	2009-10	133196	20828	154024	220.04
10	2010-11	140700	34073	174773	263.15
11	2011-12	154951	27403	182354	278.90
12	2012-13	109357	21100	130457	171.07
13	2013-14	112539	21132	133671	177.75
14	2014-15	118863	18781	137644	186.00
15	2015-16	130659	17483	148142	207.81
16	2016-17	135417	16758	152175	216.19
17	2017-18	139595	19531	159126	230.64
18	2018-19	156014	22766	178780	271.48
19	2019-20	90135	13875	104010	116.12
20	2020-21	150235	109	150344	212.39

Source: Kanha Tiger Reserve (2021)

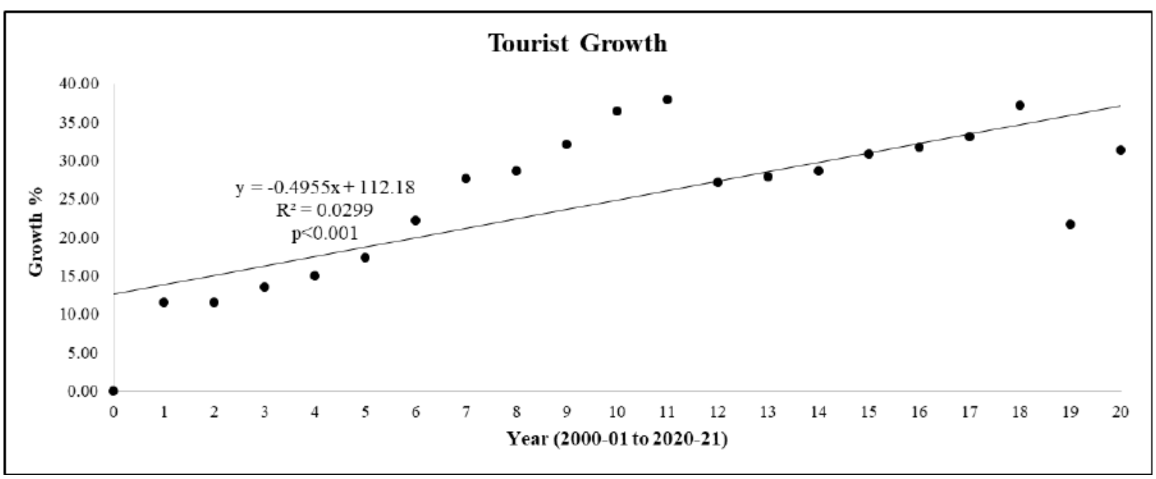

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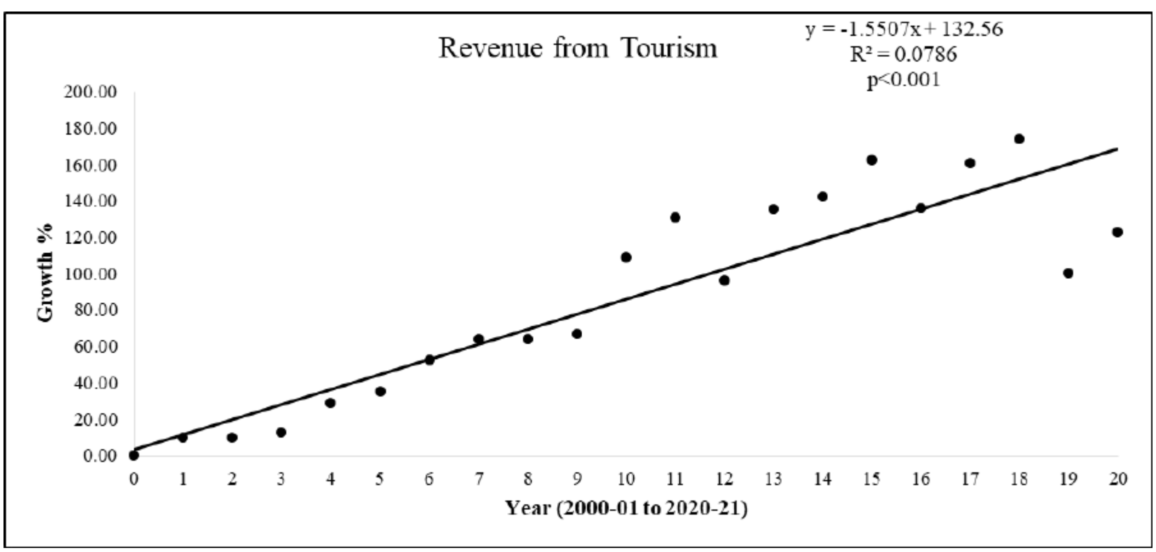
Table-72: Growth % of Revenue from Tourism with Respect to the Base Year

Year	Tourism Year	Indian	Foreigner	Total Revenue (Rs.)	Growth %
0	2000-01	45557	2570	4585652	0.00
1	2001-02	53521	1784	4483013	-2.24
2	2002-03	53498	1977	4394181	-4.18
3	2003-04	61576	2970	5866977	27.94
4	2004-05	67971	3811	13044322	184.46
5	2005-06	76774	6490	15964837	248.15
6	2006-07	95646	10651	23986592	423.08
7	2007-08	113928	18673	29165749	536.02
8	2008-09	118002	19293	29359134	540.24
9	2009-10	133196	20828	30505860	565.25
10	2010-11	140700	34073	50006266	990.49
11	2011-12	154951	27403	59850808	1205.18
12	2012-13	109357	21100	44117280	862.07
13	2013-14	112539	21132	62109430	1254.43
14	2014-15	118863	18781	65266880	1323.28
15	2015-16	130659	17483	74591744	1526.63
16	2016-17	135417	16758	62213737	1256.70
17	2017-18	139595	19531	73553828	1504.00
18	2018-19	156014	22766	79659568	1637.15
19	2019-20	90135	13875	45886552	900.65
20	2020-21	150235	109	56323520	1128.26

Source: Kanha Tiger Reserve (2021)



10.12Tourism Facilities:

The core zone 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 subsequently upgraded in 2005 and 2019. 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-32)** described as under:

10.12.1 **Orientation Centers:** There are two visitor centres, one each near the two entry gates 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 understand the amazing beauty and complexity of the web of life in the tiger reserve.

10.12.2 **The Kanha Museum Complex:** Displayed skeletons of larger mammals, interesting and illustrated notes, models, and 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.

10.12.3 **Light & Sound Show:** Tourists can also enjoy this show to watch a sequence of tiger hunting a chital at night. This is considered a rare event in the jungle.

10.12.4 **Signages:** There are various types of signages at the park entrance and other places within the core zone. 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.

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.

10.12.5 **Amphitheater:** There is also an amphitheater located at Khatia entry point where amazing spectacles of wildlife can be viewed through many national and international digital films on nature and wild animals.

10.12.6 **Vehicular Excursion:** Gypsies of the MPSTDC and private owners are available for hire at the entry gates. 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.

10.12.7 **Route Guide Service:** Route guides, handpicked from indigenous communities with a well-developed jungle instinct, have also been deployed. The Kanha management trains these guides so that they may become aware of Kanha's conservation history, and can 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.

10.12.8 **Joy Rides:** Elephants are also provided to visitors on payment basis at Kisli, Kanha and Mukki for an hour ride along a prescribed route. Visitors can enjoy scenic beauty and watch grazing animals at close quarters.

10.12.9 **Filming:** Film and documentary makers are also provided with elephants early in the morning for a maximum of three hours on payment basis. Vehicular filming is also permitted for the entire day, with some fixed spots in the tourism zone for lunch and rest.

10.12.10 **Nature Trail:** Three nature trails, close to the core zone, one each at Khatia, Mukki (Khapa) and Sarhi (Sijhora), 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.

10.12.11 **Elephant Bathing:** The park management also conducts elephant bathing show at the Gaidhar camp in the Mukki range. Visitors are allowed to watch these pachyderms getting bathed in playful mood from a distance in the buffer zone. This is also a popular tourism activity.

10.12.12 **The Kanha Literature:** This ranges from technical research papers and bulletins to entertaining information on the history, flora and fauna, and local tribes of the core zone. For the visitors who want to carry home these publications for reference, the following are available: brochures, handbooks, coffee-table book, posters, picture post cards, wild animal folder, roadside guide, stickers, and tourist information leaflet.

10.12.13 **Touch Screen:** Available in the Kanha museum complex, the Khatia and Mukki orientation centres, the programme summarizes the entire conservation and management of the Kanha tiger reserve through interesting text, photographs and film footages.

10.12.14 **Canteen:** There are three canteens that provide meals, snacks, and cold & hot beverages, adding to the joy of tourists. Canteens at Kanha and Khatia are run by the Kanha Workers' Society, whereas at Mukki it is run by the Morni-Tejaswani Women Self-Help Group. The women of this self-help group belong to a forest village of the tiger reserve.

10.12.15 **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.

10.12.16 **Public Conveniences:** A 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.

10.13Park Interpretation Programme:

This programme 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:

10.13.1 **Orientation/ Visitor's Centres:** The chief aims of these two 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. This basic orientation at the "visitor centre" makes the visit rewarding and meaningful for the visitors. These centres contain the following:

- **Maps and Panels:** 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, howling of jackals, call of the brain fever bird and call of the chital etc.

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

10.13.3 **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 Kanha 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 Kanha management, the areas of the core zone, national park, buffer zone and the Phen wildlife sanctuary have also been shown.

- **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 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.

10.13.4 **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.

10.13.5 **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 core zone.

10.13.6 **Publications:** The following publications have also been produced to spread conservation awareness in general public:

- 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).
- Shaping Kanha – Dynamics of Wildlife Management (English)
- Barasingha – Conservation at Kanha (English)
- Coffee-Table Book (English)

- Kanha Interpretation Booklet (Hindi/ English).
- Kanha Guide's Guide.

10.13.7 **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:** This is the abandoned site of the first forest village shifted out of the core zone. 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.
- **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.
- **Lapsi Kabar:** Lapsi Baiga was an expert hunter and guide in the bygone era, and a gravestone has been erected here as a memorial to his courage and wisdom.
- **Sondar Tank:** Located at 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 at 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.

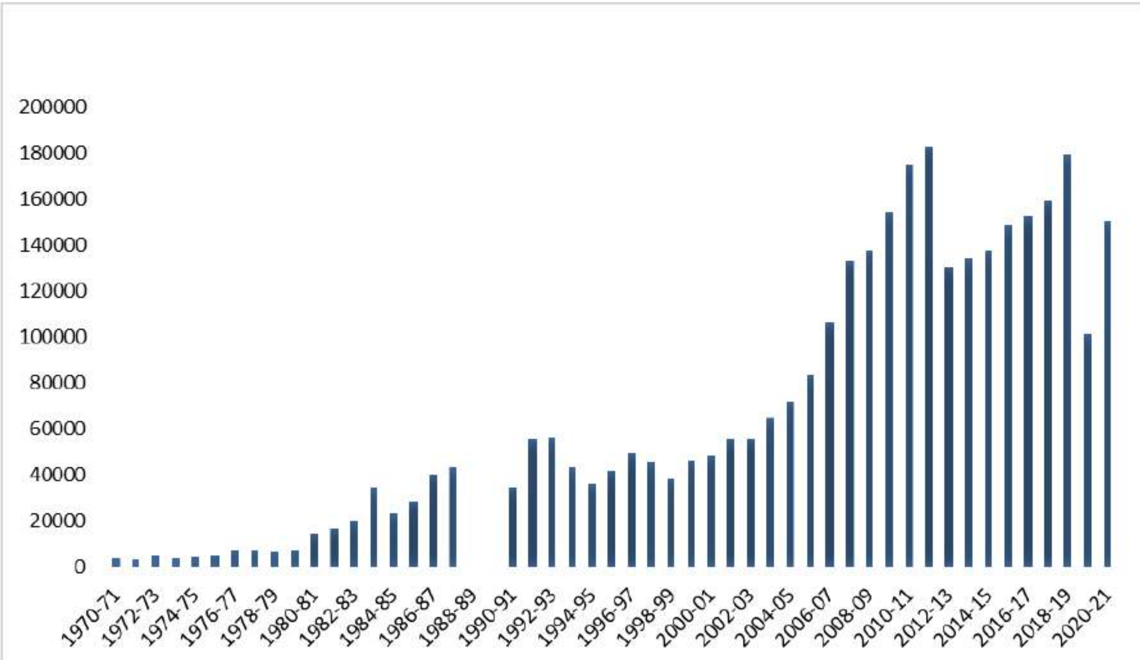
- **Bishanpura–Sondar–Ghorella:** These old village sites have now developed into beautiful grasslands with ample water and are a popular converging point for the herbivores.
- **Kopedabri–Naktighati Sector:** This lies between Mukki and Kisli, and provides wonderful views in the small openings of forests. The area also harbours, besides the tiger, a variety of herbivore species.

10.14Constraints of Tourism:

The Kanha management faces the following constraints of tourism in the core zone:

10.14.1 **Tourism Pressure:** Kanha is now one of the finest wildlife tourism destinations in the country. With its gradual ecological restoration, resulting in an increase in wildlife species populations, and continual inputs for development of tourist infrastructures, Kanha had also started attracting national and international tourists. The number of tourists grew consistently over the years, with 14418 in 1980-81 through 34164 in 1990-91, 55305 in 2001-02, 174773 in 2010-11, and 101253 in 2019-20 (upto March, 2020). 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 Kanha 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. Later, the Kanha management felt the need for another entry gate to ease the tourist pressure off the old gates, and this led to the opening of the Sarhi gate. This area is also gradually developing for tourists.

Total Number of Tourists Visiting the National Park



10.14.2 **Tiger-Centric Tourism:** The number of tourists grew steadily, and crossed the one lakh mark (106297) first time in the year 2006-07. Over the recent years, wildlife tourism has more or less become tiger–centric at 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 only along 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. 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 Kanha management finds tourists often unmanageable, resulting in day to day unpleasant situations and controversies. Ever since the Kanha management has stopped arranging tiger viewings, tourists have started taking interest in the excellent park interpretation facilities at Kanha for the creation of conservation awareness.

10.14.3 **Palpable Impact:** 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.

10.14.4 **Hospitality Ventures:** There is also a number of hotels/ resorts/ dhabas near the entry gates and close to the core zone. These buildings obstruct animal movements and defeat the concept of ecological corridors between two wildlife protected areas. Until a few years back, most of these buildings had boundary walls, and even sold-out plots of land were fenced-in with barbed wires. Needless to add, these non-porous boundaries obstructed the movements of wild animals, including tigers with their characteristic high mobility. Some buildings are still 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 constitution of the Local Advisory Committee (LAC) was effected vide the Govt. of Madhya Pradesh order No. F. 19-26/2010/10-2 dated 24th September, 2013 under the NTCA ecotourism guidelines. The LAC since has enforced tourism management in the tiger reserve, including the control over new constructions in the buffer zone and tourism activities.

The total number of beds around 2150 in these hotels/ resorts has already exceeded the maximum number of visitors (1149 in 2019) 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.

Table-73: List of Hotels/ Resorts

Sl. No.	Name of Resort	Place	Entry Gate
1	**2**	**3**	**4**
1	Kanha Earth Lodge	Narna	Khatia
2	Kamp Camouflage Kanha Homestay	Sarekha	Khatia
3	Bagh Haveli Resort	Khatia	Khatia
4	Bagheera Jungle Resort	Mocha	Khatia
5	Wild Mark Resort	Khatia	Khatia
6	Barasingha Resort	Khatia	Khatia
7	Bison Resort	Khatia	Khatia
8	Celebration Van Vilas Resort	Mocha	Khatia
9	Chital Haven	Mocha	Khatia
10	Flame of the Forest Resort	Kutwahi	Khatia
11	Narmada Green's Resort	Mocha	Khatia
12	Windsor Tiger Resort	Khatia	Khatia
13	Indian Adventure Resort	Mocha	Khatia
14	Kanha Village Eco Resort	Chhapri	Khatia
15	Kanha Resort	Mocha	Khatia
16	Karn Green Safari Resort	Patpara	Khatia
17	Kaushaliya Resort	Mocha	Khatia
18	Kipling Camp	Mocha	Khatia
19	Krishna Jungle Resort	Mocha	Khatia
20	Machan Complex Resort	Khatia	Khatia
21	Travel Woods Resort	Khatia	Khatia
22	Mahua Resort	Mocha	Khatia
23	Meadows Resort (Bagh Dera)	Mocha	Khatia
24	Starling Resort	Mocha	Khatia
25	Motel Chandan Resort	Khatia	Khatia
26	Jungle King Resort	Khatia	Khatia
27	Mridu Kishore Resort	Khatia	Khatia
28	Mistry Meadows Resort	Khatia	Khatia
29	Club Mahindra Resort	Mocha	Khatia

30	Pawar Wadi Resort	Mocha	Khatia
31	GenX Kanha Resort	Mocha	Khatia
32	Pugmark Resort	Khatia	Khatia
33	Wild Camp Resort	Khatia	Khatia
34	United 21 Resort	Mocha	Khatia
35	Sanjay Tiger Resort	Mocha	Khatia
36	Kingfisher Resort	Mocha	Khatia
37	Taal Resort	Khatia	Khatia
38	Tiger Wood Resort	Mocha	Khatia
39	Tuli Resort	Mocha	Khatia
40	Van Vihar Resort	Khatia	Khatia
41	Vansthali Resort	Rata	Khatia
42	Vanya Resort	Khatia	Khatia
43	Courtyard House	Patpara	Khatia
44	Tiger Gric Cottage Resort	Manegoan	Khatia
45	Voila Resort	Chhapri	Khatia
46	Rambhajan Home Stay	Khatia	Khatia
47	Kanha Kiskindha Resort	Mocha	Khatia
48	Shah Vila Resort	Khatia	Khatia
49	Soulacia Hotel & Resort	Khatia	Khatia
50	Mogli Resort	Khatia	Khatia
51	Vanraj Resort	Khatia	Khatia
52	Panther Resort	Khatia	Khatia
53	Dyna Resort	Khatia	Khatia
54	Gharonda Home Stay	Sarhinakan	Sarhi
55	Kanha Forest Home Stay	Sarhinakan	Sarhi
56	Jangle Home Stay	Sarhinakan	Sarhi
57	MPT Jungle Resort	Sarhinakan	Sarhi
58	Hornbill Resort	Bamhni	Mukki
59	Royal Tiger Resort	Bamhni	Mukki
60	Tiger Velley Resort	Bamhni	Mukki
61	Asteya Kanha Hotel & Resort	Bamhni	Mukki
62	Shergarh Camp Resort	Bamhni	Mukki
63	Pahuna Resort	Bamhni	Mukki
64	Heaven Resort	Bamhni	Mukki
65	Kanha Safari Lodge	Manjitola	Mukki
66	Kanha Meadows (Maikal)	Manjitola	Mukki
67	Grand Tiger Resort	Manjitola	Mukki
68	Kanha Jungle Lodge	Manjitola	Mukki
69	Nagpur Bangla	Manjitola	Mukki
70	Banjar Tola a Taj Safari	Manjitola	Mukki
71	Kanha Pride Resort	Sakrahitola	Mukki
72	Sanitary Jungle Resort	Santapur	Mukki
73	Aranya Jungle Resort	Sakrahitola	Mukki
74	The Bagh Resort	Bheema	Mukki

75	Singinawa Jungle Lodge	Kohka	Mukki
76	Lafun Resort	Kohka	Mukki
77	Pipal Resort	Kohka	Mukki
78	Mayura Resort	Dhanwar	Mukki
79	Ever Green Resort	Bhilewani	Mukki
80	Camp Dev Vilas	Gorakhpur	Mukki
81	Kanha in Tiger Resort (Singh Villa)	Kohka	Mukki
82	Chitvan Resort	Samnapur	Mukki
83	Hotel Kanha Resort	Samnapur	Mukki
84	Infinity Kanha Wilderness Resort	Baherakhar	Mukki
85	Baghtola Resort	Samnapur	Mukki
86	Bagh Vilas Resort	Baherakhar	Mukki
87	Seven Tiger Resort	Samnapur	Mukki

Source: Kanha Tiger Reserve (2021)

10.14.5 **Early Opening of the Park:** Until 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 started opening from the 1st October on a trial basis. This practice continued for some years, and presently some parts of the tourism zone is opened from the 1st October. And the entire tourism zone is opened from the 16th October. The Kanha management faces the following important managerial and ecological problems due to this early opening:

- 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 protection, 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 Kanha management has to compromise on protection as there is 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 repairs 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 core zone still receives rains. Besides, in the month of October, a few showers in the first or second week do considerable damage to road repairs, and the roads of the tourism zone have to be re-repaired. Needless to add, a lot of money goes waste.

- Besides, the Kanha management sometimes does not allow tourists to enter the core zone due to unexpected heavy showers in 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.

10.14.6 **Regulation of Tourism:** The Kanha management also takes necessary steps to regulate tourism in the tourism zone. Some of them are as under:

- Regular meetings of Local Advisory Committee (LAC).
- Regular meetings of stakeholders.
- Training of guides and drivers through the Madhya Pradesh Ecotourism Development Board.
- Use of the Bagheera Tourism App for over-speed, zone jumping and crowding of vehicles.
- Imposing fines and banning vehicles for tourism offence.

CHAPTER – 11

WILDLIFE HEALTH & ELEPHANT MANAGEMENT

11.1 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 result in dramatic epizootic outbreaks characterized by high morbidity and mortality.

Experts now suggest that in future climate change will have significant effects on wildlife, domestic animals, 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 Kanha 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 Kanha management is always alert and cautious as far as wildlife health management is concerned.

11.1.1 **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. Currently, a wildlife treatment and care centre has also been established at Mukki, with the latest operation theatre and facilities. The availability of veterinary equipment/ medicines is appended **(Appendix-33).**

11.1.2 **Wildlife Diseases:** While there has been no serious instance of epidemic in the core zone for many years, the Kanha management is always alert and cautious about the outbreak of any such pestilence. The livestock of the villages located very close to the core 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 35 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 eight 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 attached to the present way of life. While the Kanha 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 a sure source of the transmission of diseases.

11.1.3 **Wildlife Diseases Surveillance:** It is a useful and complementary component of human and animal disease monitoring, prevention and control programmes, as well as conservation efforts. At present, the Kanha management only conducts opportunistic postmortem examinations of different wildlife species. Different biological samples are collected for the histo-pathological and parasitological examinations and sent to the School of Wildlife Forensic and Health, Jabalpur. The reports of these examinations are checked and corroborated by the Kanha wildlife veterinarian. For the past two decades, no major outbreaks have been reported at Kanha. The Kanha management remains in constant touch with the veterinary departments of the Mandla and Balaghat districts to identify the pattern of disease occurrence to collect information regarding the domestic morbidity and mortality. Expert opinions from the Veterinary College, Jabalpur are also sought whenever required.

11.1.4 **Treatment of Animal in the Field:** The Kanha management has already established a wildlife treatment and care centre at Mukki, with the an advanced operation theatre and related facilities. Whenever, wild animals, which primarily include tigers, leopards, sloth bears etc., are found injured, orphaned, emaciated, or diseased, these animals need immediate veterinary interventions. Departmental patrolling elephants are used for search and immobilization operations. The wildlife veterinarian is responsible for the rescue, treatment and shifting of these animals from the wild to the treatment and care centre at Mukki. Proper care and monitoring of these animals are carried out until their full recovery. If these animals later become fit for release in the wild fit, the Kanha management makes necessary preparations. If the animal is not suitable for release in the wild, then it is either shifted to a captivity facility or a zoo.

11.2 Reported Diseases/ Infections:

Though in the recent decades, no serious epidemic affecting wildlife has been reported in and around the protected area, history does reveal some serious outbreaks. Mehta (1949-50) has referred to old documents and mentioned ill-fed and unhygienically kept cattle causing rinderpest and foot-and-mouth disease, with the consequent heavy mortality of forest animals. He has also written about a virulent epidemic of rinderpest that occurred in the Banjar range in 1925-26, killing large herds of bison and barasingha.

The disease again broke out in the protected area in 1976, and killed several gaur, sambar and chital (Gopal and Shukla, 2001; Negi and Shukla, 2011). The small population of barasingha, confined only to several small habitat-pockets, however, remained unaffected. Rinderpest has now been eradicated completely from both livestock and wildlife in the world (WOAH, 2011).

Brander (1923) has noted that the barasingha are far more immune and suffer less casualties from rinderpest and foot and mouth disease than do sambar or bison. Schaller (1967) has attributed low fawning rate to abortion of foetuses due to brucellosis, a bacterial disease. It was, however, later proven wrong (Panwar, 1991). Schaller (1967) has also pointed out that the drastic decline in the barasingha population might have caused by disease and predation. He has mentioned two species of pathogenic trematode parasites (*Paramphistomum gotoi* Fukui, and *Gastrothylax crumenifer* Creplin) in the rumen of the deer. These pathogens are responsible for causing paramphistomiasis and acute anaemia, serious diseases, in cattle.

Martin (1978) has, however, recorded that diseases were not really relevant to the decline in hard ground barasingha population, and external abnormalities were seldom discernible. The current management practices and the cervids' response to them has now established that no disease but only poaching and habitat loss were responsible for population decline. On the other hand, a lack of viable habitat, human interference, cattle influx, lack of fawning sites and the like contributed much to the population decline in the past. Gopal (1995) has pointed out that the presence of ectoparasites (*Haemaphysalis bispinosa* and *Lipoptena axis*) and endoparasites (Amphistome group) in the body of this species, as indicated earlier, may further aggravate the body condition of debilitated animals.

Several diseases/ infections have been reported in barasingha. Veterinarians suggest that infectious and parasitic diseases may also become one of the major factors for decline in its population. The occurrence of *Sarcocystis* spp., causing abortion in animals, has been reported in barasingha (Shrivastav et al., 1997).

Many post-mortem examinations of different barasingha carcasses have been conducted by the wildlife veterinarian, veterinary surgeons of the state veterinary department and School of Wildlife and Forensic Health, Jabalpur Veterinary College, Jabalpur. These examinations have revealed moderate to severe ecto and endoparasitic infestations in all the carcasses. Amphistomes were found attached to the inside wall of rumen mucosa, and other parasites like *Haemonchus contortus* on the abomasum wall of barasingha stomach. The infestation of ectoparasite like fleas, ticks, and mites were also reported more or less in all barasingha carcasses. The symptoms of moderate to severe anaemia, weakness, slow movement, rough body coat, alopecia, were reported specially in the sick animals of the barasingha enclosure at Kanha in the past. The enclosure population was found more susceptible to parasitic load as compared to free-ranging population. Sometimes in the pinch period barasingha were also recorded in poor body condition, rough hair coat, and visible bony appearance etc.

Faecal samples of different barasingha populations in the protected area were also collected and examined. They revealed different types of parasitic infestations more or less in all populations. This is very important to conduct epidemiological study of different bacterial, viral and mycotic infections for long term conservation, and to understand ecological interaction between barasingha population and pathogenic agents. It is also important to conduct a complete health investigation profile which should include complete haematology, serology and immunology for randomly selected animals from different populations. No case of mass mortality has ever been reported so far. Only sporadic cases of mortality have been reported in old barasingha due to chronic parasitic infestation leading to immune suppression, anaemia and death.

Cases of tiger predation and infighting between two dominant males have been reported in free-ranging barasingha population. In such cases, post-mortem examinations have shown different types of lesions, suggesting carnivore predation and perforation injury caused by antlers of dominant males during infighting. The post-mortems of new-borns revealed starvation due to separation from mother. Such small fawns had empty stomachs and intestine, with lesions, more or less congestion, and haemorrhages in vital organs.

Tiwari et al. (2007) conducted a study on parasite prevalence in the Kanha tiger reserve and reported parasitic load of strongyles group of nematodes, amphistomes, strongyloides, trichuris, *Moniezia expansa*, coccidia and *Moniezia benedeni* in the hard ground barasingha.

Wildlife health monitoring and disease diagnosis is an essential component of conservation of wild fauna. Since wildlife health management is a new discipline in our country, not much work has been carried out on health management of this species. Therefore, the establishment of a database for forecasting the diseases by performing epizootiological studies throughout the year in and around protected areas is of utmost importance.

11.2.1 **Body Condition Evaluation:** The health monitoring procedure of wild animals is a regular exercise. The commonest method of monitoring the appearance of free living mammals is by the Body Condition Evaluation (Riney, 1960). The BCE is generally expressed in the form of indices, referred to here as Body Condition Index (BCI). The index can be employed to compare the mean body condition of two populations of the same species, amongst different individuals of any particular age and sex category of a population, and between populations of many sympatric species. The BCE involves judging the physical conditions of live animals, based on the visual estimation as the degree of protuberance of body processes and the body surface. Instead of a mere subjective assessment of body conditions as good, fair, poor or as Class-I, Class-II, Class-III and so on, a value of BCI can be obtained by giving scores for different body parts. There is a prescribed format for this evaluation.

11.2.2 **Vaccination:** The cattle of the forest villages of the national park and those of the peripheral villages intermingle with the wild population, and there is always a chance of the transmission of infectious diseases from cattle to wild population and vice-versa. Presently, there are still 8 forest villages in the national park, outside the core, and a sudden breakout of any epidemic may play havoc with the barasingha population in a matter of only a few days. In view of the above, the Kanha management ensures regular immunization programmes for the surrounding cattle population of these forest villages and the villages within the periphery of the 5 km. of park boundary. Currently, the livestock is being vaccinated against polyvalent combined vaccine (Raksha Triovac) of hemorrhagic septicemia, foot-and-mouth disease, and black quarter. This vaccine provides immunity for a period of one year. In case of an outbreak, booster inoculation is recommended for effective development of immunity.

11.2.3 **Mortality Survey:** Mortality and survival rates are two very important characteristics of animal populations. The patterns of mortality and survival within a population suggest a great deal about the population's strategy for survival. As far as small population is concerned, mortality, irrespective of its nature, is a serious issue from the management point of view. This calls for regular mortality surveys in the core zone. The post-mortem of each dead animal is conducted, and as per protocol bio-samples are sent to the School of Wildlife and Forensic Health, Jabalpur Veterinary College, Jabalpur. The management ensures that the information on the mortality of the barasingha is accurate as far as the cause of death is concerned. This mortality survey, incorporating various information on predator, disease, season, and place along with the age class and sex class of the barasingha, may also help understand the predatory regulation of the population to work out new strategies.

11.3 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:

Bacterial Disease:

Sl. No.	Name of the Disease	Etiological Agents	Species Affected	Diagnosis	Prophylaxis	Treatment
1	2	3	4	5	6	7
1	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.
2	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.
3	Pasturellosis	Pasteurella septica	Tiger, Elephant, primates, Gaur, chital,	Blood smear exam. Biological	Adjuvant vaccine upto 300 lb, 2 ml.	Streptomycin 5-10 mg. per lb. b.wt. Sulphameathine

			barking deer, sambar, barasingha, wild boar	tests. Cultural tests.	above 300 lb, 3 ml.	33 1/3% S/C. or I/V gives good results.
4	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.
5	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.
6	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.
7	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.
8	Contagious Caprine Pleuropneumonia	PPLO	Goats	Symptoms cultivation and isolation of the agent. Goats experimentally infected.	Attenuated vaccine 2 ml. S/C	Terraymycine has been found to be effective.
9	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.
10	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.

11	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.

Source: Kanha Tiger Reserve (2021)

Viral Disease:

Sl. No.	Name of the Disease	Etiological Agents	Species Affected	Diagnosis	Prophylaxis	Treatment
1	**2**	**3**	**4**	**5**	**6**	**7**
1	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
2	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.
3	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.
4	Canine distemper	Virus	Canids	Symptoms Biological in Ferrets	Distemper virus vaccine S/C, dose from 6-9 weeks age are protective.	Symptomatic treatment.
5	Ranikhet Disease	Virus	Birds	Symptoms and history of the epidemic. Isolation of the virus int eh egg. HI test.	Attenuated Vaccine 0.5 ml. S/C	Symptomatic treatment.
6	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.

7	Contagious respiratory (C.R.D.) disease	Bacteria & PPLO	Birds	Symptoms, quick agg. test. Isolation of the causal agents.	No effective vaccine	Symptomatic treatment.
8	Rabies	Virus	Carnivores, primates, artiodactylids & proboscida	Symptoms Fluorescence antibody coating test. Biological test mice.	Attenuated Flury strain (L.E.P.) killed vaccine.	No treatment.

Source: Kanha Tiger Reserve (2021)

Parasitic Disease:

Sl. No.	**Name of the Disease**	**Etiological Agents**	**Species Affected**	**Diagnosis**	**Prophylaxis**	**Treatment**
1	**2**	**3**	**4**	**5**	**6**	**7**
1	Fasciola hepatica	Trematode	Primates, artiodactylids & proboscida	Clinical symptoms		Avlothane, I, C.I. Hexachlorethane.
2	Schistosomiasis	S. nasalis	Ruminants & proboscida	Clinical symptoms		Control of snails by ducks and geese and $CuSo_4$. Treatment of water tanks. Antimony preparations.
3	Surra	T. evansi	Carnivores, ruminants & proboscida	Symptoms, Blood smear examination, M.B. 693 test.		Naganol Bayers 205 Antripol Antricide, Diaminazine aceturate
4	Babesiosis	B. canis, B.bigemina	Carnivores, ruminants & proboscida	Symptoms, Blood smear examination.		Acapirin Babosan, Diaminazine aceturate
5	Anaplasmosis	A. marginale	Ruminants & birds	Symptoms, Blood smear examination C.F. test.		Tetracyline 3-5 mg. per lb. b.wt. one injection.
6	Coccidiosis	Emieria	Ruminants & birds	Symptoms and faecal matter examination		Sulpha drugs- Sulphonamide Nitrofurazone 1%, and in food Atebrine.

Source: Kanha Tiger Reserve (2021)

Fungal Disease:

Sl. No.	**Name of the Disease**	**Etiological Agents**	**Species Affected**	**Diagnosis**	**Prophylaxis**	**Treatment**
1	**2**	**3**	**4**	**5**	**6**	**7**
1	Aspergillosis	A. fumigatus	Birds	Symptoms Isolation of the fungus, and identification	-	-
2	Epizoatic lymphangitis	Cryptococcus farciminosis	Equidae	Pus smear examination	-	-
3	Ringworm	Fungus	Carnivores, ruminants & proboscida	Lesion on the affected part, Wood's light, scrapings examination	-	Salicylic ointment, Resorcine, Griesofulvin.

Source: Kanha Tiger Reserve (2021)

Kanha Tiger Reserve, Mandla (MP) 481 661, Phone: 07642-250760 (O), Fax: 07642-251266, Email: fdknp.mdl@mp.gov.in

Some of the common diseases that occur in the villages around the core zone are as under:

Viral	Mycotic	Bacterial
1	2	3
• Rabies	• Dermatomycosis	• Paratuberculosis
• Louping ill.	• Histoplasmosis	• Salmonellosis
• Infectious Hepatitis	• Cryptoccosis	• Leptospirosis
• Vesicular Stomatitis		• Pasturellosis
• Encephalomylitis	**Helminth**	• Brucellosis
	• Fasciolopsiosis	• Anthrax
Protozoan	• Amphistomiasis	• Actino bacillosis
• Trypanosomiasis	• Schistosomiasis	• Black disease
• Toxoplasmosis	• Echino coccosis	• Campylobacteriosis
• Babesiosis	• Trichinosis	
• Sarcosproridiosis	• Anchylostomiasis	**Protozoan**
• Anaplasmosis	• Ascariasis	• Trypanosomiasis
	• Strengyloidosis	• Toxoplasmosis
Ectoparasitic	• Taeniasis	• Babesiosis
• Acariasis		• Sarcosproridiosis
• Myiasis		• Anaplasmosis

Source: Kanha Tiger Reserve (2021)

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

Viral	Mycotic	Helminth
1	2	3
• Rabies	• Dermatomycosis	• Fasciolopsiosis
• Encephalomyelitis	• Histoplasmosis	• Paragonimiasis
• Herpes B. Virus	• Cryptoccosis	• Amphistomiasis
• Vesicular Stomatitis		• Schistomiasis
• Psittacosis	**Rikettsial**	• Echinococcosis
• Influenza	• Q. Fever	• Hymenolepiasis
• Louping ill.		• Cysticercosis
• Lassa fever	**Bacterial**	• Trichinosis
• Infectious Hepatitis A.	• Tuberculosis	• Filariasis
• Lymphocytic choriomeningitis	• Salmonellosis	• Anchylostomiasis
	• Anthrax	• Angiostrongyliasis
Protozoan	• Leptospirosis	
• Trypanosomiasis	• Listeriosis	**Ectoparasitic**
• Toxoplasmosis	• Pasturollosis	• Acariasis
• Leishmaniasis	• Tularaemia	• Myiasis
• Amaebiasis	• Brucellosis	
• Malaria	• Melioidosis	
• Sarcosporidiosis	• Campylobacteriosis	

Source: Kanha Tiger Reserve (2021)

11.4 Vaccination:

As per Section-33 A (1) of the Wildlife (Protection) Act, 1972 (as amended upto 2006) and the Supreme Court's directive the Kanha 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 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 Kanha management for vaccinating village cattle. The livestock is generally vaccinated for (Combined Polyvalent Raksha Triovac) Hemorrhagic Septicemia (HS), Black Quarter (BQ) and Foot & Mouth Diseases (FMD). The wildlife veterinarian, assisted by Corbett Foundation, an NGO, ensures timely and proper vaccination programme before the advent of monsoon. The NGOs provide monthly honorariums to around 20 *gau sewak* for the help in this programme. The vaccines, however, are supplied by the Kanha management. Instances of villagers opposing vaccination have also come to the notice of the Kanha 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 Kanha management. The information on past years' vaccination of Raksha Triovac is as under:

Table-74: Details of Cattle Vaccination

Year	Total No. of Cattle Vaccinated
2005-06	2814
2006-07	3130
2007-08	3114
2008-09	2978
2009-10	1823
2010-11	2316
2011-12	2167
2012-13	2914
2013-14	1993
2014-15	2085
2015-16	2102
2016-17	1960

2017-18	2805
2018-19	1685
2019-20	1949
2020-21	2464

Source: Kanha Tiger Reserve (2021)

Animal	Diseases	Vaccine	Dose/ Route	Immunity
Cattle & Buffaloes	Rinderpest (This vaccination is abandoned due to successful eradication of disease)	• FDGTV (for Indian breeds) • Tissue culture RP 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)
Cattle & Buffaloes	FMD	• Tetravalent (including A-22 Strain) IVRI. Bangalore, BAIF and Intervet Vaccines • Intervet (Concentrated) • Raksha (Ind Immunol) • Raksha OVAC (Ind Immunol)	- 5 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	HS	• Alum – precipitated • Oil adjuvant (IVBP) Pune	5 ml. s/c 2.5 to 3 ml. i.m.	• 6 months • 1 month
Cattle & Buffaloes	BQ	• Alum – precipitated Combined HS, BQ vaccine also available with BAIF	5 ml. s/c	• 6 months
Cattle & Buffaloes	FMD, HS & BQ	• Raksha Triovac	3 ml. s/c	• 1 year
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)	5 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	3 ml. s/c	• 1 year

		vaccinated. 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	CCCP	• IVRI Vaccine	0.2 ml. (at ear tip)	• 1 year
Goats	PPR	• 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

Source: Kanha Tiger Reserve (2021)

11.5 Postmortems:

The Kanha 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 School of Wildlife Forensic and Health, Jabalpur Veterinary College, Jabalpur for pathological, parasitological and other relevant examinations. In view of several cases of deaths by poisoning in the past, the Kanha management ensures to obtain an authoritative/ expert opinion from the State Forensic Laboratory. In case of tiger deaths in the tiger reserve, DNA samples are also sent to the Wildlife Institute of India, Dehradun for repository reference.

11.6 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.

11.7 Wildlife Rescue Squad:

Acting upon the guidelines issued by the Principal Chief Conservator of Forests (Wildlife), Madhya Pradesh, Bhopal, the Kanha 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 19 such Wildlife Rescue Squads (15 regional) have been constituted in the State. The structure of the Kanha Wildlife Rescue Squad is as under:

Table-75: Structure of Kanha Wildlife Rescue Squad

Sl. No.	Designation	Strength	Duties
1.	Assistant Director	1	Head of the Rescue Squad
2.	Wildlife Veterinarian	1	Leader of the technical work
3.	Range Officer	1	For providing necessary support/ assistance to the Rescue Squad team
4.	Dy. Ranger	2	Coordinating members of the Rescue Squad & field work
5.	Forester	2	Assisting the Rescue Squad, & field work
6.	Forest Guards	6	Assisting the Rescue Squad, & field work
7.	Drivers	2	Driving of transportation and rescue vehicles
8.	Labourers	6	Providing manpower/ physical support during Rescue operations

Source: Kanha Tiger Reserve (2021)

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 along with list of rescue equipment and relevant medicines **(Appendix-34 & 35)**.

11.8 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. 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 School of Wildlife Forensic and Health, Jabalpur Veterinary College, Jabalpur, Centre for Cellular & Molecular Biology, Hyderabad and Wildlife Institute of India, Dehradun.

11.9 Management of Departmental Elephant:

11.9.1 **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.

11.9.2 **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.

11.9.3 **Tamed Elephants at 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, known as easy tiger sightings, became popular, and the Kanha management also started charging fee for these events.

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 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 Kanha 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 18 elephants **(Appendix-36)**. At times, these elephants are used for special patrols 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.

11.9.4 **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 Kanha 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 Kanha management has also constructed open sheds that are used during the treatment of sick and indisposed elephants.

11.9.5 **Elephant Health:** The health of the park elephants is of utmost importance to the Kanha 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 Kanha 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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CHAPTER – 12

TIGER LANDSCAPE DYNAMICS

12.1 Background:

Over the years, adaptive management in the tiger reserve has added considerably to the understanding of the intricacies of tiger conservation in the backdrop of typical problems of a rapidly advancing country like ours. The protected area has supported a viable population of tigers for the past many years. So far, no inexplicable instance of any serious downward fluctuation in tiger numbers or any controversy regarding tiger populations has been recorded. The topography of Kanha, with its several vegetal cover types, has given rise to different settings and transitions, with good perennial water holes and rocky outcrops, with natural shelters and dens. All these physiographic and habitat attributes have made the core zone a wonderful tiger nursery. Effectively juxtaposed and interspersed, these wildlife habitats have sustained a large number of ungulates, a good prey base for tigers. Besides, stringent and pro-active protection and adaptive management practices over the years have also ensured outstanding natal areas for tigers within these habitats that have since long witnessed a huge number of tiger cubs reared to adulthood and integrated into this wildlife ecosystem.

12.2 Breeding/ Natal Areas of Tigers:

As already mentioned, tigers' prey base populations in the core are not well distributed but rather patchy in relatively good habitats, with ample water, forage, shelter and cover. This distribution also commands a bearing on movements/ concentrations of tigers. These areas naturally become good breeding habitats/ natal areas for the tiger population, and the core zone supports such excellent natal areas in different vegetal cover types. These natal areas have traditionally borne witness to the safe rearing of a large number of cubs and their integration into the tiger population of the protected area. The pregnant tigress starts searching for such safe places during the last around 15 days before the parturition.

Good natal areas must have several adequate cover and concealment places against predators. The tigress remains extremely cautious throughout the first several months while rearing her litter. She may also have to change the hiding place several times, in case of disturbance or danger from other animals. Nearby source of water is another important requirement. The natal areas should also support prey base for hunting. These natal areas are of immense importance for tiger conservation and needs to be protected and developed for this purpose.

12.3 Population Dynamics:

Several important concepts have also been developed from our knowledge of the dynamics of and life events in tiger populations, which are monitored and managed in the protected area on the basis of these crucial scientific understandings. Some basic concepts derived from the above include social organization and land tenure system, home ranging and territoriality, and the source and sink population phenomenon. Now it is established knowledge that tigers need tranquility and undisturbed habitat for breeding and survival to a normal span of around 8-10 years for males and 12-14 years for females in the wild. Tigers have such a high reproductive potential that if there is sufficient prey base and the population is well-protected against the usual decimating factors, they can contribute enormously to a sinking population outside. This is the reason why the number of breeding females in a tiger population is of vital importance to wildlife managers. A viable population of tigers consists of 80-100 animals, with at least 20 breeding females in an inviolate area of around 800-1000 sq. km. (Jhala et al., 2008).

The tiger is a highly mobile and long ranging animal and its survival precariously depends on genetic exchange with other tiger populations in the landscape. In places like Kanha, with a good tiger population, the inherent mechanism in social organization and tenurial complex results in several tendencies/ events within the population, such as association, dissociation, dominance, infighting and death. Consequently, some tigers have to move away to peripheral and sub-optimal habitats, even outside the protected areas. Needless to add such suitable habitats, abundant prey and cover are scarce outside the core zone. These tigers have to face a hostile environment of diverse land uses and poaching that ultimately lead to their extermination. In this way, the core zone cannot carry a tiger population beyond a certain limit, and the survival of spill-over tigers outside the core zone is rendered difficult by the incompatibility of land uses for tiger conservation. These incompatible land uses also include many managed forest divisions where forestry operations/ workings prevail over tiger conservation, and the degree of protection is perilously low. Finding on population dynamics of tiger from long-term study is discussed below under the section of field studies.

12.4 Core as the Source Tiger Population:

Presently, the core zone commands an excellent ecological nucleus for the source population of tigers in this tiger eco-region or tiger landscape of around 10000 sq. km. in central India. Kanha supports, though fragmented, natural linkages/ connectivity with several other wildlife protected areas in the region, viz. Phen WLS (MP), Bandhavgarh and Pench TRs (Madhya Pradesh), Bhoramdeo WLS and Achanakmar TR (Chattisgarh), Nagzira WLS and Pench TR (Maharastra). The connectivity between Kanha tiger reserve and these protected areas may be fragile, there is an ample scope for ensuring gene flow from the Kanha core conservation unit by resorting to appropriate site-specific restorative management. Thus, Kanha is considerably significant as a conservation nucleus. Besides, it affords ample scope for fostering eco-regional development to complement the conservation initiatives. Now as breeding tiger populations in the core zone forms the source from which tigers disperse throughout contiguous forests to maintain tiger occupancy of entire landscapes, protecting and managing these source populations is the crux of tiger conservation.

Tiger movements have been reported frequently outside protected areas, sometimes even in the unlikeliest areas on the landscape, such as fragmented forest patches, cultivation fields and close to habitations. However, most of these reports were not relied upon completely due to lack of concrete evidence. In the recent past, camera traps and radio telemetry have helped in the identification of some of these tigers as immigrants from/ emigrants to the core zone itself. The movements of radio-collared tigers well outside the protected area have also confirmed the use of existing, though fragmented, connectivity to some extents in the landscape. Lately, some excellent field studies on genetics, long dispersal distances covered by tigers and on the dynamics of their population in the core zone have added to our knowledge of landscape approach to the conservation of tigers in this eco-region.

12.5 Field Studies & New Methodologies:

During the past several years, studies have also been conducted by the Wildlife Institute of India in collaboration with the National Tiger Conservation Authority, and Kanha tiger reserve to understand tiger dynamics and predator-prey dynamics in the protected areas. Some of these major studies are as under:

12.5.1 **Intensive Monitoring of Tigers, Co-Predators, Prey, and Study of Tiger Dispersal:** This project was started along with the Pilot project of developing monitoring methods for All India tiger estimation in 2002. The project has three phases the output from initial phase (2002-2010) was incorporated in the Tiger Conservation Plan 2011-2021 (Negi and Shukla, 2011). The main objectives of the second phase of the project were:

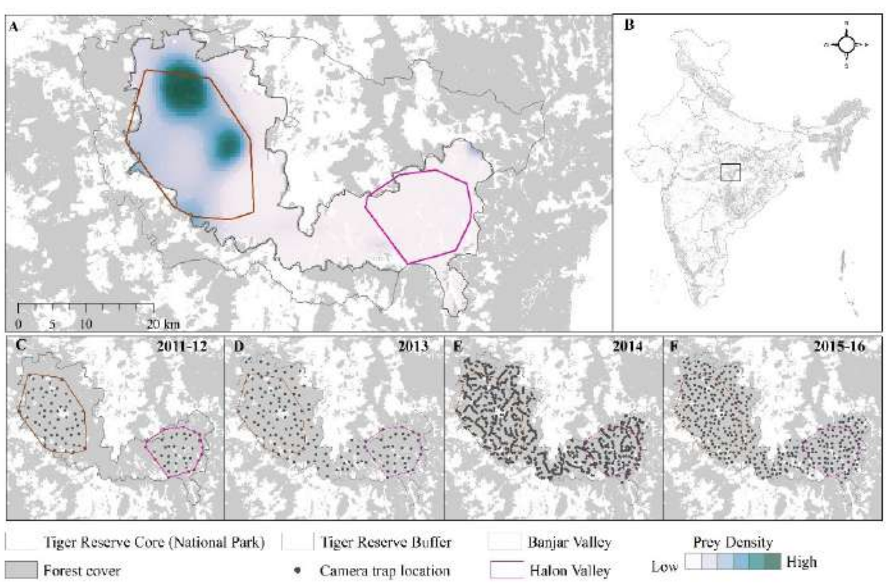
a) Monitoring tigers and co-predators
   - Population dynamics of tiger and leopard
   - Land tenure dynamics of tiger, leopard and dhole

b) Monitoring prey and habitat conditions
   - Population trend of ungulates

c) Developing and testing techniques, analytical tools for country wide monitoring

Demonstration the importance of monitoring, both at local and PA scales, so as to gain an understanding of spatial population dynamics and to guide conservation management with site specific information was the major output of the project.

12.5.2 **Study Design:** The camera trap based mark-recapture framework (Karanth, 1998) was employed to estimate spatially explicit densities of tiger and leopard (Borcher and Efford, 2009). The survey area was divided into two regions, i.e. the Banjar catchment and the Halon catchment based on prey densities and logistic regions. In the initial two years 2011 to 2012, sampling areas were smaller, and an area of 280 sq. km. in the Banjar catchment and 180 sq. km. in the Halon catchment with average trap spacing of 1.8 km. were sampled. Later, from 2013 to 2016 with extra resources, teams were able to sample the entire core zone. From experience, it was learnt that sufficient recaptures for leopards were not received for precise abundance estimation, when camera traps were optimized for tigers. This was because leopards had smaller home ranges and were more "trap shy". Then the team subsequently increased the camera density by reducing inter-trap distance. Extensive sign surveys were conducted to select the best possible location of camera traps. Camera traps were placed on the forest roads, animal trails and dry streams that were intensively used by tigers and leopards to maximize the detections (Karanth and Nichols, 1998, 2002). Individual tigers and leopards were identified through their pelage pattern and prepared capture histories for each individuals using Program Extract Compare (Hiby et al., 2009) and Hotspotter (Crall et al., 2013). For prey estimation, the line transect design has been described within the section (Phase-IV monitoring) of this chapter.



Study area and study design at Kanha tiger reserve A) Map showing Kanha TR management units and prey density surface (Negi & Shukla, 2011; Jhala et al., 2014 b) in 2011 & 2012, (C) in 2013, (D) in 2014, and (E) in 2015 & 2018. Data from areas that were consistently sampled across all years (the Banjar catchment -brown polygon, the Halon catchment-blue polygon).

12.5.3 **Population trend of Tiger and Leopard:** Often abundance estimates and population trends of threatened species are required for evaluating the success of management actions and prioritizing conservation investments (Krebs, 2009). Despite their ecological importance, there are limited studies on long-term population trends of large carnivores (Durant et al., 2011). Development of camera trap based classical capture-recapture (Otis, 1978, Karanth & Nichols 1998) is the method of choice for estimating abundance of uniquely identifiable individuals of a species e.g. tiger (Karanth & Nichols, 1998), jaguar (Kelly, 2003), leopard (Harihar et al., 2011) and ocelots (Trolle & Kéry, 2005). Most studies on tigers and leopards are limited to assessment of their abundance (Jhala et al., 2015, Karanth & Nichols 1998, Kalle et al., 2011, Harihar et al., 2011), while studies that address other demographic parameters are rare (Bisht et al., 2019, Smith & McDougal, 1991, Karanth et al., 2006, Sadhu et al., 2017). Most population trend studies on tigers use either classical non-spatial closed capture-recapture models (Karanth et al., 2006, Harihar et al., 2009) or statistically less rigorous track counts (Miquelle et al., 2015). Herein, the project team has used spatially explicit capture recapture (SECR) (Borchers & Efford, 2008, Royle et al., 2009) to estimate tiger and leopard spatial densities, sex ratios (Sollmann et al., 2011) and their trends over a six-year period in the Kanha core zone, a major stronghold for both species in central India.

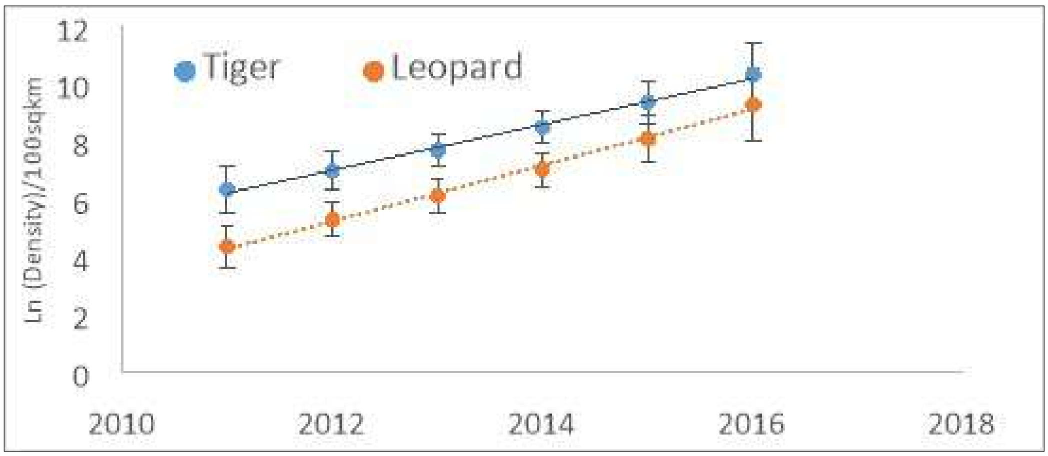
12.5.4 **Methods:** Maximum likelihood based Spatially Explicit Capture Recapture (SECR) were used to estimate densities (Borchers & Efford, 2008). The basic parameters for this model are detection probability at the home-range centre, g_0

and spatial scale of detection, σ. For SECR animals are assumed to be distributed independently in space and occupy home-ranges. The model incorporates spatial locations of captures to estimate detection probability (g) as a declining function of increasing distance (σ) from the animal's activity centre (Efford et al., 2004) akin to distance sampling (Buckland et al., 2001). We analyzed our data using package "secr" (version 3.1.8) (Efford, 2018) on R platform. For estimating trends in density, we used data from the area that was consistently sampled across all years. Capture histories for tigers and leopards were recorded for both blocks separately between 2011 to 2018 as well as for the entire Kanha core zone between 2013 to 2018. The Multisession model of SECR was used to estimate densities and their trends across all sessions (years), to compute the finite rate of increase (λ) by fitting session as a predictor in the model (Efford, 2018). Males and females of large felids have different home-range sizes (Sunquist & Sunquist, 2002). Hence, sex specific movement could potentially be a source of variability in capture probability (Efford & Mowat, 2014). Genders of tigers and leopards were identified based on genitalia and secondary sexual characters (nipples) from the long-term dataset. Potential sources of variability in the data were accounted by modelling g_0 and σ as a function of gender and sampling year (as density was likely to change between years and potentially alter σ).

12.5.5 **Results:** The best model for the analysis of the entire core zone data as well as individual blocks/catchments was where variation in g_0 and σ were explained by sex as well as sampling years for both tigers and leopards. Tiger density ranged from 4.82 ± 0.33 to 5.21 ± 0.55 per 100 sq. km. and the leopard densities varied between 6.63 ± 0.71 to 8.64 ± 0.75 per 100 sq. km. Since variation in sex ratio between years did not contribute to explaining data and was, therefore, not selected in the top model hence overall sex ratio for each catchment was reported. Overall sex ratios in the core zone (M: F) was biased towards females for both tigers **(**0.66 ± 0.03) and leopards **(**0.50 ± 0.02**)**.

The density for both tigers and leopards in the Banjar catchment showed growth with a λ = 1.10 ($CI_{95\%}$ 1.02-1.18) for tigers and λ = 1.15, ($CI_{95\%}$ 1.05-1.27) for leopards (Table 1; Fig 1). While for the Halon catchment, the tiger and leopard densities remained stable at λ = 0.98 ($CI_{95\%}$ 0.86-1.14) and λ = 1.09 ($CI_{95\%}$ 0.98-1.22) respectively.

Population Trends of Tiger and Leopard in the Banjar Valley



Population Trends of Tiger and Leopard in the Halon Valley

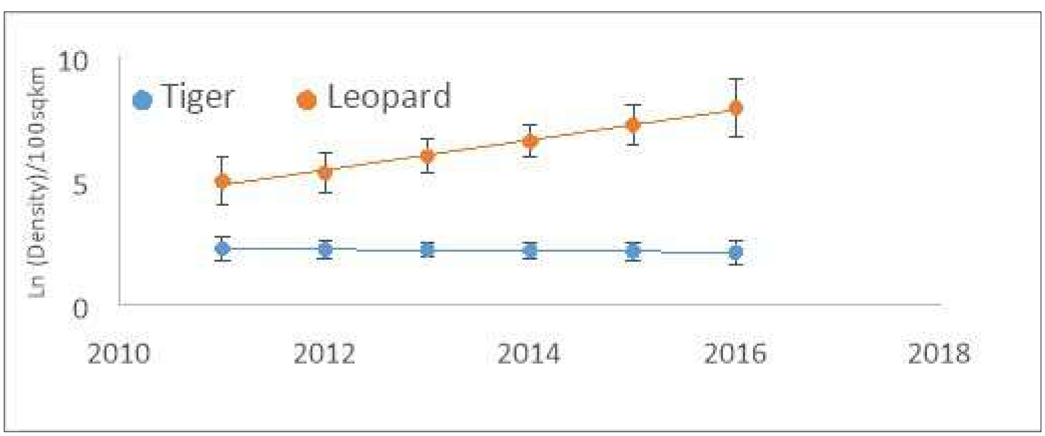


Table-76: Density (±SE at 100 km−2), Detection Probability (g0), Spatial Scale of Detection (σ km), and Detection Corrected Sex Ratio of Tigers in the Core Zone

Site	Sampling Year	Tiger					
		Density (100 km^{-2})	g_0 Female	g_0 Male	σ (km) Female	σ (km) Male	Sex Ratio (M: F)
Banjar Catchment	2011	6.34 ± 0.80	0.07 ± 0.003	0.05 ± 0.001	1.59 ± 0.05	2.56 ± 0.08	0.55 ± 0.03
	2012	6.99 ± 0.64			1.86 ± 0.07	3.00 ± 0.10	
	2013	7.70 ± 0.53			1.64 ± 0.06	2.64 ± 0.09	
	2014	8.49 ± 0.54			1.41 ± 0.02	2.27 ± 0.05	
	2015	9.36 ± 0.74			1.39 ± 0.03	2.25 ± 0.05	
	2016	10.32 ± 1.09			1.27 ± 0.03	2.04 ± 0.04	
Halon Catchment	2011	2.27 ± 0.50	0.05 ± 0.003	0.04 ± 0.003	2.64 ± 0.16	3.74 ± 0.28	0.66 ± 0.06
	2012	2.24 ± 0.37			2.30 ± 0.12	3.25 ± 0.23	
	2013	2.21 ± 0.29			2.46 ± 0.15	3.58 ± 0.23	
	2014	2.19 ± 0.29			2.21 ± 0.89	3.13 ± 0.14	
	2015	2.16 ± 0.36			2.40 ± 0.16	3.39 ± 0.19	
	2016	2.13 ± 0.47			2.08 ± 0.87	2.95 ± 0.13	
Kanha National Park	2013	5.21 ± 0.55	0.04 ± 0.001	0.03 ± 0.0008	2.60 ± 0.50	3.03 ± 0.75	0.66 ± 0.03
	2014	5.01 ± 0.34			1.59 ± 0.23	2.37 ± 0.45	
	2015	4.87 ± 0.33			1.95 ± 0.35	2.91 ± 0.52	
	2016	4.82 ± 0.33			1.85 ± 0.30	2.76 ± 0.44	
	2017	5.81±0.67			1.76±0.39	4.48±0.76	
	2018	5.83±0.53			1.79±0.027	5.5±0.18	

Source: Wildlife Institute of India (2021)

Table-77: Density (±SE at 100 km−2), Detection Probability (g0), Spatial Scale of Detection (σ km), and Detection Corrected Sex Ratio of Leopards in the Core Zone

Site	Sampling Year	Leopard					
		Density (100 km^{-2})	g_0 Female	g_0 Male	σ (km) Female	σ (km) Male	Sex Ratio (M: F)
Banjar Catchment	2011	4.36 ± 0.76	0.003 ± 0.001	0.003 ± 0.001	1.39 ± 0.09	2.98 ± 0.2	0.45 ± 0.09
	2012	5.30 ± 0.66			1.64 ± 0.12	2.71 ± 0.08	0.37 ± 0.08
	2013	6.10 ± 0.57			1.30 ± 0.08	2.58 ± 0.08	0.35 ± 0.08
	2014	7.03 ± 0.59			0.79 ± 0.04	1.66 ± 0.07	0.54 ± 0.08
	2015	8.09 ± 0.80			0.78 ± 0.05	1.68 ± 0.09	1.86 ± 0.09
	2016	9.30 ± 1.26			1.04 ± 0.04	2.23 ± 0.08	0.54 ± 0.07
Halon Catchment	2011	4.98 ± 0.97	0.04 ± 0.004	0.03 ± 0.002	1.21 ± 0.11	2.48 ± 0.20	0.46 ± 0.04
	2012	5.32 ± 0.80			1.23 ± 0.12	2.54 ± 0.21	
	2013	6.00 ± 0.67			1.17 ± 0.09	2.41 ± 0.20	
	2014	6.59 ± 0.64			1.05 ± 0.08	2.16 ± 0.20	
	2015	7.24 ± 0.82			1.01 ± 0.06	2.08 ± 0.13	
	2016	7.95 ± 1.19			1.34 ± 0.07	2.76 ± 0.13	
Kanha National Park	2013	6.63 ± 0.71	0.018 ± 0.001	0.02 ± 0.001	1.40 ± 0.06	2.52 ± 0.09	0.50 ± 0.02
	2014	7.24 ± 0.49			1.34 ± 0.04	2.44 ± 0.06	
	2015	7.90 ± 0.46			1.59 ± 0.63	2.86 ± 0.08	
	2016	8.64 ± 0.75			1.84 ± 0.50	2.92 ± 0.07	
	2017	Not Estimated yet			Not Estimated yet	Not Estimated yet	
	2018	Not Estimated yet			Not Estimated yet	Not Estimated yet	

Source: Wildlife Institute of India (2021)

12.5.6 **Discussion:** The overall density of tigers and leopards in core zone did not show any trend. The density of leopards was significantly higher than tigers. The two sampling blocks, the Banjar and the Halon catchments were selected based on substantial differences in prey densities and conservation investments with the objective of studying the response of large carnivores to these differences. Contrary to our expectation, both predators occurred at reasonably high densities and both showed positive growth in the Banjar catchment. Here the tiger density significantly increased from 6.34 to 10.32 per 100 sq. km., while leopards increased from 4.36 to 9.30 per 100 sq. km. While in the Halon catchment that had fewer prey and less investment in conservation management, both carnivores did not show a detectable increase. Tigers are more K-selected when compared to leopards (Chapron et al., 2008), and should exhibit slower life history traits manifesting in slower population growth when compared to leopards. But contrary to expectations, the growth rate of leopards was comparable to that observed for tigers. This result is suggestive of competitive inhibition of leopards by the larger tiger. Besides competing for food (which was plentiful), tigers are known to pursue and kill leopards (McDougal, 1988). Leopard densities were significantly higher compared to tiger densities in the Halon catchment and both carnivore populations did not show growth here. It is believed that this was due to high human disturbance and possibly poaching of prey and carnivores. Leopards fare better than tigers in the face of poaching due to higher illegal demand for tiger body parts, as well as by having faster life history traits compared to tigers (Chapron et al., 2008). This was reflected in Halon catchment that had more leopards compared to tigers. The results also show that σ, an index of home-range size, was similar for tigers and leopards, suggesting that leopards had to invest almost as much as tigers, that are almost three times larger in size, for surviving in the core zone. This further points to the high adaptability of leopards that not only survive well in human dominated landscapes (Athreya et al., 2013) but also do well in areas with high tiger density through higher investments (e.g. maintaining large home-ranges). Though camera trap based SECR with sex based heterogeneity models (Solmann et al., 2011) have provided these ecological insights, a telemetry study on leopards would permit a better understanding on how leopards adept to high density of tigers and still manage to increase in numbers.

12.6 Population Dynamics (Reproductive parameters, Survivorship and Dispersal etc.) of Tiger:

These parameters are important to device recovery strategies for endangered species. Limited information is available on the tiger's vital rate. Camera trap based demographic parameters cannot distinguish between dispersal and mortality and lump these as apparent survivals. Continuous monitoring of individually known animals through radio-telemetry and/or by other means, which permits the researcher to determine the fate of the animal, provides a correct estimate of survival by differentiating between mortality and dispersal. However, till date there has been no study of a carnivore population where demographic information is simultaneously obtained with both approaches i.e. camera trapping and individual known animal monitoring. This was the first study which used both camera trap based mark-recapture and continuous monitoring known fate information to estimate reproductive parameters along with age specific survival and dispersal probability of tigers.

12.6.1 **Methods:** Data from 127 tigers, those were regularly monitored since 2005 to 2018 were collated. Regular monitoring of tigers was done by the forest staff and researchers on elephant back or gypsy, through routine foot patrolling by trackers, radio-telemetry and camera traps. Thirteen tigers were radio-collared between 2005 to 2014 under the long-term tiger-monitoring project in Kanha tiger reserve. Each tiger was identified either through its pelage pattern or through VHF frequency of its collar. Information on their fate (live, dead, and censored) at every six months was prepared in the known fate model matrix. Tigers were aged as under:

Table-78: Tiger's Age and Stages

Age	Stage
0-1 year	Cubs
1-2 years	Juvenile
2-3 years	Sub-Adult
3-5 years	Young Adult
5-10 years	Prime Adult
10-18 years	Old Adult

Source: Wildlife Institute of India (2021)

Age/ stage specific true survival were estimated. This model provides true survival estimates from the individuals whose fates are known throughout their life span. Tenures of male tigers were also calculated using long-term monitoring. Reproductive parameters such as Litter size, Inter-birth interval and age of first reproduction was estimated based on regular monitoring of females. Apparent survival was estimated through the Pollock robust design camera-trap based mark-recapture for 7 years of annual sampling. Then dispersal rate (emigration) was separated from mortality by subtracting apparent survival from true survival.

12.6.2 **Results:** Females showed higher survival throughout their adult stages. Male tigers exhibited a typical Type II survivorship curve while survivorship of tigresses was a curve between Type I & II).

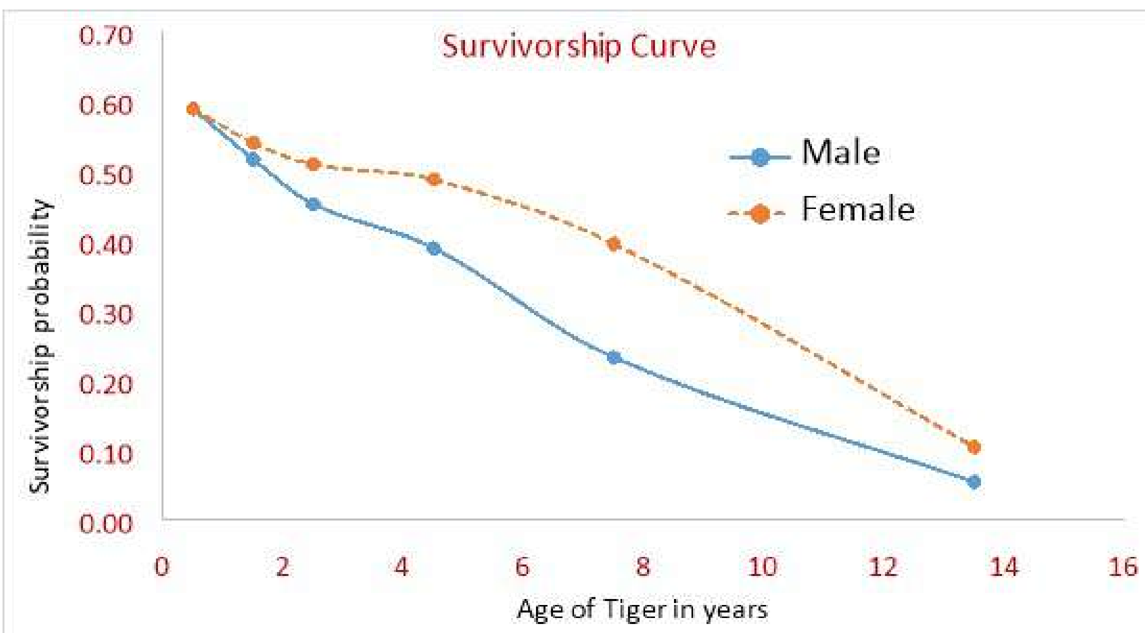


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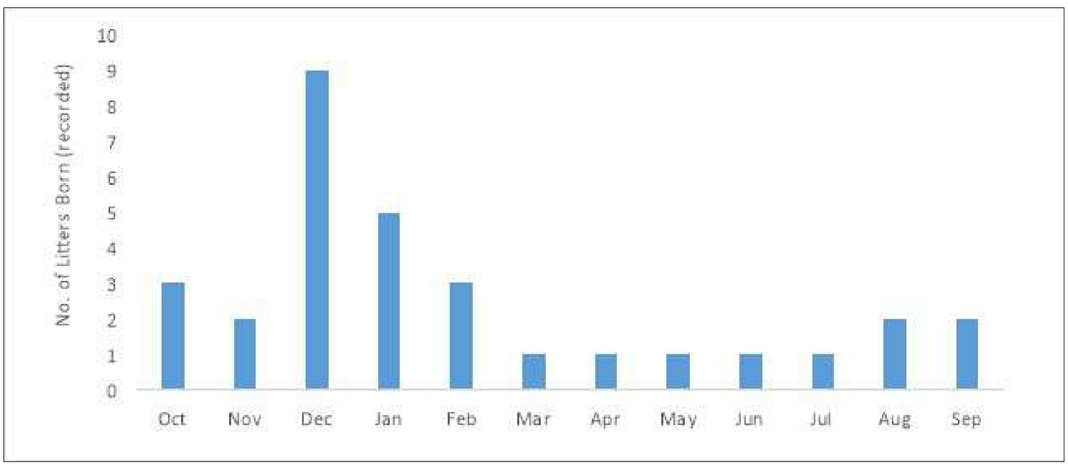
Table-79: Reproductive Parameters of Tigers in the Core Zone

Parameters	Estimates (±SE)
Breeding female (%)	48.5 (±1.5)
Litter size	3.24 (±0.13)
Cub survival	0.59 (±0.06)
Age of first reproduction [Years]	3.30 (± 0.13)
Inter Birth Interval [Years]	1.83 (± 0.22)
Age of Dispersal (Female) [Years]	1.95 (± 0.03)
Age of Dispersal (Male) [Years]	2.3 (± 0.12)
Tenure of Resident Male [Years]	3.28 (± 0.26)

Source: Wildlife Institute of India (2021)

No. of Tiger Litters (n=31) Born During the Months in the Core Zone



December month followed by January has been reported with the maximum litters. From camera trap based mark-recapture Pollock robust design during 07 years of the study (2011-2017) a history of 147 individual tigers (77 males and 70 females) were obtained. The point estimates of apparent survival of females (0.84 ± 0.025) was higher than males (0.75 ± 0.035) as expected. Population turnover rate was estimated to be 40 (SE 11) % and 13 (SE 4.5) % for male and female tigers respectively. The average recruitment rate was 9.4 (± 4.5) and 6.39 (± 1.01) individuals per year for male and female tigers respectively. Dispersal probability was estimated to be 09 (02-09) % for males and 08 (03-09) % for the female tigers.

12.6.3 **Discussion:** The results of this study concede the importance of wildlife corridors between protected areas for long-term survival. Kanha is the largest source population in central India and well connected to the Pench, Achannakmar, Navegaon Nagzira tiger reserves. Kanha has also connectivity with Bandhavgarh and Indravati tiger reserves through a fragmented linear forest patch. The genetics evidence of emigration is well-studied and genetic signature of Kanha tigers were found in Pench, Tadoba, Satpuda, Achankamar and Bandhavgarh tiger reserves (Yumnam et al., 2014, Sharma et al., 2013). Yumnam et al. (2014) found 4 males and 1 female migrants from Kanha in the Kanha-Pench corridors. Photographic-evidence of dispersals from Kanha to Bandhavgarh, Satpuda, Pench, Sanjay-Dubri, and to the Balaghat, Shadol, Kawardha forest divisions, and the Navegaon Nagzira tiger reserve were recorded based on the data from the All India Tiger Estimation exercise of four cycles 2006 to 2018. On an average, 07 tigers are annually dispersed (9% of the population size) from Kanha to repopulate the nearby tiger landscape.

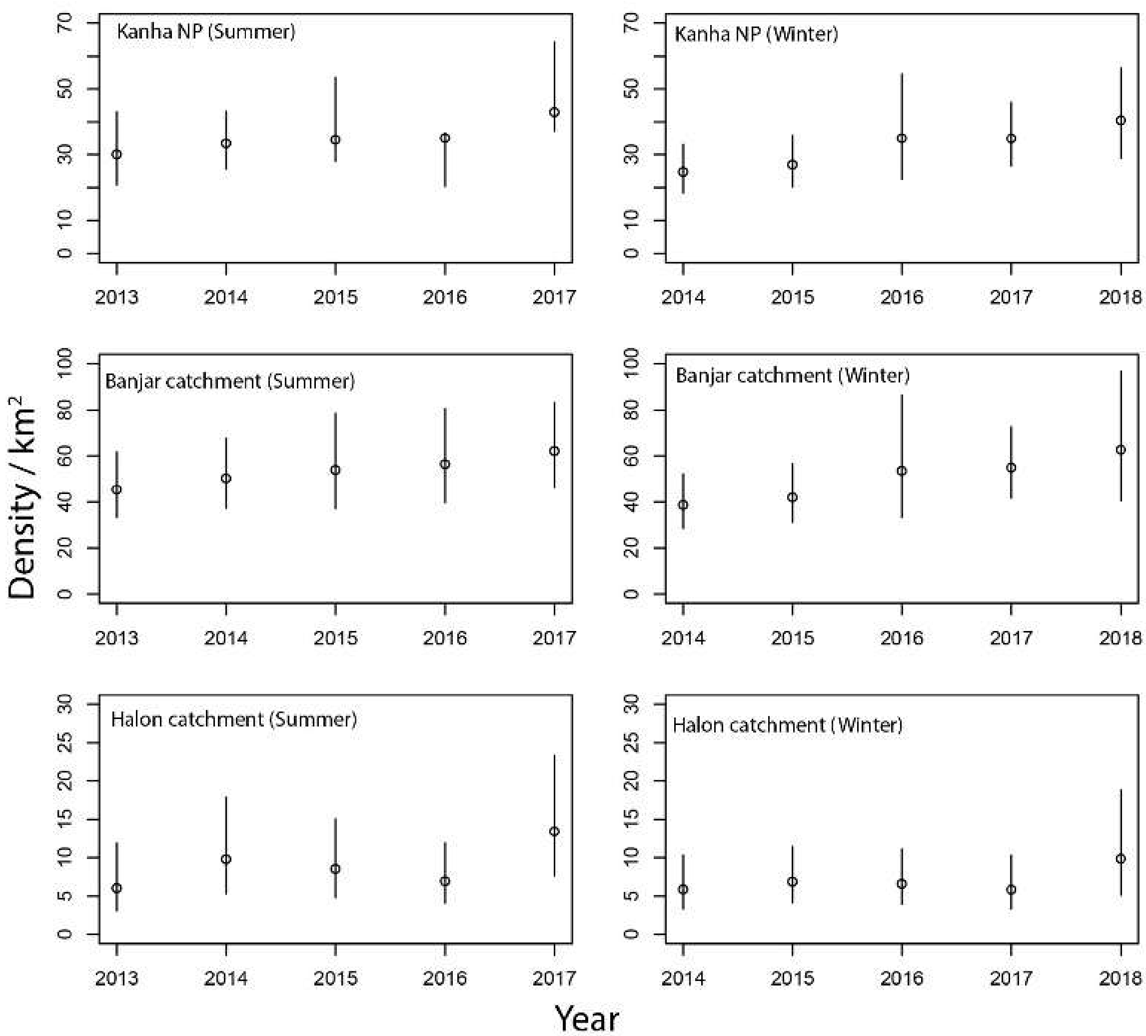
12.7 Prey Monitoring:

Ungulates as prey plays an important role in prioritizing conservation actions for large carnivores. When sufficient prey is unavailable, large carnivore populations will decline, possibly become locally extinct. Therefore, monitoring changes in population size of ungulates over time is critical for effective conservation and management in protected areas. Long term monitoring data will not only help us in decipher population dynamics but will also be of great help in allocating conservation efforts.

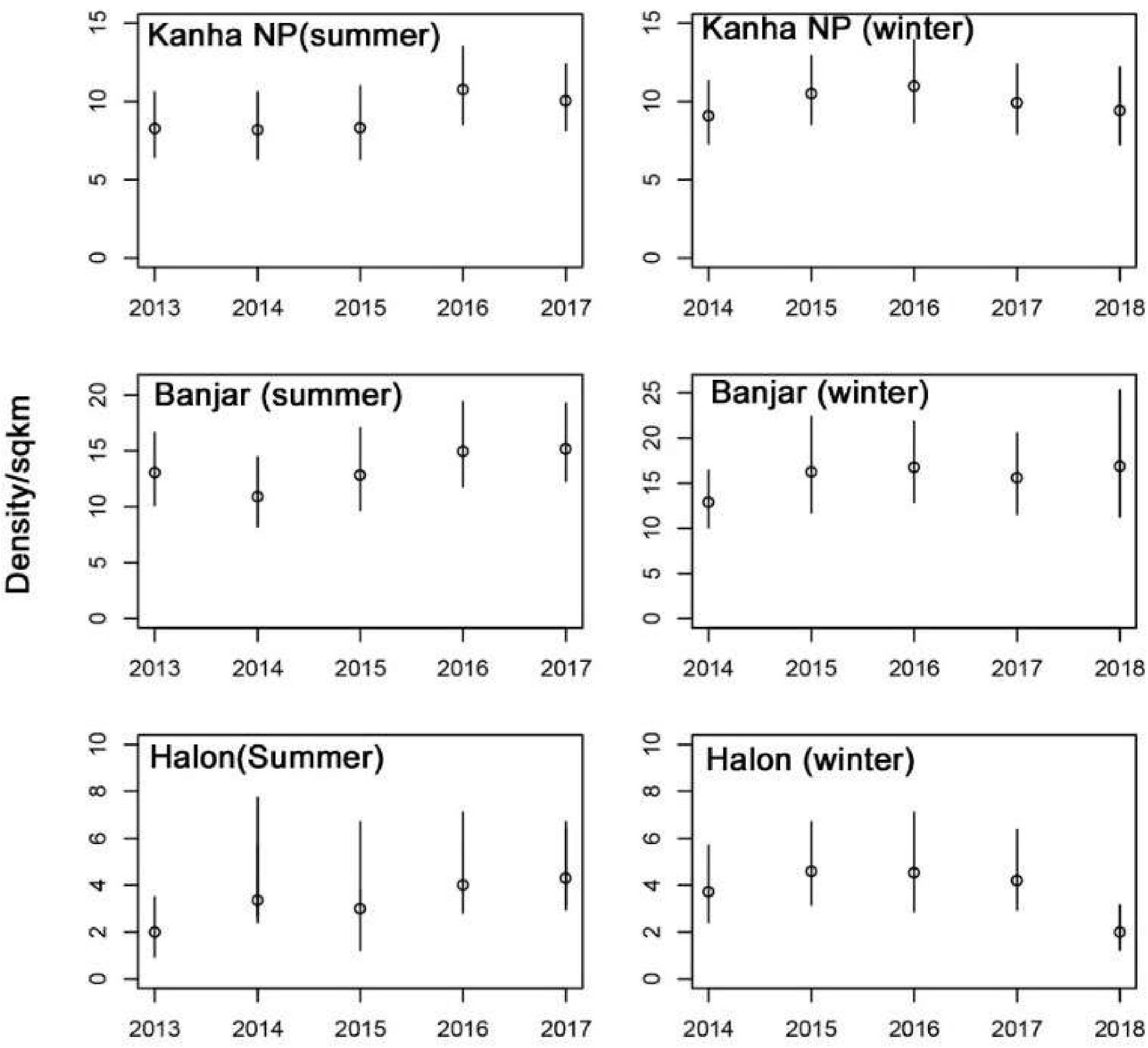
12.7.1 **Method:** Study of demographic patterns of ungulates was carried out at two spatial scales. At the landscape scale, the entire core zone was sampled for ungulate densities and their population trend over the years in each season of summer and winter. While, at a local scale, stratified designs were used in the core zone in two zones; the Banjar (539 sq. km.) and the Halon (402.2 sq. km.) catchments, which differed in terms of conservation investments. Spatial density distribution was developed through density surface modelling of line transect data.

12.7.2 **Results:** Ungulate density showed stable density over the years in the core zone as well as in their local catchments, the Banjar and Halon, in both summer and winter seasons. Amongst all ungulates, the chital only showed significant growth in density (realized rate of increase, r=0.09, SE=0.02; P value=0.0032) over the years in core zone. The chital also shows significant growth rate in local catchment, the Banjar valley (r=0.09 SE =0.01; P value=0.0011) as compared to the Halon valley. The sambar showed significant density growth in the Banjar valley (r=0.06, SE 0.02; P value= 0.0321) (Fig 12.8) while the gaur showed significant growth in the Halon valley (r= 0.25, SE=0.07; P value= 0.00658).

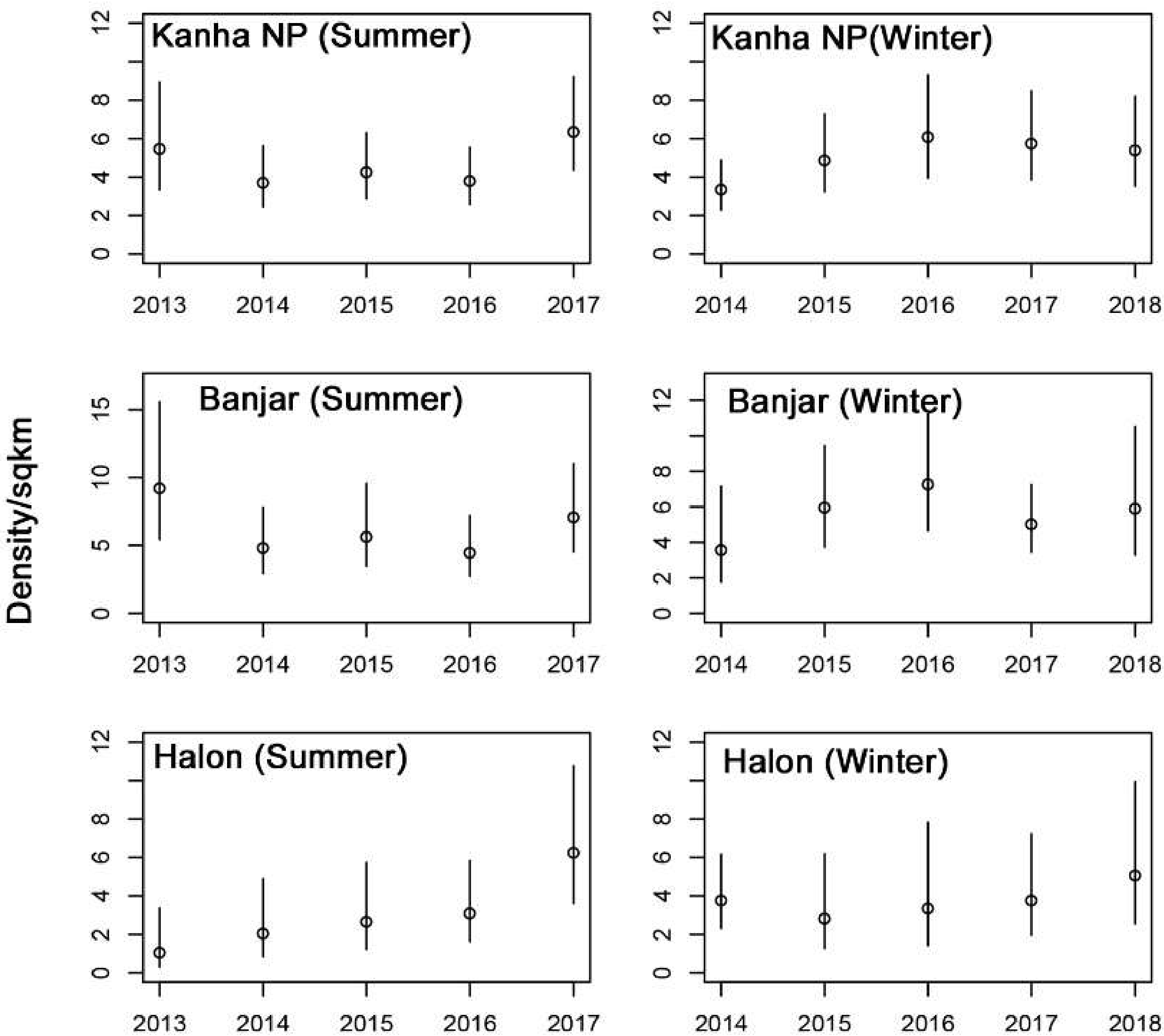
Density Trend of Chital in the Core Zone, Banjar and Halon Catchments in Summer (Year 2013-2017) and Winter Seasons (Year 2014-2018)



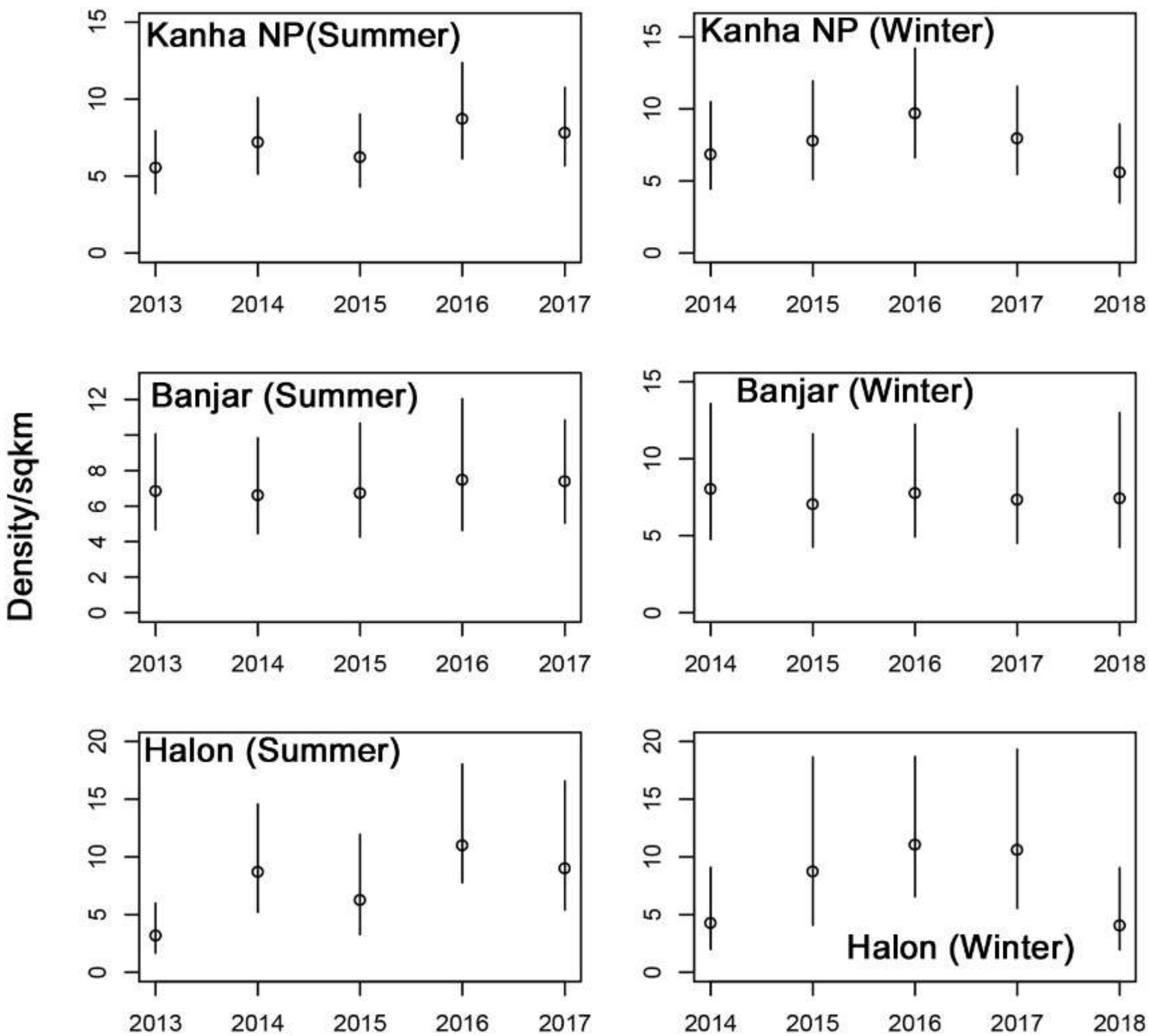
Density Trend of Sambar in the Core Zone, Banjar and Halon Catchments in Summer (Year 2013-2017) and Winter Seasons (Year 2014-2018)



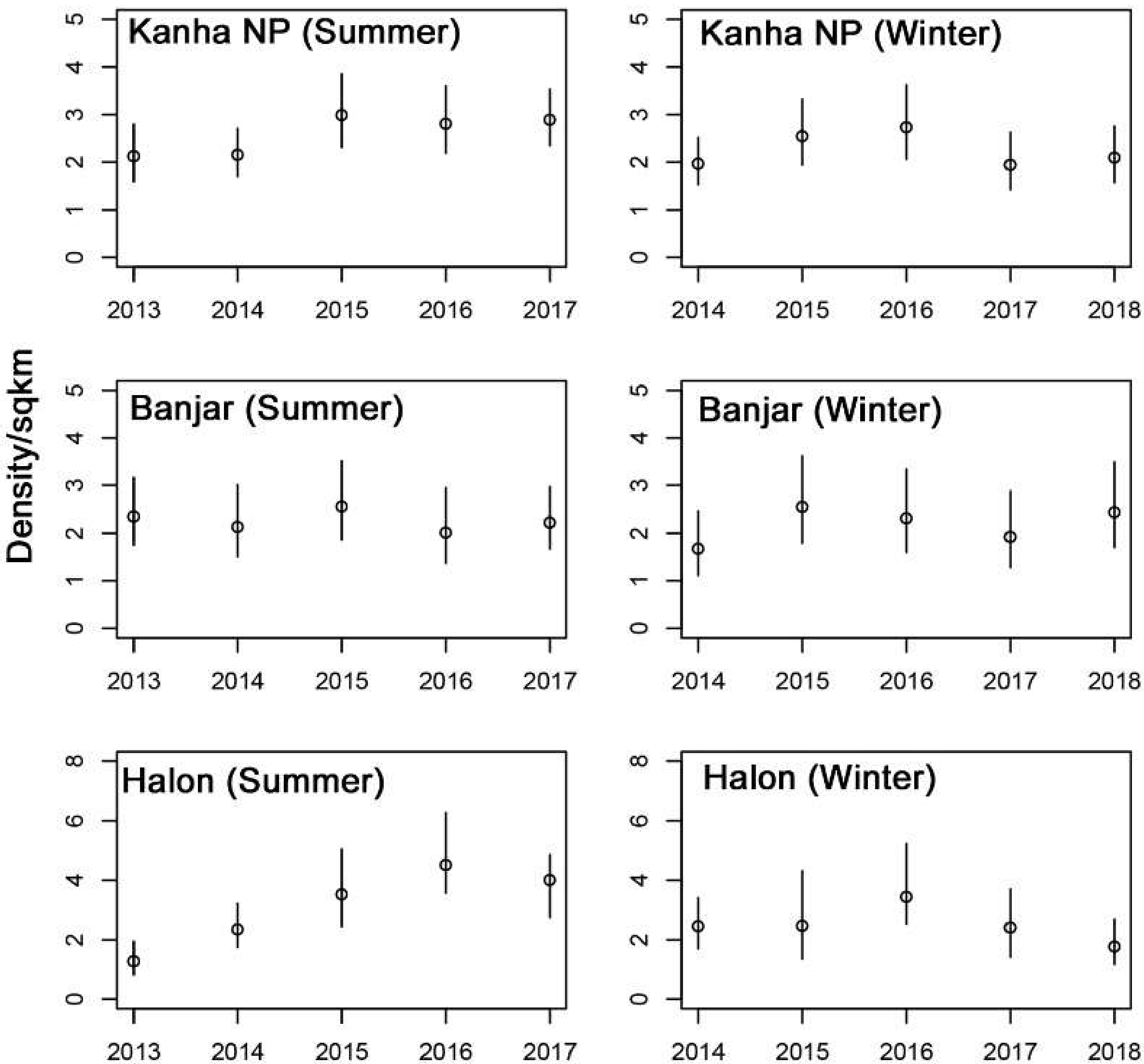
Density Trend of Gaur in the Core Zone, Banjar and Halon catchments in Summer (Year 2013-2017) and Winter Seasons (Year 2014-2018)



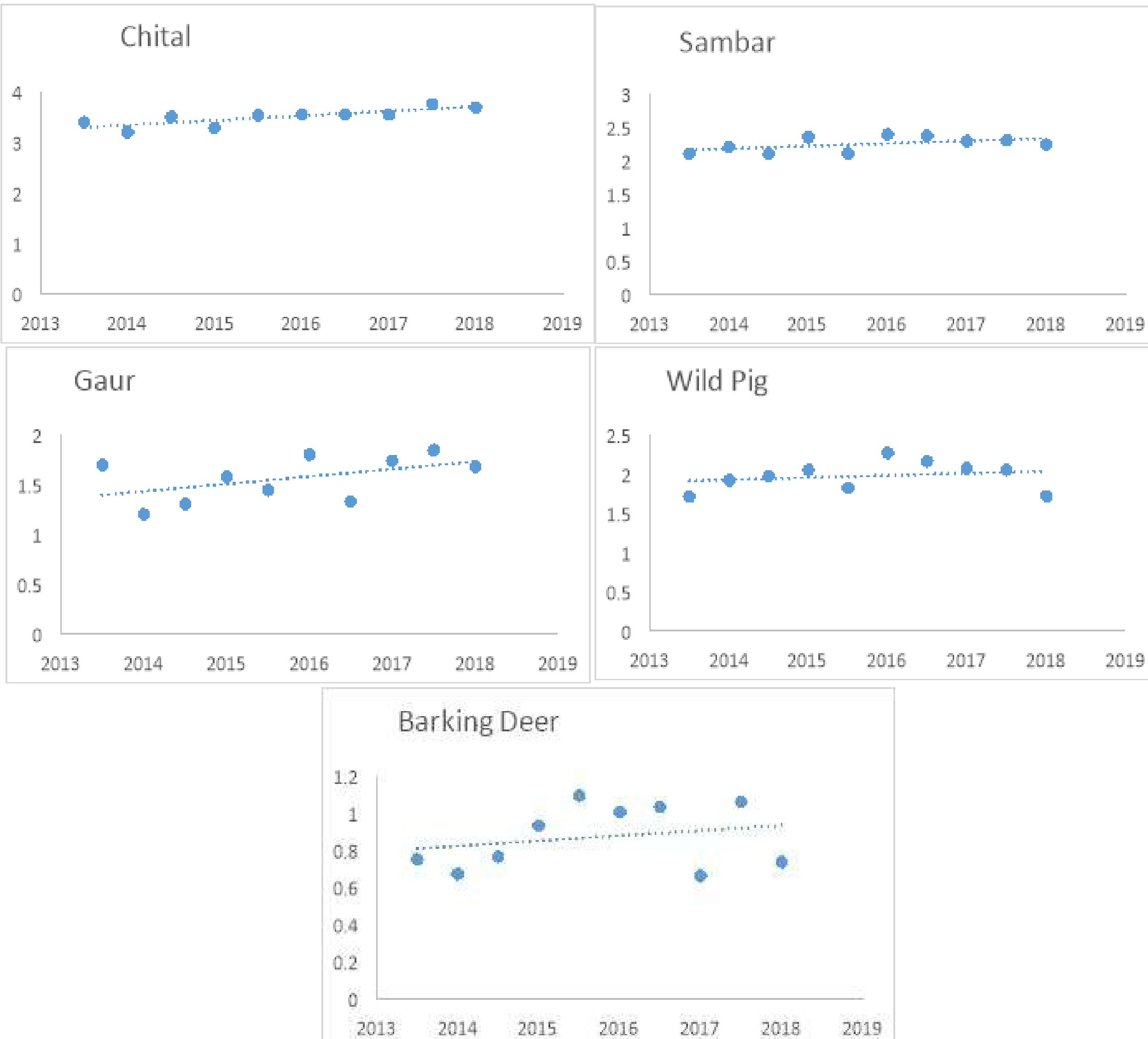
Density Trend of Wild Pig in the Core Zone, Banjar and Halon catchments in Summer (Year 2013-2017) and Winter Seasons (Year 2014-2018)



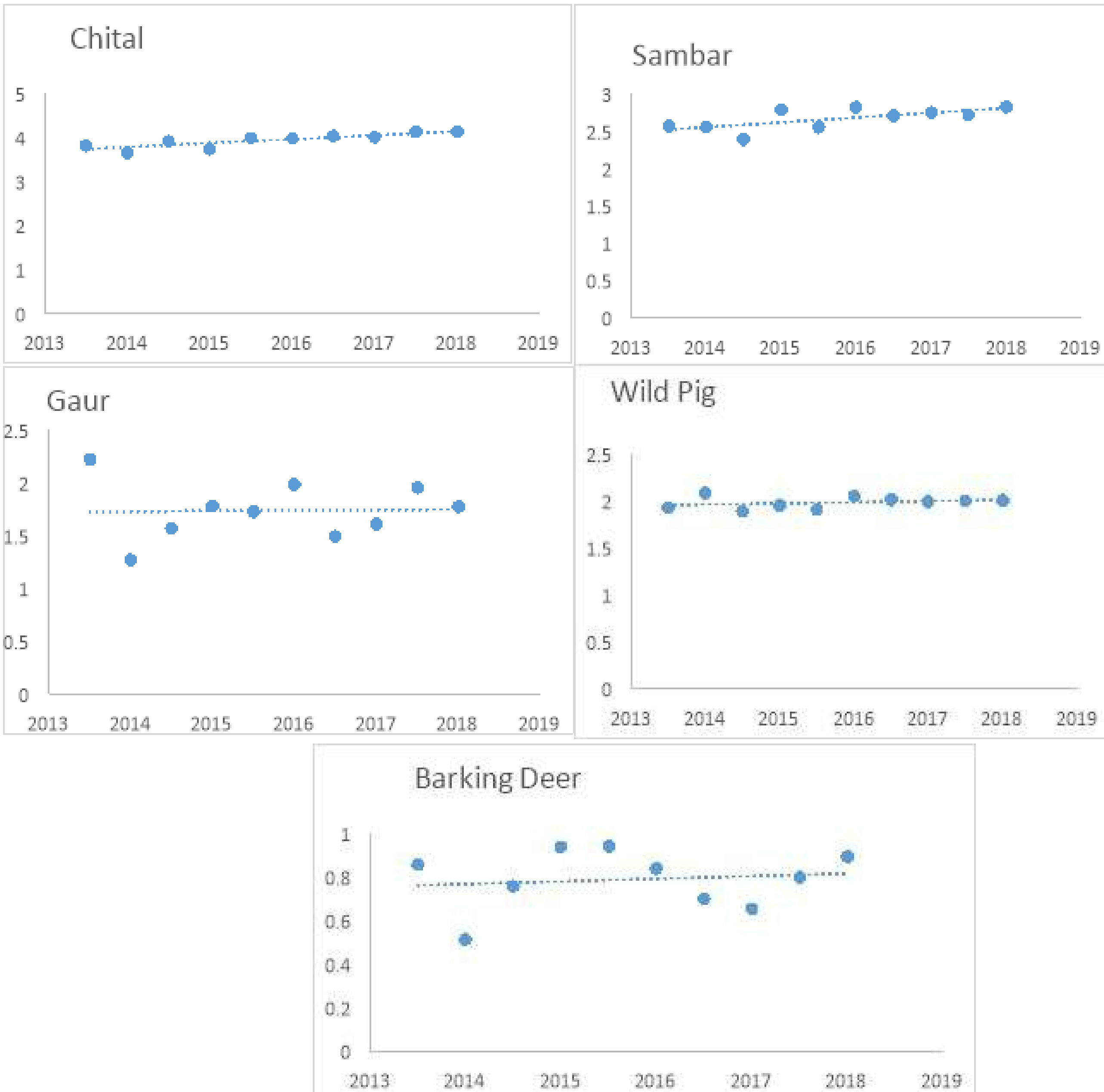
Density Trend of Barking Deer in the Core Zone, Banjar and Halon catchments in Summer (Year 2013-2017) and Winter Seasons (Year 2014-2018)



Population Growth Rate Depicted through Seasonal Abundance (Log Transformed) of Ungulates in the Core Zone from 2013 to 2018



Population Growth Rate Depicted through Seasonal Abundance (Log Transformed) of Ungulates in Banjar Catchment of the Core Zone from 2013 to 2018



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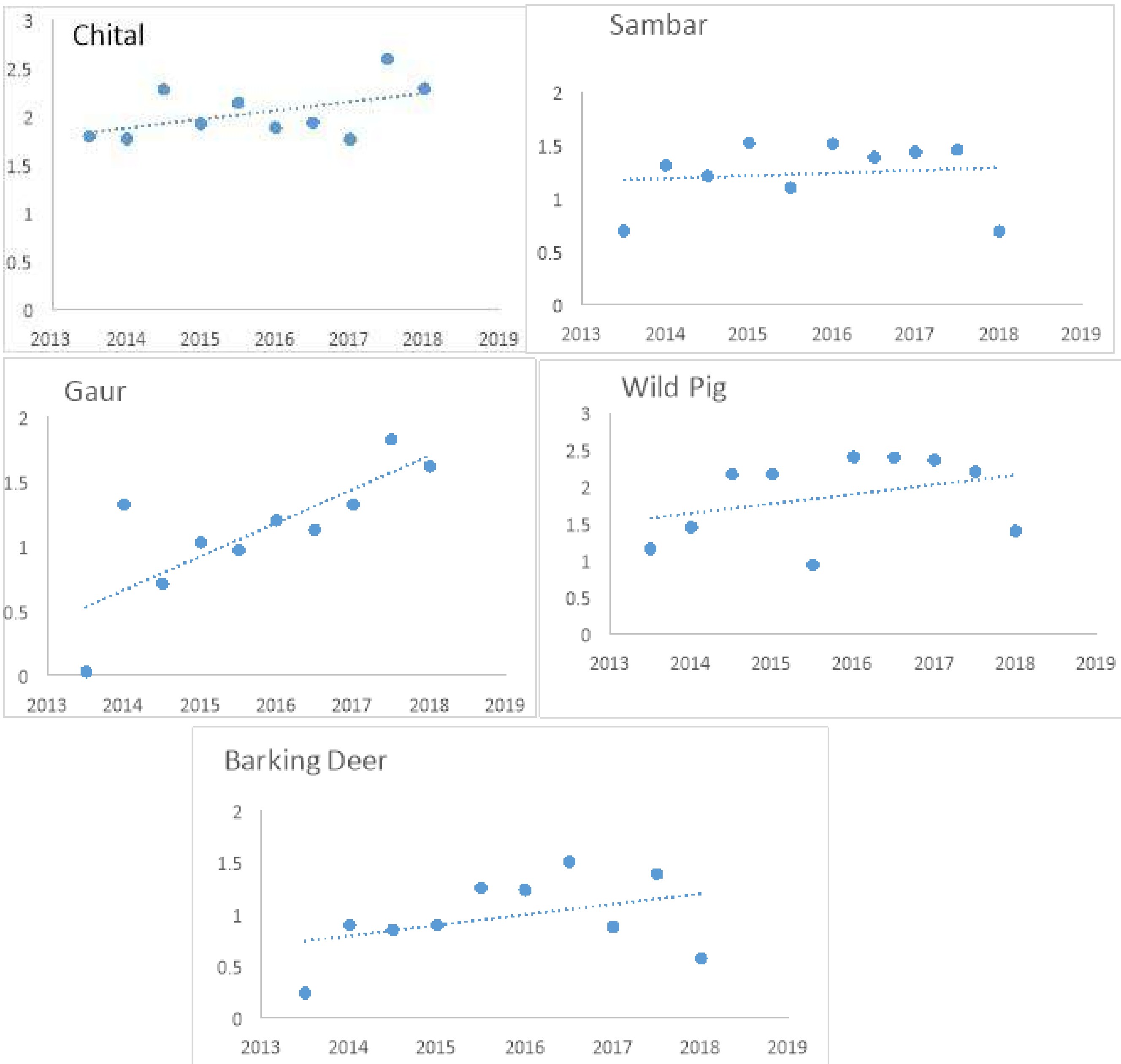
Population Growth Rate Depicted through Seasonal Abundance (Log Transformed) of Ungulates in Halon Catchment of the Core Zone from 2013 to 2018



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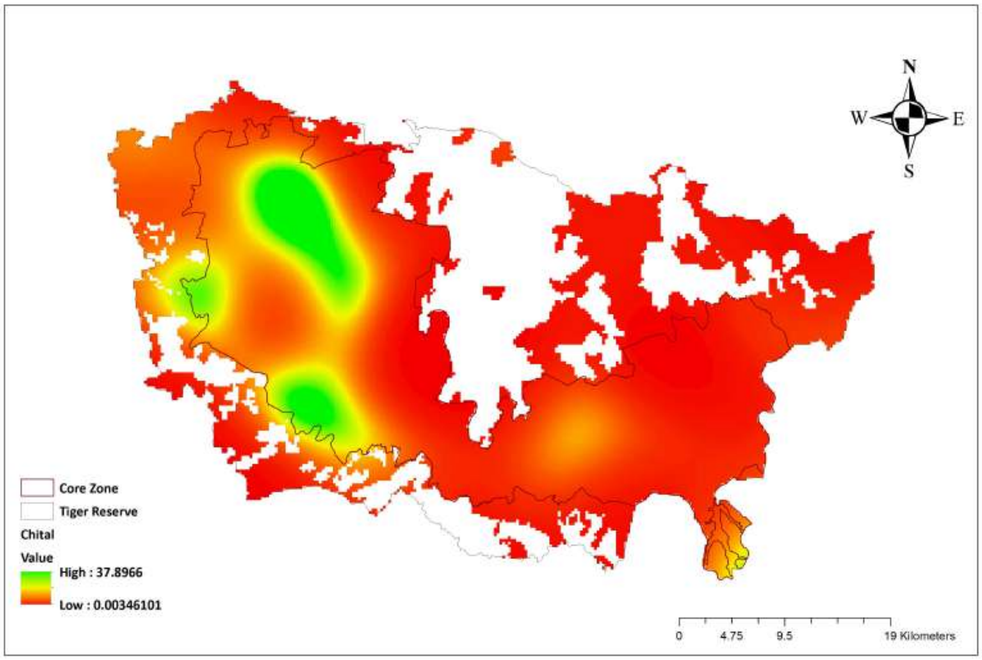
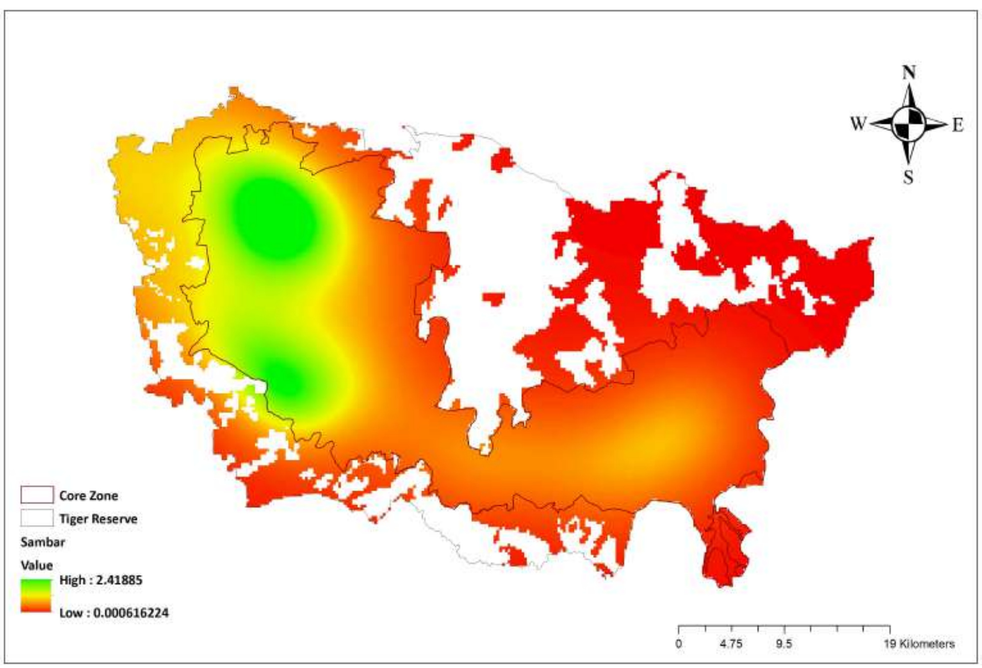
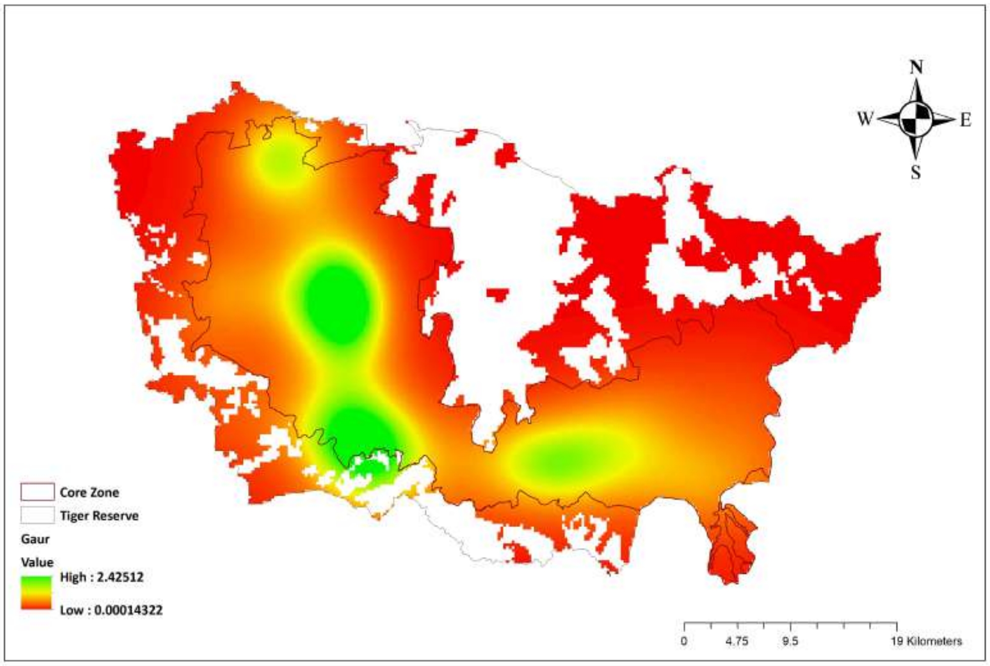
Density Surface Maps of Chital, Sambar, Gaur, Wild Pig, Barking Deer and Barasingha Group Size in High Chital Density Area in the Core Zone, based on Line Transect Based Density Surface Modelling

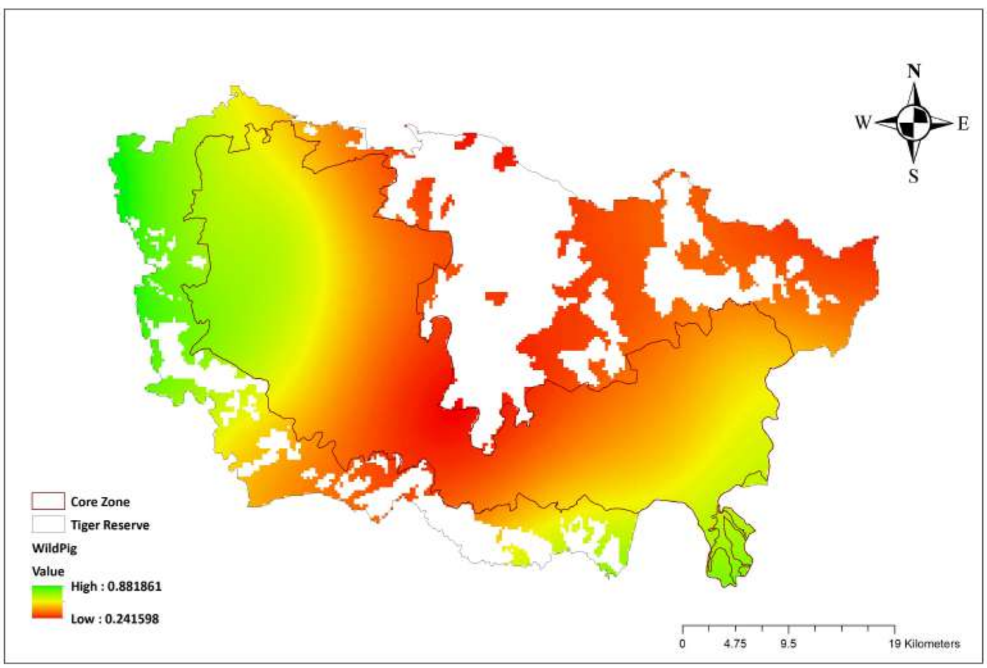
(Density scale: The Higher (Green Colour) the Value, the Higher the Density of the Species)

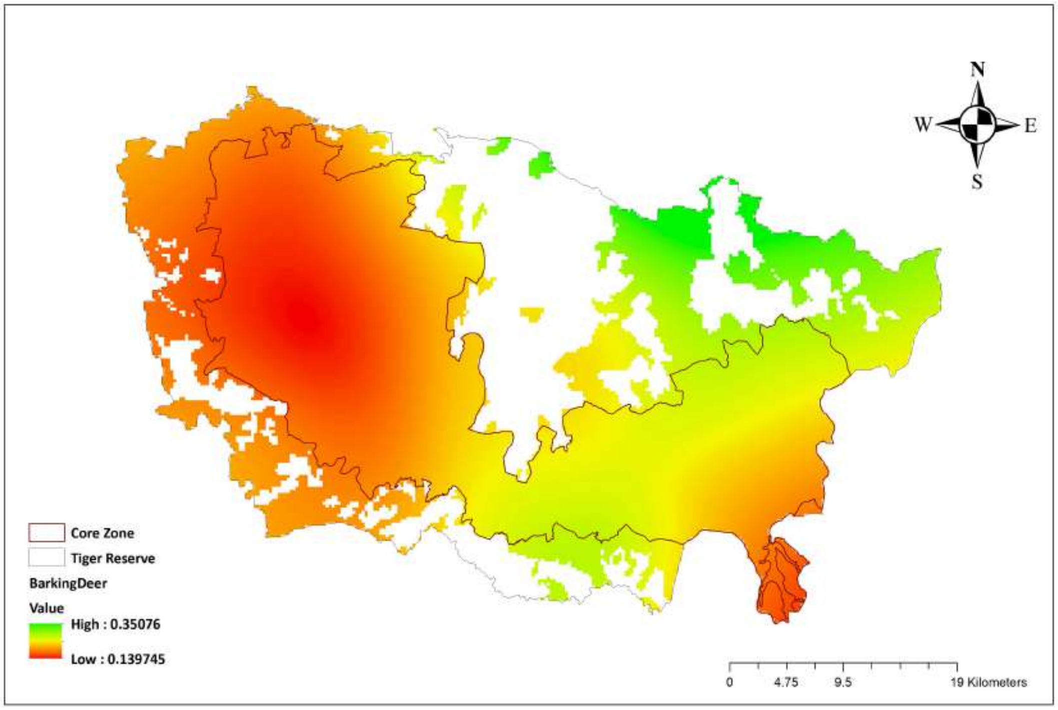


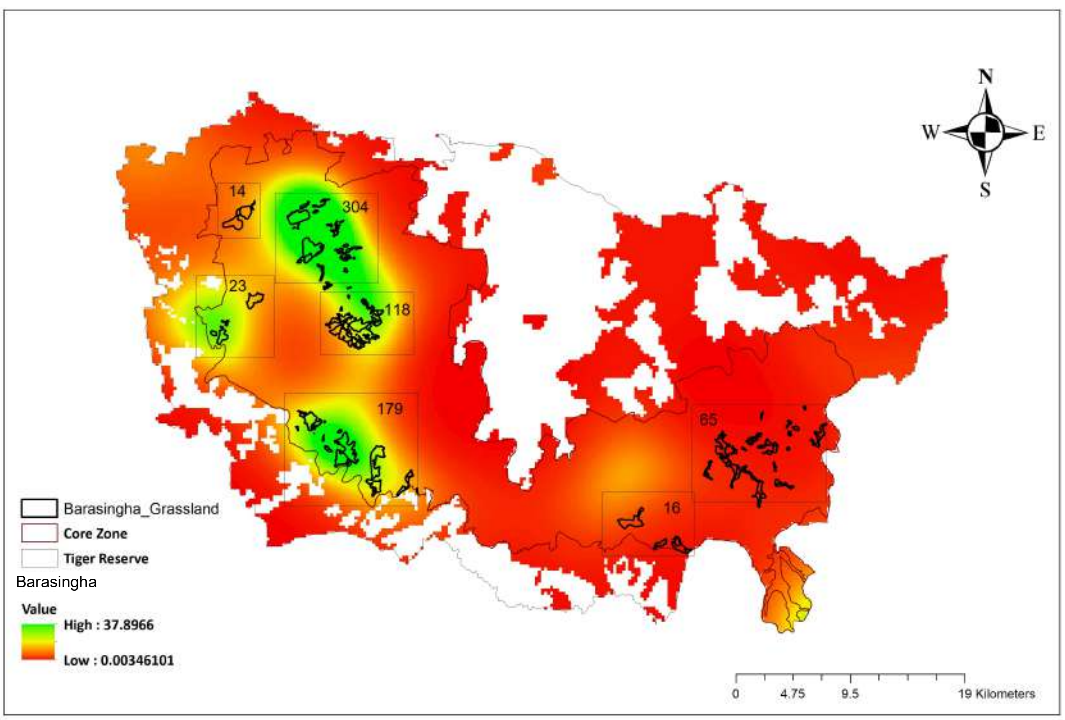


Kanha Tiger Reserve, Mandla (MP) 481 661, Phone: 07642-250760 (O), Fax: 07642-251266, Email: fdknp.mdl@mp.gov.in


N
W
E
S
Core Zone
Tiger Reserve
Gaur
Value
High : 2.42512
Low : 0.00014322
0
4.75
9.5
19 Kilometers


N
W
E
S
Core Zone
Tiger Reserve
WildPig
Value
High : 0.881861
Low : 0.241598
0
4.75
9.5
19 Kilometers


N
W
E
S
Core Zone
Tiger Reserve
BarkingDeer
Value
High : 0.35076
Low : 0.139745
0
4.75
9.5
19 Kilometers


N
W
E
S
14
304
23
118
179
65
16
Barasingha_Grassland
Core Zone
Tiger Reserve
Barasingha
Value
High : 37.8966
Low : 0.00346101
0
4.75
9.5
19 Kilometers

12.7.3 **Discussion:** Population trend derived from line transect based distance sampling over a 6-year period showed that all ungulates density appears to have remained relatively stable at the protected area level. Analyzing population trend in the overall protected area will not be appropriate for decision making for management interventions. Therefore, two sampling blocks, the Banjar and the Halon catchments, were selected based on substantial differences in prey and predator densities and conservation investments with the objective of studying the response of ungulates to these differences. Local scale densities of ungulates will provide more useful information to wildlife managers about actual growth rate of ungulates. Separation of the study period into winter and summer season was important in order to observe the annual recruitment pulses in seasonal ungulate abundance in the core zone and its Banjar and Halon catchments.

The chital, a dominant and abundant species in the core zone, shows a low population growth rate but does seem to have considerably increased between 2013 to 2018 in the core zone and the Banjar catchment. The Sambar also showed a substantial increase in density in the Banjar catchment from 2013 to 2018. The increase is probably attributable to high conservation investments in the Banjar area in terms of village relocation, which led to tranquil areas, and stringent protection measures throughout the year since a long time.

The gaur, showed a high growth rate in the Halon catchment in comparison to the Banjar. Unlike other species in this estimation, the gaur being a migratory animal, likely move between Kanha and Indravati through existing connectivity, and immigration would increase population growth rates and subsequently restrict gaur populations to more protective habitat at Kanha. This could be the reason for high density of Gaur in the recent time in the Halon valley which is connected to Achanakmar and Indravati. While other ungulates such as barking deer and wild pig shown stable trend between 2013 and 2018 in both the core zone and the local catchments.

Resident ungulates of the Banjar and Halon catchments have either increased or remained stable between 2013 and 2018. The Halon catchment, area with maximum rainfall and less intra-specific competition due to low densities of ungulates, chital and sambar had better body condition in comparison to those in the Banjar catchment. Further increase in the population will only be seen in future surveys in the Halon area, as several villages were relocated between 2010 and 2016, also resulting in reduction in biotic pressure. Besides, there were also several chital supplementations from the Banjar area recently. All these events released more land for wildlife populations and at the same time competition for food between ungulates and cattle was reduced in the Halon valley. Overall stability in ungulate assemblages highlights the importance of long-term monitoring and comprehensive data in future surveys in order to understand ecological dynamics. The observed pattern and timing of population dynamics in combination with ancillary information may allow for the formulation of hypothesis about the causality underlying the observed population trends.

12.8 Carrying Capacity of Tiger:

Intensive management best practices often lead to increase in the tiger densities to the extent where individuals started competing each other for food and space that leads to either high level of intraspecific competition or they move frequently to multiple use buffer zone (human dominated areas) and involves in frequent conflict with humans. Hence, it is necessary to know that how many maximum tiger can be sustained by the core zone without causing its deterioration that is carrying capacity of the tiger reserve. Therefore, there is no need to manipulate any habitat to improve prey populations till this density is reached. This is particularly important when such protected areas are small or situated in high human density where movement of free ranging carnivores like tiger are compromised. Knowledge of carrying capacity is essential for informed management decision such as predator reintroductions or removals, implementation of fertility control, or plans for park expansion. This is important for local management of the protected area where the resident population is increasing as well as the sink habitat where reintroduction is planned. In natural ecosystem carnivore densities vary and dependent on the varying prey abundance. High prey densities will have carnivore densities. This relationship is well established in many studies, where carnivore (predator) densities are determined by prey densities. Hayward et al. (2007) developed an equation for estimating carrying capacity of African large carnivore Lion in a multi-predator guild using preferred prey (species abundance and weight range).

12.8.1 **Method:** Hayward et al. (2007) collated the information on predator and prey densities, from several sites in Africa. The densities were converted into the biomass/ sq. km. using 3/4th of the adult female biomass. The logic behind selecting 3/4th of adult prey female biomass was to account for sub-adults and the young preyed upon (Schaller, 1972). They then regressed the predator density against the biomass of significantly preferred prey and the biomass of prey within each predator's preferred weight range. Preferred prey species and weight ranges were estimated from previous studies on the lion, leopard, cheetah, wild dog and spotted hyena. Given the high dietary overlap between lions and hyenas, they also tested for relationships between hyena density and that of the preferred prey of lions. They also regressed data presented in relevant studies on leopard and cheetah to derive predictive equations with which to compare those relationships derived from this work on prey preferences. They used the equations calculated from by Carbone and Gittleman (2002) to compare their predictive accuracy. These equations to were used to predict the potential predator population density. The equations for estimating potential lion density from given prey base were:

Using preferred prey species

$y = 2.158 + 0.377x$ ……………………………… (i)

$y = \log_{10}$ (Lion Density), $x = \log_{10}$ (Preferred Prey Biomass)

Tiger Carrying capacity estimation Using Hayward et al. (2007) model at Kanha:

This model may be suitable for tigers, since body size and diet requirement is similar to lions, also Kanha has multi-predator system, with the leopard and dhole and diverse prey base similar to African ecosystem.

Prey densities were estimated through Distance sampling and preferred prey were estimated from diet analysis of tiger through faecal remains examination. Preferred prey species were estimated through scat analysis. Despite large body size the gaur was not a preferred prey for the tiger, though it has also contributed to the diet. Other prey species which have contributed to the diet of tiger were the langur, chousingha, barasingha, barking deer and peafowl. Here we have considered the chital, sambar and wild pig as the preferred prey of the tiger.

12.8.2 **Results:** Prey densities and biomass in the core zone are as under:

Table-80: Prey Densities and Biomass

Species (1)	**Density (SE range)/ sq. km. (2)**	**3/4th Weight of Adult females (kg) (3)**	**Biomass (kg) / sq. km. (SE range) (4) = (2) x (3)**
Chital	33 (28.53 – 37.47)	30	990 (855.9 – 1124.1)
Sambar	8.51 (7.4 – 9.62)	100	851 (740 – 962)
Wild Pig	5.48 (4.52 – 6.44)	30	164.4 (135.6 – 193.2)

Source: Wildlife Institute of India (2021)

Total prey biomass (kg) / sq. km. = 2005.4 (1731.5 – 2279.3)

$\log_{10}$ of prey biomass = $\log_{10}$ (2005.4) = 3.30

Substituting the value of x in Equation (i)

$y = 2.158 + 0.377x$ ……………………………… (i)

here,

$y = -2.158 + 0.377 * (3.30)$

$y = -0.9130$

Predicted Tiger Density =antilog of y =$10^{-0.9130}$ =0.122/ sq. km. =12.2/100 sq. km. Similarly using the SE range of Prey Biomass the range is (11.5–12.8) /100 sq. km.

The carrying capacity of the core zone is about 12.2 tigers per 100 sq. km. within the range of (13.7 – 15.4) /100 sq. km.

12.8.3 **Discussion:** The current population of core zone is 88 adult tigers, but based on the available prey it can be increased up to 110 tigers within the area of 917 sq. km. of the critical tiger habitat. There is, however, an urgent need of developing tiger specific models based on the Indian habitat scenarios.

12.8.4 **Carrying Capacity Proposed by the WII, Dehradun:** Jhala et al. (2020) developed the total carrying capacity of tigers in the core and the buffer zones in Kanha tiger reserve as under:

Animal Species	**D**	**SE**	**LSR**	**USR**
Chital	38.14	5.04	33.1	43.18
Wild Pig	4.88	0.91	3.97	5.79
Sambar	6.95	0.94	6.01	7.89
Gaur	3.87	0.82	3.05	4.69
Barking Deer	2.57	0.28	2.29	2.85
Total Prey Density	**49.97**	**27.11**	**22.86**	**77.08**
Prey and SE	**49.57**	**5.21**	**44.36**	**54.77**

Parameter	**a**	**b**	**X (Prey Density)**	**Y Calculated Tiger density**
Mean	-0.377	0.143	49.97	6.77
Lower SE Range	-0.737	0.133	44.363	5.16
Upper SE Range	-0.017	0.153	54.777	8.36

For the Entire Tiger Reserve (Density)

Carrying Capacity	6.77
Lower SE	5.16
Upper SE	8.36

Parameter	Density	SE
Currently Operating/ Current Density	4.40	0.40
Lower SE	4.00	-
Upper SE	4.80	-

A simple linear regression explained the relationship adequately (R = 85; P<0.001; PRESS R =0.83) and was estimated as under:

Equation Y = a + bx

Where, y = Tiger density, a = the intercept of the regression line, b = the slope of the regression line, and x is the total prey density.

Tiger Density (per 100 km^2) = (-0.377±0.36) + (0.143±0.01) X (tiger prey density per km^2).

The total tiger prey density (on the basis of preferred prey chital, sambar, wild pig, gaur, and barking deer) at Kanha tiger reserve (Core and Buffer) = 49.57 ± 5.20.

While the maximum potential tiger density can be 6.77/ 100 km^2 at the prey density of 49.57/ km^2, the current tiger density is 4.40 in the tiger reserve.

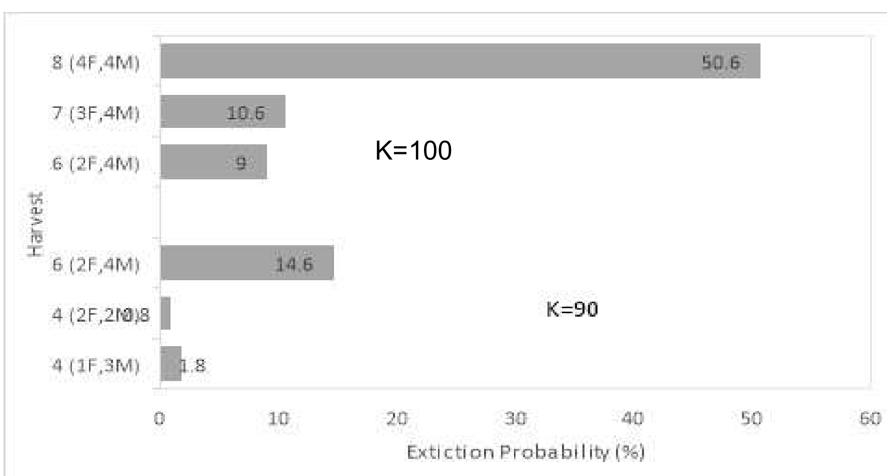
12.9 Population & Habitat Viability Analysis of Tiger (PHVA):

The minimum population size essential for population persistence of a species over a defined period of time is essential for defining management goals. For large carnivores that occur at low density due to the virtue of them being at the top of the food chain, often Population Habitat Viability Analysis (PHVA) provides useful insights into limiting factors and threats that can cause extinctions. Poaching is one of the major threats to the persistence of wild tiger populations (Kenney et al., 1995). All tiger populations in south-east Asia (China, Vietnam, Cambodia, Lao PDR) and those of Sariska and Panna in India are examples of extinction of tigers due to poaching. As long as there is an illegal market for tiger body parts, no wild tiger population is safe from poaching despite best measures of protection. We assessed the minimum tiger population required for long-term persistence in Kanha under different scenarios of poaching and carrying capacity to inform management of timely action. This would help management to identify critical threats and threshold to harvest animals for reintroduction and to invest in protection measures.

12.9.1 **Method:** Population Habitat Viability Analysis (PHVA) was performed in program VORTEX (Lacy, 1993). The PHVA models were parameterized using our long-term data on tiger demography, carrying capacity based on prey density (Fuller, 1989), and potential threats in Kanha tiger reserve. Scenarios were run for 100 years with 500 iterations at different carrying capacity and poaching levels, without additional supplement. Periodic environmental catastrophe was considered once in 50 years, which caused additional mortality of 20% and reproductive failure of 30% for the catastrophe year.

12.9.2 **Result:** The carrying capacity (K) of tigers in Kanha, based on prey density, kill rates of tigers and growth rates of ungulates was estimated to be between 120 tigers (conservative estimate not after Hayward et al. (2012)). The Kanha tiger population had a high probability for long term persistence under current scenarios. However, the models were sensitive to high female mortality, cub survival, and additional mortality caused by poaching.

Probabilities of Extinction of Tigers in Kanha due to Annual Harvesting (Poaching or Removal of Tigers for Management Interventions) for 100 Years (M= male tiger, F= female tiger)



12.9.3 **Discussion:** The carrying capacity (K) of tigers in Kanha, based on prey density, kill rates of tigers and growth rates of ungulates (Fuller, 1989) was conservatively estimated to be between 100 -120 tigers. Current tiger population is around 85-90 in the Kanha tiger reserve and its surrounding landscape and there is a scope of this increasing in the future if prey-base remains the same. We thus, modeled conservative scenarios of K=90 and 100. Using the demographic parameters of tigers recorded for Kanha the tiger population had high persistence probability under most normal scenarios (occasional poaching incidences, catastrophe, and 5-10% increase in cub-juvenile mortality). However, the PHVA results show that an increase in annual poaching of over 2 females and 2 males per year, can increase extinction probability over the critical threshold of 10%. Kanha tiger population cannot sustain an annual harvest of 6 tigers under most realistic scenarios. The model was sensitive to the removal of adult females more than that of any other cohort. Due to the intensive annual camera trapping, absence of established breeding tigers can easily be picked up by the management. If young established breeders are lost – these can conservatively be attributed to poaching. Beyond an annual loss of four such tigers, the Kanha management should take precautionary measures to enhance protection and prevent any more poaching as well as avoid removal of tigers for translocation during that year.

12.10 Identification of Corridors:

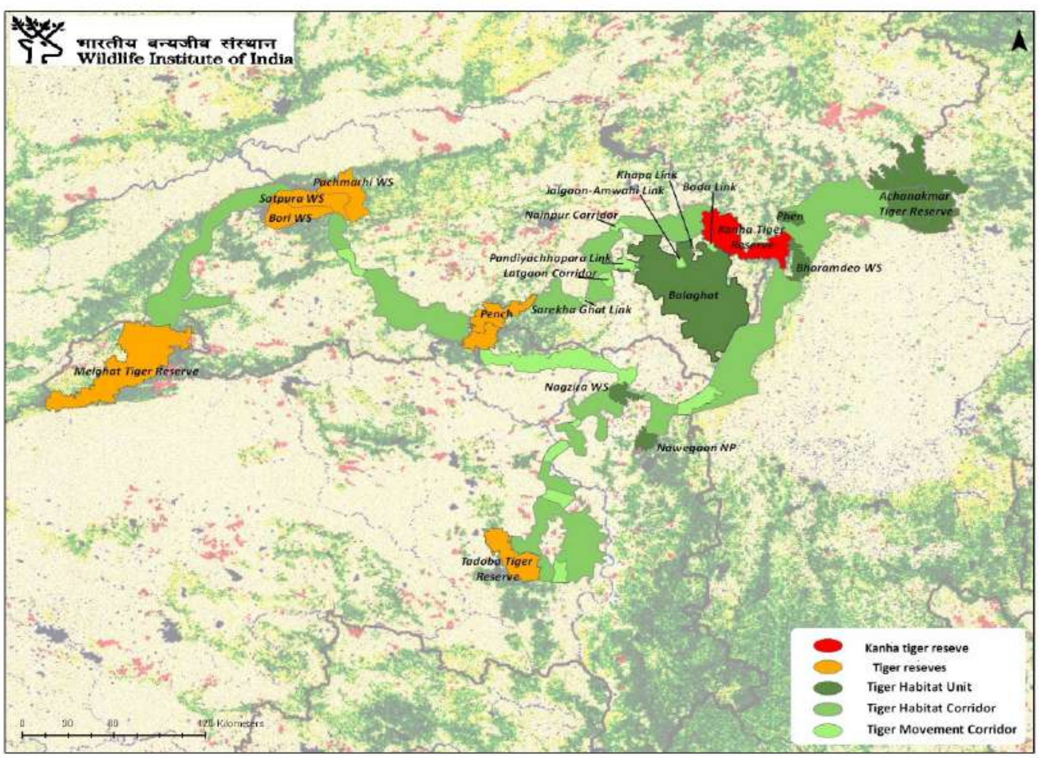
The following potential corridors have been identified by Jhala et al. (2011) & Qureshi et al. (2014) for the dispersal of tiger from Kanha Tiger Reserve. These corridors are also identified and confirmed through genetic study by Yumnam et al. (2014) and Sharma et al. (2013).

12.10.1 **Kanha-Pench Corridor:** This corridor is an example of a two source populations of tigers can be managed as meta-population. Apart from genetic study, there is evidence from telemetry and camera trapping to show that tigers regularly use this corridor to move between Kanha and Pench. The corridor at places is sufficiently wide so as to support prey species and patches of habitat that serve as temporary refuges for dispersing tigers. This corridor consists of forests of territorial and forest development corporation divisions of the Mandla, Balaghat and Seoni districts

12.10.2 **Kanha- Achankamar Corridor:** This linkage ensures the eastward connectivity of the important Pench-Kanha-Achankamar landscape through the forests of Phen Wildlife Sanctuary (KTR) and the reserved forests of the Mandla & Dindori forest divisions along the neighbouring districts (Kabirdham & Bilaspur) of Chhattisgarh. and from Achanakmar further extended to Bandhavgarh Tiger Reserve This corridor is vital for sustenance of the Achanakmar tiger population and for metapopulation management of Pench-Kanha-Achanakmar tiger populations and further to Bandhavgarh tiger reserve.

12.10.3 **Kanha-Navegaon-Nagzira:** The Balaghat forests and forests along the border of Chhattisgarh connect the Kanha tiger population to the southern tiger populations of Maharashtra (Nagzira-Navegaon and Tadoba) and with Indravati- Northern Andhra Pradesh (Kawal).

Location of Kanha Tiger Reserve with Respect to other Wildlife Protected Areas



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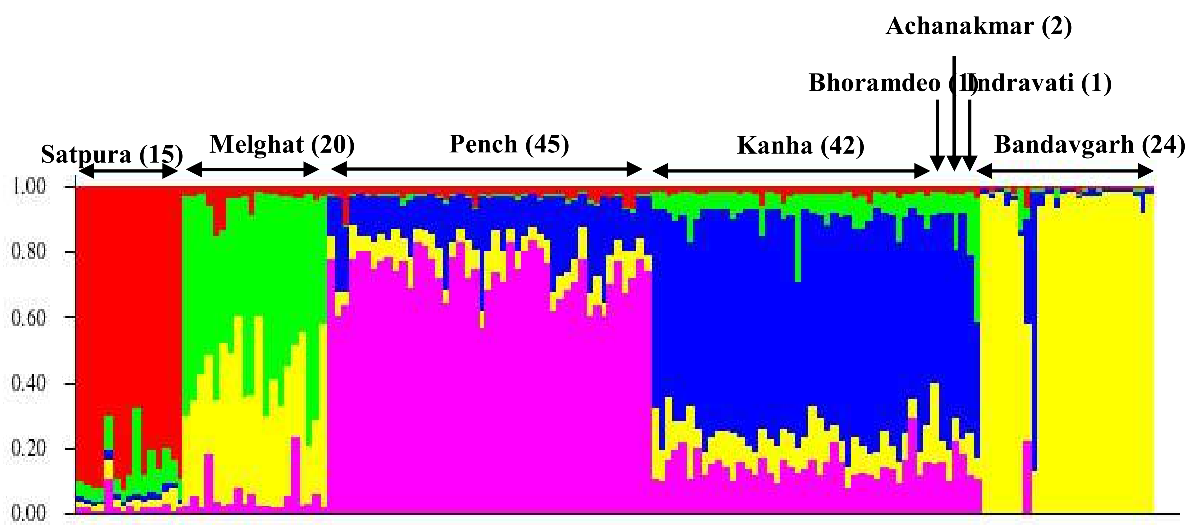
12.11 Findings of Genetic Analysis:

This study (Yumnam et al., 2014) was conducted by the Wildlife Institute of India, Dehradun and National Tiger Conservation Authority, New Delhi. DNA was extracted from 17 blood/ tissues samples of collared tigers and 552 scat samples collected from throughout the area. Microsatellite loci genotyping on the DNA extracts produced a total of useable 213 tiger genotypes. A subset of 150 individual tigers was identified from the 213 genotypes. This amount is representative of more than 50% of the total population in the sampled tiger reserves in the area. Calculation of genetic diversity statistics and analysis of population structuring patterns was subsequently conducted on these 150 genotyped individuals to infer preliminary generalizations about the allelic diversity, and other population genetic parameters. The diversity values across the seven loci are highly informative (6-11 alleles per locus, 63 to 80% heterozygosity) and have a combined probability of identity - siblings value of 1.8×10^{-3}. In other words, the low overall PI score obtained here means that 1 individual in a population of 500 related sibling individuals carry the identical DNA fingerprint.

Results of the STRUCTURE analysis reveal moderate to high levels of population structuring among the major sampled populations. The bar plot in Figure B of individuals assigned to the five major populations show ongoing isolation in the Bandhavgarh and Satpura populations, genetic exchange between Pench and Kanha at modest levels with both populations having some cross-assigned individuals, and reduced gene flow between Pench–Melghat and Kanha-Melghat. The genetic assignments of individuals from Achanakmar, Bhoramdeo, Indravati and including two from Bandhavgarh are cross-assigned to the Kanha population. Population-wise genetic diversity estimates are high, heterozygozity values being highest in Pench (73%) and lowest in Bandhavgarh (57%), while the *Fst* estimates of genetic isolation was highest in Bandhavgarh (0.3361) and lowest in Pench (0.1272) reflecting the degree of isolation and connectivity of these two respective populations. On the other hand, despite the low *Fst* estimate, the Satpura population distinctly showed structuring. The degree of admixture (α local) was highest in Kanha and Pench, while very low to moderate levels were observed in the other populations. Allele frequency divergence among populations shared similar values between most populations, and overall was not very conclusive. Though tentative, these results based on both the classical *Fst* values and the newer model based individual clustering methods provide definitive evidence of fragmentation induced population genetic structuring among all five sampled source populations. The population in Kanha is as a major source for dispersing tigers in the landscape and the barplot summarizes the importance of this finding. All tigers from Bhoramdeo and Achanakmar were assigned to the Kanha population. Some individuals from Pench, Bandhavgarh and Indravati were also assigned to Kanha, and a major proportion of the Melghat population shares genes with Kanha.

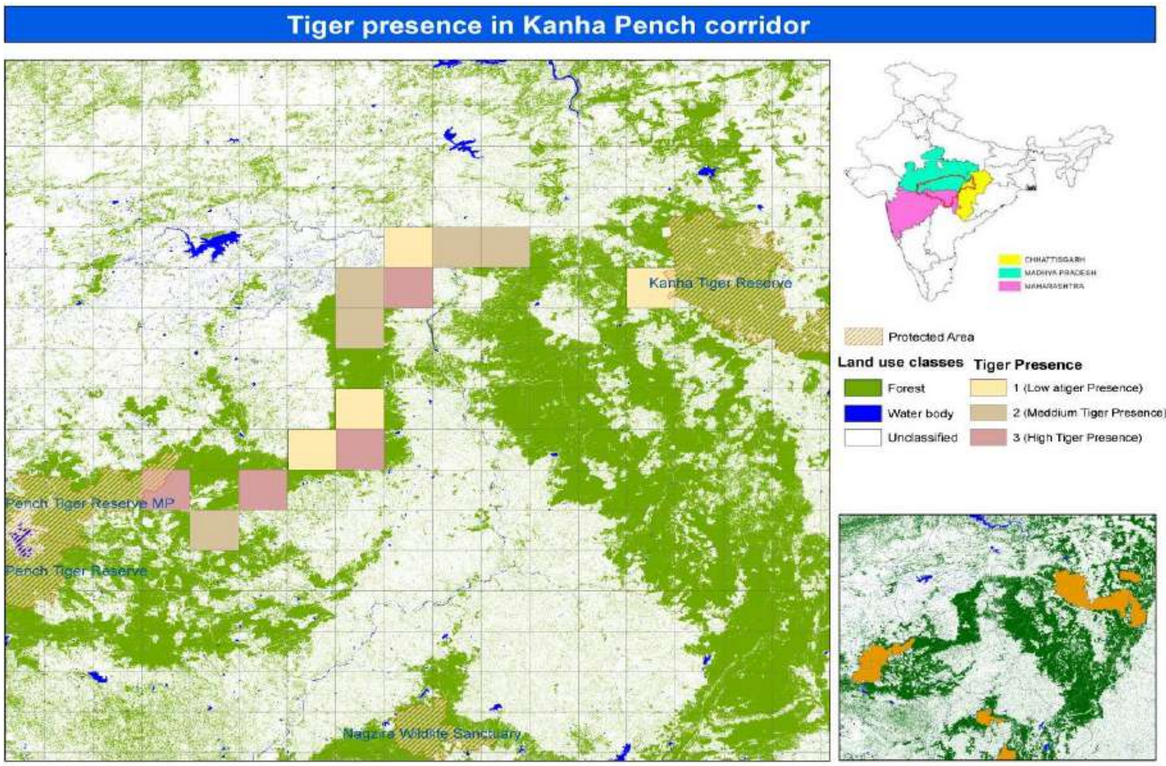
Summary Plot of Estimates for Population-wise Assignment of Individuals Obtained from STRUCTURE Analysis. Y-axis Depicts the Membership Coefficients (Q Values) for each Individual to Assigned Populations. Distinct Structuring between all Five Sampled Populations



12.12 Tiger & Other Carnivores in the Kanha-Pench Corridor:

WWF-India has also undertaken a study on the presence of tiger and other carnivore species in the Kanha-Pench corridor (Jena, J, J Borah, C Dave & J Vattakaven (2012). The study was part of the All India Tiger Monitoring Exercise and was conducted in collaboration with National Tiger Conservation Authority, Wildlife Institute of India and Forest Department of Madhya Pradesh. The gist of the study is as under:

12.12.1 **Tiger Presence and Occupancy:** The intensive study that lasted forty-five days revealed that of the over 2200 sq. km. of potential tiger habitat available in the Kanha-Pench Corridor (KPC), tigers occupy 84%, or an area of 1848 sq. km. (SE = 332.64 sq. km.).



Tiger presence was high in the South Seoni division, as the majority of the KPC falls in this division. But among all the ranges sampled in this division, Rukhad, Kurai, Keolari, Barghat and Ugli range hold good tiger presence. It's worth mentioning that since Rukhad and Kurai are adjacent to the Pench Tiger Reserve and the prey density in these areas is good, the area supports some tigers, which venture out of the tiger reserve. Besides this study, there have been several tiger sightings in the Kopijhola beat of Barghat range, Rukhad and Kurai range.

The camera trapping of cattle kills revealed some more interesting facts on large carnivores of KPC. Information on cattle kills along the corridor gathered by

WWF-India field staff from the Forest Department and local people from July 2010 till date. The payment of interim relief along with setting up of camera traps at livestock kill-sites was started from January 2011, after getting formal permission from the Forest Department. The cases recorded up to May 2012 were used for the analysis.

A total of 181 cases of cattle kills have been reported from January 2011 to May 2011. The actual number of cases would be higher than this figure as information from the entire corridor wasn't available. Out of 181 cases, on 130 (72%) occasions cattle owners were provided interim relief by WWF-India. For rest of the 51 (28%) cases, interim relief couldn't be paid either due to delay in getting permission from forest department in initial stage or due to a delay in reporting the case. A total sum of Rs. 1,25,000.00 was paid to cattle owners as interim relief for cattle depredation.

Table-81: Carnivore Identified on Cattle Kills in Kanha-Pench Corridor

Tigers	11 individuals
Leopards	7 individuals
Hyena	4 individuals
Jackals	10 occasions
Wild dogs	3 occasions

Source: Wildlife Institute of India (2021)

It was found that out of 181 cases reported, 93 (51.4%) kills were made by tigers, 69 (38.1%) by leopards, and in 16 (8.8%) cases, it was difficult to identify the carnivore involved. Wild dogs rarely predated on cattle (only 3 incidents) and mostly killed goats and cattle calves. Though other carnivores like hyenas and jackals are common in this corridor and on many occasions have been photographed on kills by camera traps, they remain confined to scavenging the carcass.

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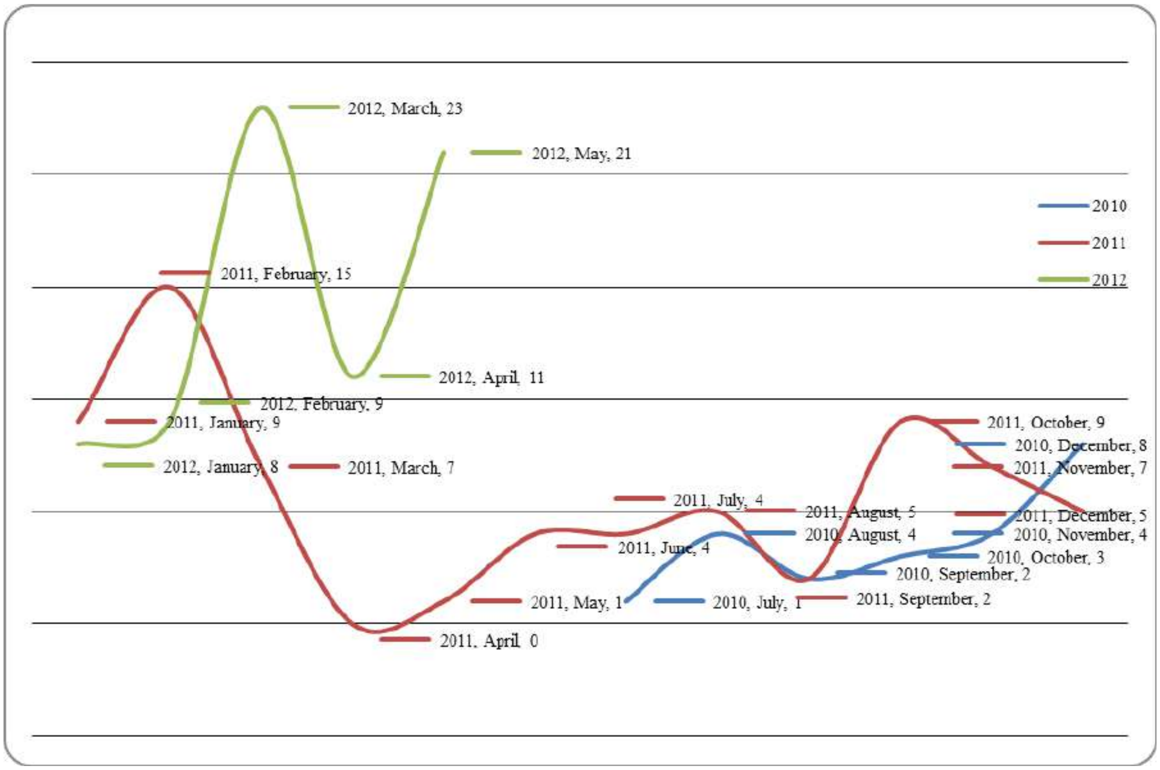
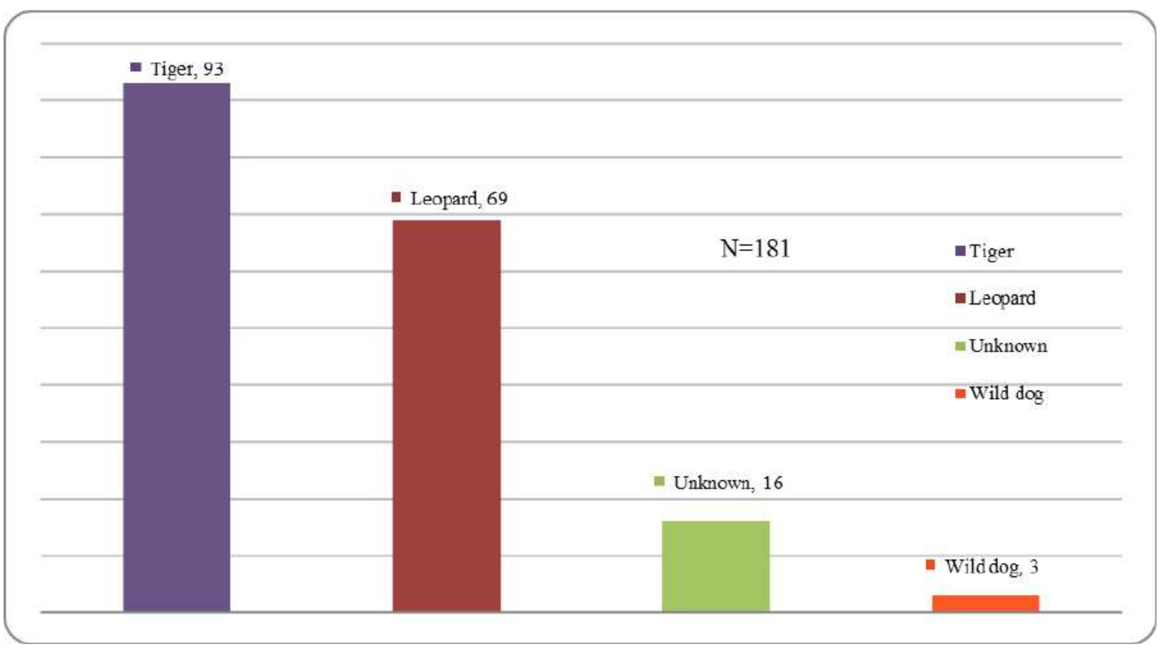
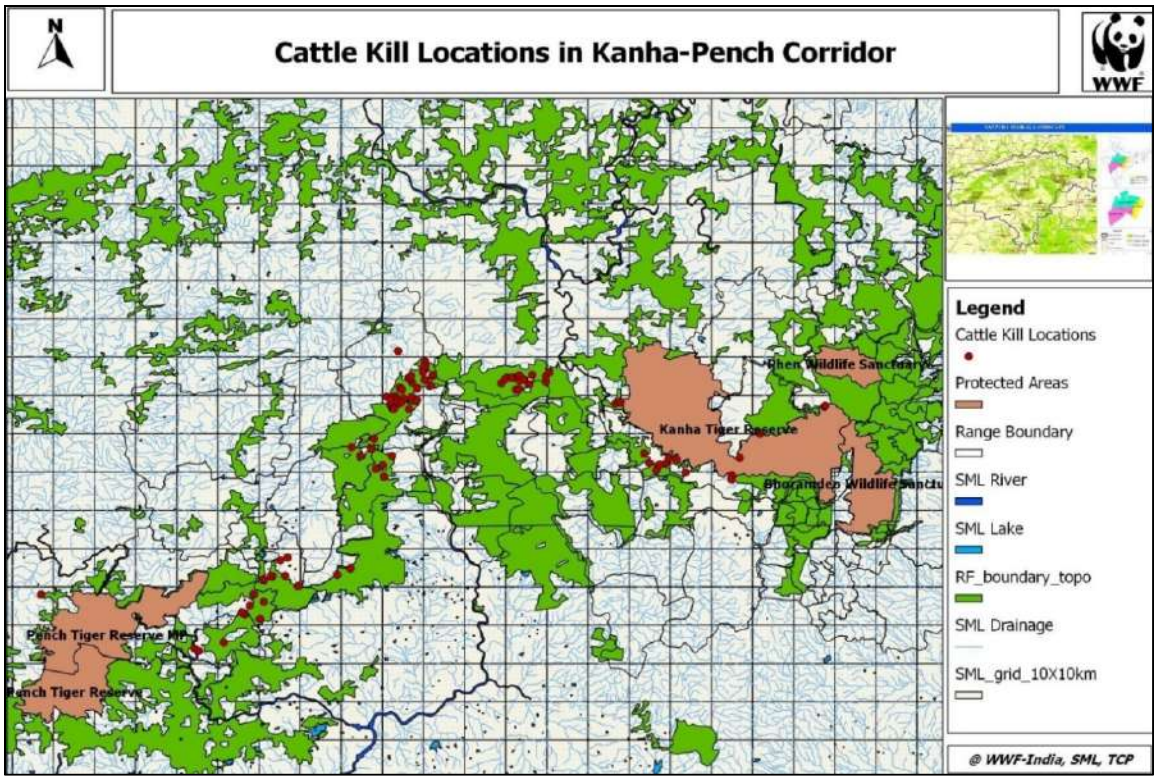
Monthly Variation of Cattle Depredation Cases



Showing Carnivores Involved in Cattle Depredation Cases

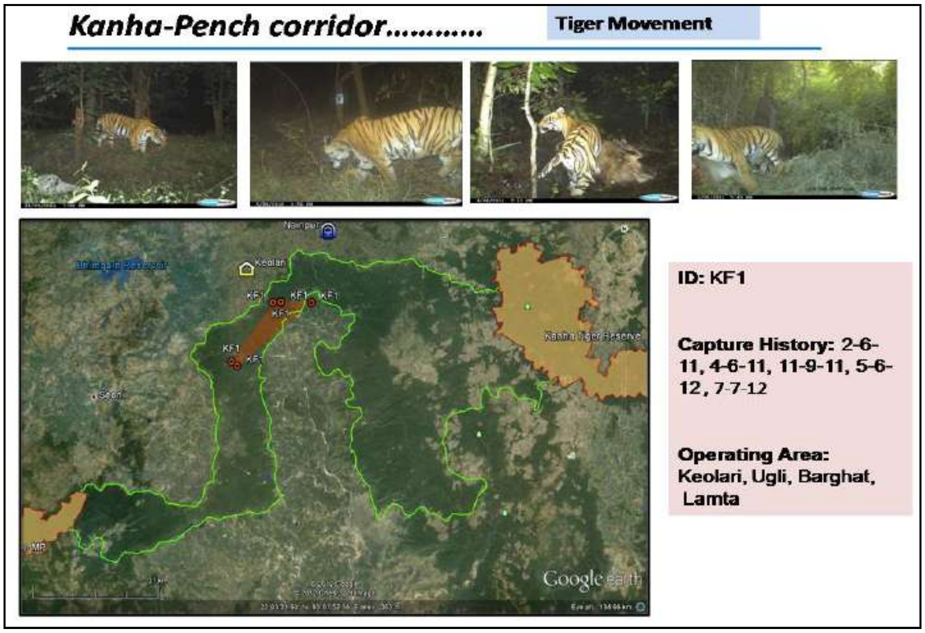


The study not only recorded 11 different tigers using this corridor but also recorded 7 individual leopards and other carnivores. Overall, the compensation scheme covered 37 villages and 12 ranges in the corridor. The primary objective of reducing the retaliatory killing of tigers to zero has been achieved by providing immediate interim relief to cattle owners.

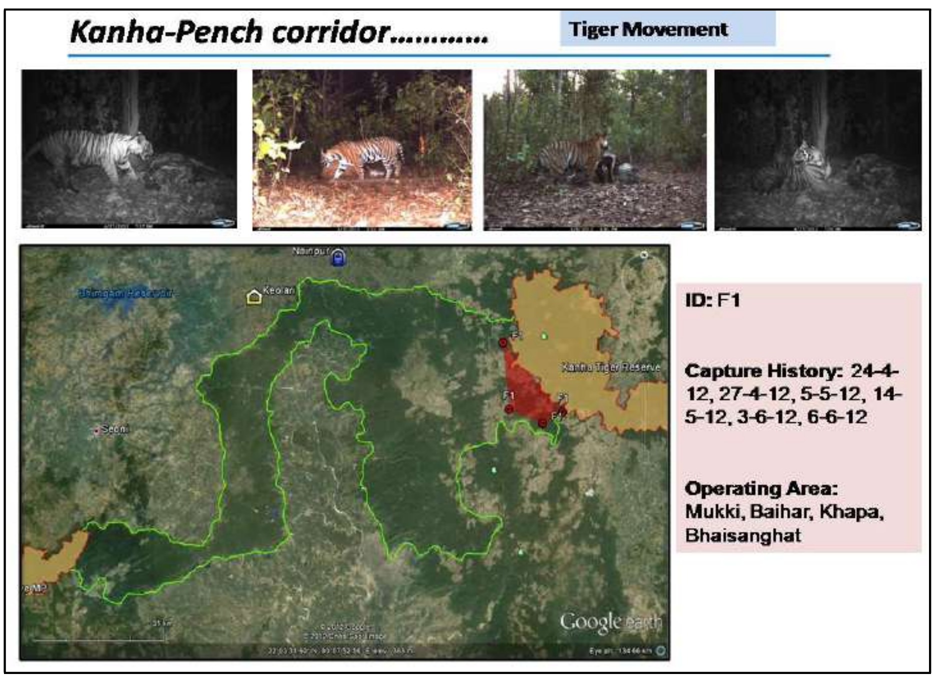


In addition, the operational area of two individual tigers was mapped through camera trap capture locations to know their habitat use in the KP corridor, which is as follows:

Showing Tigress (KF1) Trapped Locations



Showing Tigress (F1) Trapped Locations



12.13 Some Findings on the Carnivores of Kanha:

A collaborative study by the Wildlife Institute of India, Dehradun, National Tiger Conservation Authority, New Delhi and Kanha tiger reserve, Madhya Pradesh on the intensive monitoring and dispersal of tigers (Jhala et al., 2019) in the Kanha tiger reserve was taken up during the past several years. Some of the salient findings of this study are as under:

- The average Daily Distances Moved (DMD) in 24 hours by adult male tigers was 8.85 km.
- The average Daily Distances Moved (DMD) in 24 hours by adult female tigers was 6.87 km.
- Adult females with small cubs (< 3 months) moved the shortest distances (Avg. 4.50 km.).
- Adult females with large cubs (> 6 months) moved the largest distances (Avg. 8.10 km.).
- An adult female without cubs moved 24.4 km. as the maximum distance in a day.
- A sub-adult male in dispersal phase moved 21.1 km. in a day.
- An adult male moved 18.9 km. in a day.
- Home range size for female tiger varies from 2-66 sq. km. with an average of 14.9 sq. km.
- For males average home range size is 51.9 sq. km. which varies from 15-139 sq. km.
- Based on long term camera trapping data, 6-7 tigers annually dispersed from Kanha to the adjacent tiger reserves and forested areas.
- One sub-adult tiger captured during the All India Tiger Estimation exercise in 2006 at Pench moved to Kanha tiger reserve during 2010.
- In the 2018 All India Tiger Estimation, tigers born in Kanha found dispersed to Bandhavgarh, Pench, Sanjay, Satpura tiger reserves (MP), Navegaon-Nagzira tiger reserve (MH), Shahdol and Mandla forest divisions (MP).

- In 2016, the overall density/ 100 sq. km. of leopards is significantly higher (8.64) than tigers (4.82) in the tiger reserve.
- The average tiger cub litter size was 3.24 (± 0.63, range 2 to 4).
- The average age of first reproduction was 3.30 (± 0.13, range 2.67 to 4.0) years.
- The average Inter-Birth Interval (IBI) was 22 (± 2.7, range 8 to 40) months, with the shortest IBI was recorded to be 8 months.
- The majority of litters were born in winter (October-February).
- The average recruitment rate was 9.4 (± 4.5) and 6.39 (± 1.01) individuals per year for male and female tigers respectively.
- The mean litter size of Kanha tigresses were higher compared to any published literature.
- The IBI and age of first reproduction of Kanha tigresses found lower compared to isolated Ranthambore tiger population; however, it was similar to Chitwan tiger population.
- The annual cub survival (59.5%) was the lowest compared to other age classes of tigers in Kanha national park.
- Home range size of three radio-collared female dholes ranged from 45.8 to 172.2 sq. km.
- The Kanha population a major source for dispersing tigers in the landscape.
- All tigers from Bhoramdeo and Achanakmar assigned to the Kanha population.
- Some individuals from Pench, Bandhavgarh and Indravati also assigned to Kanha.
- Major proportion of the Melghat population shares genes with Kanha.

CHAPTER – 13

MISCELLANEOUS PRACTICES

13.1 Some Other Initiatives:

The core zone is now an old wildlife protected area. Consequently, besides field works required for the development of forests, wildlife habitats and the whole gamut of wildlife species, some initiatives regarding staff welfare/ development have also been started by the Kanha management. Some of the major initiatives are as under:

13.2 Hospital at Mukki:

There is also a small hospital at Mukki for the treatment of the staff of Kanha and nearby villagers. The hospital is modestly equipped with necessary medical instruments and medicines. A retired senior orthopedician is in-charge of this hospital. There are also two ambulances in the core zone for taking the physician to far-off places within the tiger reserve, and also transporting patients to the Mukki hospital for treatment. The Kanha management has also organized many health camps in the villages with support from various NGOs.

13.3 *Kanha Workers Sahkari Sakh evam Kamgar Samiti Maryadit*:

One of its own kind, the Kanha Workers *Sahkari Sakh evam Kamgar Samiti Maryadit*, Kisli was formed under the Society Act, 1960 for the welfare of the Kanha staff. Every serving individual of the Tiger Reserve, including daily wagers, are the members of this Society. The members have to pay annual membership fees of the Society. As service conditions, specially in the core zone, are very difficult, and most are non-family postings to remotely located patrolling camps, the staff sometimes has to go 8–10 km. for weekly market to buy household goods. In this way, the Society provides the remotely placed wildlife personnel with the essentials of the household at concessional prices. The Society also gives almost interest free soft-loans to the frontline staff and daily wagers on easy installments. Moreover, the Society also caters to the needs of tourists at Khatia and Mukki entry points of the core zone. It makes arrangements for breakfast, meals and basic daily needs on payment basis at both the entry points. Through its sale counters, the Society also deals in mementos and other reminiscences of the tiger reserve, which include: T-shirts, caps, key rings, badges, stickers, cards, posters, the Kanha literature etc.

13.4 Staff Welfare Programme:

The Kanha management also undertakes frequent staff welfare programmes through the MP Tiger Foundation Society and Kanha Workers' Society to make the lives of the frontline staff and their families as comfortable as possible. Some of these welfare programmes include:

- Construction of hostels for school children outside the tiger reserve
- Two school vans for school children of remotely stationed staff
- Scholarship for meritorious school children of staff
- Insurance for frontline staff and daily wagers
- Special yearly cash incentive to the staff from the Kanha Workers Society
- Monthly ration allowances to foresters, forest guards, mahouts, characutter and daily wagers
- Establishment of the Kanha Bhoorsingh Public School at Mukki for the children of staff and villagers
- Special health camps for check-ups and treatment
- An operative dispensary for the field staff and villagers at Mukki
- Posting of contractual physician for the staff
- Special financial aid for seriously injured/ ill employees
- Arrangement of two ambulances for the transportation of sick employees
- Provision of rain suites, winter ware, long boots, water filter, cycles and trunk etc.
- Study tours and periodic awards of excellence for the staff

13.5 Park Development Fund (Kanha Vikas Nidhi):

The Govt. of Madhya Pradesh vide order No. F. 14/ 156/ 93/ 10/ 2 dated 25-02-1997 constituted the Park Development Fund (Kanha Vikas Nidhi) to recycle funds received from tourists' entry fees, accommodation charges, filming/ photography, and elephant charges for tiger viewing in the protected areas of the state. All these tourism activities are legitimate under Sections-34 and 35 of the Madhya Pradesh Wildlife (Protection), 1974. All protected areas are required to open a separate account for these funds with a nationalized/ cooperative bank to be operated by the respective Field Directors/ Directors. The accounts of these development funds are also required to be audited as usual by the Accountant General, Madhya Pradesh following the customary procedure.

This novel concept has since been extremely helpful in the strengthening/ renovating of tourism infrastructure in protected areas, specially tiger reserve, and also taking up important managerial activities for conservation of forests and wildlife. Besides, there is also an impressive network of 164 ecodevelopment committees constituted under the Madhya Pradesh government's resolution of Joint Forest Management (JFM) vide notification No. F-16/4/91/10-2 dated 07/02/2000. These micro-institutions are responsible for taking up developmental activities in their respective villages under the technical guidance of the Kanha management. Presently, 33% of the park development fund is also used for the upliftment of forest and revenue villages in the tiger reserve every year through these well-established ecodevelopment committees.

In the case of the Kanha tiger reserve, the 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. Some of the development works in these villages include: construction of drinking water facilities such as anicuts, tank, stop dams, wells, etc., construction of approach roads, community halls, school buildings, and leveling of agricultural lands etc. Besides, 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. Sometimes, if sanctioned budget is not received from the government on time, this money from this development fund is also used for conservation works in the tiger reserve. And, as soon as this budget is received, the spent money is deposited with the respective development funds.

The government has also constituted a state-level coordination committee under the Chairmanship of the Principal Chief Conservator of Forests & Head of Forest Force, Madhya Pradesh, with Chief Wildlife Warden, Madhya Pradesh as Member Secretary, to oversee the use of these development funds in different protected areas. All the protected areas are required to submit proposals/ estimates of a wide range conservation works/ staff incentive money to the coordination committee for discussion and approval. This committee is required to meet every three months at Bhopal.

The park development fund is also used for the welfare of the frontline staff of Kanha, including daily wagers. 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, provision of good incentives also plays a very important role. Monthly monetary incentives are also been given to forest guards, permanent and casual daily labourers, including drivers, mahouts and characutters etc. Money from this fund has also been given to some frontline staffs to meet the expenses of medical treatments.

13.6 Bhoorsingh Public School & Study Centre at Mukki:

The Kanha management has undertaken an initiative to start a school for the young children of the remotely posted staff and those of nearby villages in order to help develop a foundation for their education. The school is a daycare facility for children, and a coaching institute for the dropouts. This initiative took shape in the summer of 2017. The school, has been set up at Mukki, and offers admissions to the staff's children eligible to enroll in nursery, Nursery, LKG, UKG, Class-I and II, as government schools do not offer this facility. Qualified teachers have been engaged, and presently, there are around 83 students in the play school.

13.7 Community Engagement:

The Kanha management is now also convinced that it is not possible to conserve wildlife without support from the local communities surrounding the fragile wildlife ecosystem. This requires continual engagement with local communities, and provide immediate confidence building measures to win over these villages. The buffer zone has to be managed under mutual benefiting and participative programmes wherein the nistar demands of local communities are met and their socio-economic conditions are improved. In this backdrop of confidence building measures, the concerns of wildlife management, including restoration of habitats are addressed through public support. The Kanha management was engaged with the local communities in the following ways:

13.7.1 **Sports Tournaments:** Considering the importance of sports involving the youths of villages in the buffer under various ecodevelopment committees, the Kanha management organized volleyball and kabaddi tournaments in the tiger reserve. These events became very popular and teams of different ecodevelopment committees participated. Final matches of these two sports were organized at Khatia, and prizes were also given away. Besides, trophies for winning teams, t-shirts- nickers sets were also given to all the teams.

13.7.2 **School Kit Distribution:** As a good confidence building measure to help the school-going children in the buffer zone, the Kanha management has distributed the kitd to school students.

13.7.3 **LPG Connection and Pressure Cooker Distribution:** The Kanha management has also distributed LPG gas connections and pressure cookers to reduce dependency of villagers on the surrounding forest areas. This initiative has also become popular, and more and more villagers are interested in using these alternative and efficient fuels.

13.8 Skill Development:

There are many villages in the buffer zone of the tiger reserve. The majority of villagers belong to the Gond and Baiga tribes. The Baiga, specially, are regarded as one of the most primitive tribes in the country. These populations have also contributed to the success of the Kanha tiger reserve as one of the finest protected area in the country. As there was no special opportunity for these people, the Kanha management also took some important initiatives for their livelihood. The Kanha management entered into agreements with some NGOs and companies to train these youths for assured employment.

Kanha tiger reserve occupies a special place in the local economy through its management and tourism. The tiger reserve, through habitat management, employment generating trainings, and tourism management, provides employment for guides, gypsy drivers, and local people engaged in hotels/ resorts, besides creating other small economic activities. The following income-flow, chiefly through employment generating works, contributes to the local economy:

Sl. No.	Fund Received	Annual Average Expenditure (Rs. in Lakh)	Earned Man-Days
1	Project Tiger	1500.00	296000
2	Working Plan	150.00	27000
3	Campa	250.00	52000
4	Vikas Nidhi	450.00	76000
5	MP Tiger Foundation Society	75.00	3000
6	MP Ecotourism Development Board	10.00	2500
	Total:	**2435.00**	**456500**

Besides all these, employment was also generated in tourism management in the tiger reserve. The Kanha management has also taken some important initiatives for the livelihood of people in the surrounding buffer villages:

13.8.1 **Hospitality Training:** The Kanha management has entered into a 3-year agreement with the PRATHAM, Mumbai and the Jagatguru Swarupanand Parmarth Sansthan, Balaghat to select youths from buffer villages and train them in the development of hospitality skills. So far, 396 youths have been trained, and most have got employment.

13.8.2 **Baiga Jwellery:** Kanha management has taken an initiative to increase this skill of Baiga tribal living near Kanha Tiger Reserve and give them a new source of income. With the help of NGO, 36 women of the Baiga tribe were trained to make jewellery, which is being sold in Kanha souvenir shops and online Amazon platform. Baiga women get an average earning of Rs. 400- 600/ day.

13.8.3 **Boutique, Machine-Stitching and Embroidery Training for Women:** Efforts have also been made to enter an agreement with the Lakshya Mahila Mandal, Hoshangabad, an NGO, to impart these training courses to village women. So far 40 women have trained in the above in a 2-month course. Around 20 women have also found job in and around Bhopal.

13.8.4 **Cooking & Bakery Training:** Registered under the Tejswani Women Self-help Group, 10 women have been trained in cooking and bakery. These women are presently selling their products to tourists at the Mukki entry gate and also preparing mid-day meal for nature education camps. Besides, in collaboration with the MP Tourism Board, Bhopal, the Kanha management also organized a training programme in F & B (Food and Beverages) for 12 youths of the buffer zone.

13.8.5 **Computer & English Speaking Training:** 8 women have also been trained in computer and English speaking. They have also got employment.

13.8.6 **Vehicle Driving Training:** The management has entered into an agreement with the Ashok Leyland Company, Chhindwara for conducting a vehicle driving training course for willing village youths. Under this agreement, 343 youths have been trained so far. Hopefully, these trained drivers will get employment in future.

13.8.7 **Construction Sector:** 108 unemployed youths (3 batches) from buffer zone villages given skill development training by the Larsen & Toubro Ltd. All these trained youth have employment in construction sectors.

Sl. No.	Particulars	No. of Person	Total Annual Income (Rs. in Lakh)
1	Guide	175	196.00
2	Vehicle driving	257	890.00
3	Persons engaged in Hotel/ Resorts	472	286.00
4	Contribution to local economy was assessed by the IIFM, Bhopal	-	24000.00
	Total:	**904**	**25372.90**
5	Skill development trainings provided by the Kanha management (Vehicle driving, hotels/resorts workers, guide, masonry, electrician, private security)	1335	-

13.9 Establishment of Petrol Pump:

Kanha tiger reserve had a petrol pump at Kisli, which was inside the core area. Commercial sale from here was stopped as per the Hon'ble Supreme Court guidelines to stop all commercial activities in the core zone. This petrol pump was started again at village Lamna which is away from the boundaries of Kanha Tiger Reserve. The petrol pump is run by Kanha Workers' Society all the profit will go in the welfare activity of workers /Members of Society such as health care, soft loans, education of workers children's. Land for this project was made available by Collector Mandla & Rs. 40.00 Lakh was donated by Dr. Ramakant Panda, CEO of Asian Heart Research Institute, Mumbai for the establishment. Average monthly sale of petrol is 26380 liter and diesel is 18124 liter. Average annual profit as per at current rate of commission expected to be Rs. 10 lakh.

13.10 Nature Education Awareness Camp:

The Kanha management has also started the Nature Education Awareness Camp for creation of awareness. The Last Wilderness Foundation, a prestigious NGO is also contributing very significantly to this programme. These camps focus on imparting nature education to the students that will in turn help in securing the future of our forests. This is also a tool to provide correct and factual information about the forests and wildlife along with solutions and guidelines to the people living in the buffer of the tiger reserve thus helping in reducing the impact of humans on wildlife. The duration of each awareness camp at Kanha is two full days and one night. The students are put up at Khatia/ Mukki for this programme. The students are also taken on a nature trail wherein they are made familiar with the forest ecosystem and finally games with an environment message are initiated with the students so that the message of forest protection is clear in their minds as they depart.

13.11 Wildlife Week Celebration:

A week-long wildlife protection week was also celebrated at the Mandla office and also at different range headquarters/ schools/ colleges in the buffer zone of the tiger reserve. A wide range of competitions among students of different levels were arranged. Film shows were also arranged throughout the week at the Mandla office. An exhibition was also arranged at Mandla that drew a large number of visitors every day. Students took part in different competitions such as drawing, essay writing, poster making, bird watching, rangoli and fancy dress etc.

13.12 Eco-Anubhuti Programme:

The Kanha management feels that education and awareness amongst the students living in the tiger reserve, is of utmost importance. Therefore, one of the most important goals of wildlife management in the tiger reserve is also to spread awareness about wildlife conservation in public, and also to educate the students of various middle and higher secondary schools located in the buffer zone of the tiger reserve. The state government's resolve to popularize tourism in Madhya Pradesh, and also the above goal has led to the concept of Eco-Anubhuti camps. The duration of each Eco-Anubhuti Camp is one full day. This has been launched by the Madhya Pradesh Eco-Tourism Development Board, Bhopal. The programme is initiated by a team by undertaking school visits situated in the buffer zone of the reserve, wherein they interact with the students about the biodiversity that exists in the forest and conservation of the same. Following the interaction, the students are then given a specific conservation issue to write about, in an essay form. The selected students (chosen by the school) are then taken for a park visit via a safari, to help them learn about forests, help appreciate the bio- diversity that exists in our forests and understand the interconnectedness of all the denizens. The safari is followed by a de-briefing session, reiterating the conservation value of our wilderness spaces with the help of a presentation and movie.

THE PROTECTED AREA

PART-II

(PROPOSED MANAGEMENT)

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CHAPTER – 14

VISIONS, GOALS, OBJECTIVES & PROBLEMS

14.1 Introduction:

The core zone has been part of an internationally renowned wilderness area for many decades, and been famous for its diverse floral and faunal species, including some iconic and endangered ones. In spite of ever-increasing signs of biotic pressure on and threats to the forest and wildlife of the country, the protected area still remains one of the few excellent and promising tiger habitats in the country. Besides, the resurrection of the endemic hard ground barasingha over all these years, diverse vegetation types, and possible natural linkages of the core zone to some other potential protected areas add to its vision of being a conservation nucleus for this vast eco-region in future. In spite of so much biotic pressure in the eco-region, the core zone still enjoys some ecological connectivity with a few wildlife protected areas in and around the state. While these corridors need to be strengthened and restored under a detailed and meticulous planning, the vision of successful wildlife conservation in such an ecologically well- linked protected area is achievable.

In this way, the value of this protected area has grown manifold as an effective conservation unit that still affords opportunities for eco-regional development to complement wildlife conservation initiatives significantly.

14.2 Management Vision:

The Kanha management has set the following vision for the management of the core zone:

“The core zone may be envisioned as a well-protected natural wildlife ecosystem for the conservation of the tiger as an umbrella species, and its safe dispersal on the

Kanha landscape and beyond through ecologically functional corridors, with low impact tourism".

14.3 Management Goal:

The Kanha management has set the following management goal for conservation:

"To conserve and enhance the biodiversity of the core zone, with special focus on large mammals, specially the tiger and the hard ground barasingha, along with low-impact, dispersed and diversified ecotourism ensuring maximum economic benefits for local communities".

14.4 Management Objectives:

The core zone was among the first nine national parks in India to be included in Project Tiger in 1973. The management objectives of this protected area are broadly based on the objectives as envisaged under para 4.1 and 4.2 of the Project Report submitted by the Task Force of the Indian Board for Wildlife, Govt. of India. These broad objectives are as under:

- Ensure the maintenance of a viable population of the tiger for scientific, economic, aesthetic, cultural and ecological values.
- Preserve, for all times, areas of such biological importance as a national heritage for the benefit, education and enjoyment of the people.

Based on ground realities, opportunities as well as constraints, some specific objectives of the management of the core zone are as under:

- Expand the area of the core zone by including the area of two relocated villages – Kariwah and Ranwahi.
- Strengthen protection against all kinds of poaching, intrusion, illicit grazing and illicit collection of MFP.

- Protect and manage over-all diversity of wildlife habitats in the Kanha ecosystem.
- Manage/ improve grasslands for supporting a good prey base of large ungulate species for carnivores.
- Ensure ecologically sustainable growth in tiger population.
- Increase small population of the hard ground barasingha.
- Conduct research and monitoring activities for technical support.
- Supplement ungulate species from high to low density areas within the tiger reserve.
- Manage and maintain the health of wildlife populations through veterinary interventions.
- Manage man-animal conflict in and around the tiger reserve.
- Management and training of semi-captive departmental elephants.
- Ensure low impact and ecologically sustainable wildlife tourism for the enjoyment of visitors and conservation awareness.
- Develop technical skills of select staff for the translocation of various wildlife species under proactive wildlife management.
- Reintroduce the wild buffalo under a well-planned and well-designed project.
- Manage stray, problematic and orphaned wildlife, specially tigers and leopards, and make efforts for their rehabilitation through rearing and captivity.

14.5 Rationale for Management Objectives:

The core zone, now completely free from human habitations, is comprised of mosaics of excellent wildlife habitats, and carries the potential to support huge populations of various ungulate species for a wide range of carnivores, specially the tiger, whose conservation has always been a concern for national and international communities, and holds a tremendous scope for long term survival in this eco-region. The core zone can now be further expanded by including areas of two relocated villages and having this notified. The resurrection of the hard ground barasingha in the core zone has been an inspiring conservation story so far, and the small population needs to be increased. Besides, excellent wildlife habitats, a well-monitored tiger population and thousands of grazing ungulates, and an impressive interpretation complex in the protected area, can give tremendous joy to and inculcate effective awareness of forest and wildlife conservation in tourists, and this potential needs to be tapped. As the protected area has sizeable populations of several wildlife species, another consideration is to train select park staff for capture and translocation of founder animals to other wildlife protected areas, and to even low density areas within the protected area itself. Applied wildlife research and monitoring activities in the core zone, with a wide range of wildlife species and habitat and vegetal cover types, need to be brought into the mainstream management, which can contribute tremendously to the protected area. The health of wildlife populations is another important issue in the light of any dormant epidemic pathogens, besides day-to-day veterinary interventions.

14.6 Problems in Achieving Objectives:

The Kanha management faces the following problems in achieving the above objectives of the management of the core zone:

- Islanded location of the core zone, surrounded by the buffer zone with biotic pressure of a large number of villages and cattle.
- Gradually growing influence of extremist/ naxalite insurgency/ movement in and around tiger reserve area.
- Propaganda/ disinformation campaign by self-styled social activists and eco-illiterates against the core zone having a history of successful village relocation.
- Lack of special statutory protection to the frontline staff for acts done in good faith while discharging their duties, and delayed judicial proceedings.
- Rapid increase in hotels/ resorts etc. very close to the boundary of the core zone.
- Authorization of forest officers for legal action in the Environment (Protection) Act, 1986.

14.7 SWOT Analysis:

A SWOT analysis is a strategic planning method employed to compile and evaluate the strengths, weaknesses, opportunities, and threats involved in a project. The objective of this analysis with special reference to Kanha is to help develop essential awareness about all the factors involved in making a conservation decision. SWOT involves specifying the objectives of the project in question and identifying the internal and external factors that are favourable and unfavorable to achieve these objectives.

14.7.1 **Strength:** These are the attributes of the core zone that are helpful to achieving the stated objectives.

- The entire core zone is a duly notified and undisputed Reserved Forest with clear boundaries.
- The core zone is presently free of human habitations.
- The core zone (CTH) is duly notified within the national park.
- Notified eco-sensitive zones of Kanha national park and Phen wildlife sanctuary.
- Excellent conservation history of wildlife management.
- Adequate infrastructural inputs, with excellent forest road network, effective wireless communication network, buildings and civil works.
- Effective protection inputs, with strategically located patrolling camps, barriers, vehicular anti-poaching squads, and elephant patrol etc.
- An effective fire protection strategy: fire-lines, prevention strategy, and control measures.
- Excellent collaborative projects have resulted in good database, research and monitoring inputs.
- Relocated village sites morphed into good heterogeneous grasslands.
- Ideal “doughnut” model with the buffer zone under unified control of the Tiger Reserve management with a separate establishment of officers and frontline staff
- Linkages with other protected areas.
- No militant history of the indigenous people living in and around the core zone.
- Presence of Phen wildlife sanctuary (Satellite micro-core).
- Income from tourists as Kanha *Vikas Nidhi*, and its recycling for the betterment of the local communities.

- Contractual appointment of a fulltime physician at the Mukki dispensary for the treatment of staff and villagers.
- Staff welfare initiatives under the *Kanha Workers Sahkari Sakh evam Kamgar Samiti Maryadit, Kisli*.
- A good network of information technology equipment, including Internet facilities at the Mandla headquarters and availability of computers at range level.
- Also has technical, financial and social support by several good NGOs.

14.7.2 **Weakness:** These are the features of the core zone that are harmful to achieving the stated objectives:

- Illiteracy and lack of awareness in the indigenous communities and their reluctance to deviate from traditional occupation.
- Relocation history of forest villages tends to antagonize local communities.
- Presence of eight forest villages inside the national park, technically outside the core zone.
- Presence of villages close to the core zone boundary.
- Low education standard.
- No employment opportunity due to non-availability of industries.
- Insufficient staffing.
- Inconsistent funding flow

14.7.3 **Opportunities:** These are the external conditions that are helpful to achieving the stated objectives of the management of the core zone:

- Notified core zone.
- Exclusion of the national park area comprised of 8 villages, and adding this to the buffer zone.
- Planning for the expansion of the core zone by including areas of two relocated forest villages.

- Planning to include the Phen wildlife sanctuary as the core zone of the tiger reserve.
- Integrated eco-regional planning on the landscape to foster corridor connectivity
- Supporting problem solving field research.
- Introduction of new technique for the monitoring/ estimation of wildlife population.
- Promoting steps to enhance Kanha *Vikas Nidhi* and fostering local development through this fund.

14.7.4 **Threats:** These are the external conditions that could adversely affect the efforts to achieve the objectives:

- Biotic pressure close to the boundary of the core zone.
- Animosity/ acrimony against the core zone arising out of interface problems.
- Frequent crop raiding by ungulates.
- Contamination of peripheral water points by village livestock with risks of disease transmission.
- The Supkhar range forms a boundary with the state of Chhattisgarh.
- Presence of the Chilpi-Mukki highway.
- Traditional trails through the core zone.
- Manmade fires during summer owing to MFP collection close to the core zone boundary.
- Lack of MFP like mahul climbers, tendu in the peripheral areas luring villagers into the core zone.
- Proximity to cities like Nainpur, Gondia, Nagpur, Katni, Jabalpur increasing the risk of wildlife related crimes by traditional nomadic population.
- Self-styled social activists inciting the local communities against the core zone.
- Extremist engineered disturbances in the adjoining district.

CHAPTER – 15

MANAGEMENT STRATEGIES

15.1 Legal Status:

The total area of the core zone is 917.43 sq. km. **(Appendix-37)**. The entire core zone is a Reserved Forest and derives its legal sanctity/ inviolability from Section-35 and 38-V (2) and (4) (i) of the Wildlife (Protection) Act, 1972 (amended subsequently). The core zone or the critical tiger habitat has been created as per provision envisaged under Section-38V (4) (i) of the Wildlife (Protection) Act, 1972. This has also been notified by the MP State Govt. No. F 15-31-2007-X-2 dated 24-12-2007.

15.2 Boundaries of the Core Zone:

The existing boundaries of the core zone are described briefly as under:

- **North:** From village Bhimdongri the nala coming down from Katangidadar and forming common boundary between compartment No. 575 and 581 upto Kantangidadar, and thereafter a nala going down as common boundary between compartment No. 574 and 576 upto it meets the Bahin nala and thereafter the Bahin nala forming compartment boundary between 573 and 578 and thereafter the boundary of Topla Reserved Forest Block forming the eastern boundary of compartment No. 147 and 146, thereafter the northern boundary of Topla Reserved Forest Block upto it meets the Reserved Forest boundary of the Raigarh west Block near forest village Kadla, thereafter upto the eastern boundary of forest village Kadla and thereafter along the forest village Kadla boundary in compartment Nos. 157, 100, 104, 106 and 105, thereafter, the northern boundary of the Raigarh west Reserved Forest Block, upto the eastern boundary of forest village Dhaniajhor, thereafter forest village boundary in compartment Nos. 117 and 118 upto it meets the inter-district boundary of Balaghat and Mandla, thereafter the eastern boundary of Banjar Valley Reserved Forest in compartment Nos. 734, 733, 731, 729, 726, 728, 727, 781 and 782 upto it meets eastern boundary of forest village Kisli-Bhilwani cluster, thereafter the eastern, southern and western boundaries of forest village Kisli-Bhilwani cluster upto it meets the northern boundary of compartment Nos. 677 and Nigga nala, thereafter Nigga nala upto the trijunction of compartment Nos. 664, 670 and 671, thereafter the common boundaries between compartment Nos. 664 and 671 and 663 and 664 upto it meets the northern boundary of Tendua Reserved Forest Block near village Mohgaon, and thereafter the continuation westwards of the boundary of Tendua Reserved Forest Block upto it meets the nala flowing to Kariwah vevenue village, forming the common boundary between compartment Nos. 659 and 660, thereafter the southern boundary of Kariwah revenue village upto the road connecting forest village Kariwah and Aurai, thereafter along the road southwards forming the eastern boundary of forest village Kariwah upto the river Surpan, thereafter along the boundary of compartment Nos. 655 and 657 formed by the river Surpan, thereafter the nala forming the common boundary between compartment Nos. 656 and 657, thereafter the northern boundary of compartment Nos. 655, 654, 653, 652 upto it meets the nala forming western boundary of compartment No. 652 upto village Batwar.

- **East:** From the eastern boundary of compartment No. 214 forming the inter-state boundary between Madhya Pradesh and Chhatisgarh upto the boundary of the Chhatarpur forest village, thereafter the southern and western boundary of Chhatarpur forest village which continuous northwards as the western boundary of the Patua forest village, thereafter the southwards along the eastern boundaries of Patua and Chhatarpur forest villages upto it meets the inter-state boundary between Madhya Pradesh and Chhatisgarh, thereafter the inter-state boundary upto it meets the western boundary of Ranwahi forest village, thereafter the north-western and north-eastern boundaries of forest village Ranwahi upto it meets the interstate boundary between the Madhya Pradesh and Chhatisgarh States, thereafter along the inter-state boundary and continuing along the Bilaspur–Jabalpur road upto the eastern boundary of forest village Janglikheda and thereafter along the eastern, southern, and western boundaries of forest village Janglikheda upto upto revenue village Bhimdongri in Mandla district.
- **West:** The eastern boundary of village Batwar and then the foot path Batwar to Chhapri forming compartment line between 630 and 644 upto it meets Chhapri nala

then Chapri nala forming compartment line between 631 and 643 upto its origin in Lingadadar, then ridge of Lingadadar running north to south, then another nala forming compartment line between 631 and 632 upto it meets the southern boundary of Tendua Reserved Forest Block at village Khatia–Narangi, thereafter the eastern boundary of village Khatia – Narangi upto it meets the northern boundary of Reserved Forest compartment No. 691 and thereafter the northern and the western boundaries of forest village Indri upto it meets the Baghmar nala forming the northern and western boundaries of the interstate boundary between Mandla and Balaghat districts, upto revenue village Jhulup in Balaghat district, then eastern boundaries of village Jhulup and Sarekha upto village Parsatola.

- **South:** Northern boundaries running eastwards of village Parsatola, Bhilewani, Kalegaon, Parrapur, Mohgaon, Malkhedi and thereafter eastern boundaries of village Malkhedi and Khapa upto it meets river Banjar, thereafter river Banjar eastwards upto southern boundary of Mukki forest village, thereafter the western, northern and eastern boundaries of Mukki forest village in compartment No. 63 and 62, upto it joints the western boundary of compartment No. 64 upto the Banjar river, thereafter Bhaisanghat Reserved Forest Block along village Samnapur, thereafter the cut line forming boundary of the Bhaisanghat Reserved Forest Block upto the nala forming the south-eastern boundary of compartment No. 74, thereafter the southern boundaries of compartment Nos. 75, 103, 102 and thereafter the common boundary running west to east between Bhaisanghat and Raigarh west Reserved Forest Block, upto it meets the inter-state border between Madhya Pradesh and Chhatisgarh in compartment No. 96, thereafter the continuation eastwards of the inter-state border between Madhya Pradesh and Chhatisgarh upto Chhatarpur forest village in Balaghat district.

15.2.1 **The Core Zone (CTH) & Inviolate Areas:** As per the legal definition of a tiger reserve, Kanha tiger reserve is comprised of two entities – the core zone and the buffer zone. Core zones, also known as Critical Tiger Habitats (CTHs), are identified as inviolate areas under Section-38 V (4) i of the Wildlife (Protection) Act, 1972, based on scientific evidence that where it has been established, on the basis of scientific and objective criteria, that such areas are required to be kept as inviolate for the purposes of tiger conservation, without affecting the rights of the Scheduled Tribes or such other forest dwellers, and notified as such by the State Government in consultation with an Expert Committee constituted for the purpose; such areas are required to be kept as inviolate for the purpose of tiger conservation, without affecting the rights of the Scheduled Tribes or such other forest dwellers. Section-38 V (5) of this act, however, has also laid down conditions whereby relocations of villages can be effected on mutually agreed terms and conditions. As already described in an earlier chapter, the critical tiger habitat of Kanha tiger reserve has already been notified as such. Presently there is no settlement/ village inside this inviolate core zone.

The floral, faunal and conservational significance of the core zone has already been discussed in the preceding chapters. The entire core zone, now with no human settlements/ villages inside, supports critical habitats for a wide range of wildlife species in general and endangered species such as the tiger and the hard ground barasingha in particular. The Kanha management has already made a proposal to include the areas of two relocated forest villages into the core zone and to excise eight villages, technically in the national parks but outside the notified core zone, by redrawing the boundary of the national park and keeping these villages in the buffer zone.

Forest villages located close to the boundary of the core zone do exert biotic pressure and have impact to some extent. Cases of intrusion, illicit MFP collection, illicit grazing, illicit felling, several forms of poaching, and quarrels with park personnel are common. The human populations of these villages show a typical Indian decadal demographic growth. The same is also true of cattle population, with most defective animal husbandry practices and their consequent dependence on the bio-resources of the core zone. The Kanha management, however, also appreciates the problems these villages have to face in the light of various Acts and Rules under enforcement for forest and wildlife conservation that may threaten their tendency 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, the existing park-people interface in Kanha actually drags rather uncomfortably at the cost of each other, which is very inconvenient to both.

As most of these eight forest villages had already been relocated in the past, it would be rather callous to suggest their relocation again. In case these villages agree on relocation in future under some attractive package offered by the govt., this can be arranged. The demographic and cattle population along with the number of families and area of the eight forest villages proposed for excision is appended **(Appendix-38)**. The total area of these eight villages is 1994.225 ha. (19.942 sq. km.). As stated above, after this proposed excision, these villages will automatically fall within the buffer zone.

The decadal growth of human and cattle population in these eight forest villages in the national park is as under:

Table-82: Decadal Growth of Human & Cattle Population

Sl. No.	District	Name of Forest Village	No. of Families			Total Population			No. of Cattle		
			2000	2010	2020	2000	2010	2020	2000	2010	2020
1	2	3	4	5	6	7	8	9	10	11	12
1	Mandla	Bhilwani Group	126	462	523	885	2016	2267	877	1332	1678
2	Mandla	Jhapul	8	63	63	39	364	411	50	323	372
	Total:		134	525	586	924	2380	2678	927	1655	2050
3	Balaghat	Kadla	22	92	91	170	576	545	203	262	291
4	Balaghat	Dhaniajhor	14	62	66	91	254	295	149	361	369
5	Balaghat	Mukki	33	87	137	275	582	816	252	395	679
6	Balaghat	Patua	72	78	143	531	642	920	532	438	597
7	Balaghat	Chhattarpur	36	46	117	318	439	578	320	284	357
8	Balaghat	Janglikheda	30	38	42	218	211	263	202	170	186
		Total:	**207**	**403**	**596**	**1603**	**2704**	**3417**	**1658**	**1910**	**2479**
		G. Total:	**341**	**928**	**1182**	**2527**	**5084**	**6095**	**2585**	**3565**	**4529**

Source: Kanha Tiger Reserve (2020)

This is evident from the above table that the decadal growth of human populations with respect to 2000 and 2010 in these forest villages recorded an increase of 241.19% and 119.89% respectively, while that of the corresponding cattle populations rose by 175.20% and 127.04% respectively. In view of the above, the rate of decadal growth is all the more reason for the Kanha management to keep them in the buffer zone by redrawing the boundary of the national park.

The core zone has a long conservation history and is renowned for the conservation of the tiger and endemic hard ground barasingha. To protect this unique wildlife area, many inputs have been given till date in the form of protection measures, weed and brushwood eradication, water development, civil works, and various other initiatives. The area in and around the erstwhile seven relocated forest villages in the core zone is now completely tranquil and rich in wildlife, therefore, this relocation programme over the past several years and notification of the core zone or critical tiger habitat is amply justified.

15.3 Management Issues:

The significance of the protected area, past experience and the stated objectives of wildlife management give rise to the following major management issues:

15.3.1 **Barasingha Conservation:** The central Indian barasingha (*Rucervus duvaucelii branderi*) is an endangered sub-species of the nominate swamp deer (*Rucervus duvaucelii duvaucelii*). Until a few years back, before its reintroduction to Satpura tiger reserve, the cervid was endemic to the Kanha core zone, with its only world population. The species witnessed a steep decline in the population, and was almost on the brink of extinction during the early Seventies when a mere 66 animals survived in 1970. Thanks to special managerial efforts and a high degree of protection, the barasingha population was gradually restored to a relatively safer status. The conservation of this small population in the core zone requires species as well as habitat specific approaches.

15.3.2 **Tiger Conservation:** The tiger (*Panthera tigris tigris*) is also an endangered species in all of its range-countries in the world. The conservation of this species has attracted international attention, and even after around five decades of the launch of Project Tiger, it remains a vital issue in wildlife conservation. The core zone fosters a typical representative of tiger habitat with all the intrinsic attributes required for a viable population of the species. Besides, the protection and scientific management afforded to the species have also led to a steadily upward trend of population. The tiger being a "flagship" species of Project Tiger in this tiger reserve, the protected area requires specific approaches to facilitate its safe dispersal in large forested area under an effective core-buffer strategy, ensuring the survival of strayed transients from the natal area and free-ranging individuals within the contiguous forest.

15.3.3 **Habitat Management:** A viable population of tigers needs good prey base, which in turn needs healthy habitat for survival. Kanha supports several major ungulate species that survive in two major habitat types – grassland and forest. Grasslands, however, form the mainstay of thousands of ungulates in the core zone, and need to be kept in good health through a wide range of standard habitat improvement and water development practices. These practices, as far as possible, need to be science/ study based, and undertaken judiciously vis-à-vis carrying capacity of the core zone for tiger and ungulate populations, requirement of field inputs per unit area, and past inputs etc. to avoid aggressive manual and mechanical handling of landscape/ soil that may result in unintended and unforeseen ecological consequences for natural habitats.

15.4 Management vis-à-vis Relevant Guidelines/ Acts:

It needs to be ensured that the Tiger Conservation Plan provides site-specific habitat inputs for a viable population of tigers, co-predators and prey, without distorting natural prey-predator ecological cycle in the habitat. Besides, the Tiger Conservation Plan should also conform to the guidelines issued by the National Tiger Conservation Authority, New Delhi, and should also be in consonance with the following Acts/ Directives:

- Wildlife (Protection) Act, 1972
- The Biodiversity Act, 2002
- Forest (Conservation) Act, 1980
- Indian Forest Act, 1927
- Environment (Protection) Act, 2006
- Directives received from the Supreme Court of India, from time to time on the subject

The Tiger Conservation Plan has also taken into consideration the weaknesses of the core zone, i.e. threats of animal poaching from electrocution, inadequate fund flows, staff strength and regulation of growth of resorts near the core zone as mentioned in the fourth cycle of Management Effectiveness Evaluation (MEE) of tiger reserves in India (2018).

15.5 Zone & Theme Approaches to Management Strategies:

We have adopted the zone and theme approaches in the proposed management strategies of the core zone. A "zone" within the plan area can be defined as an area of special management category with its own specific objectives. Sometimes separate zones need to be created so that compatible and related management objectives may be prescribed for different zones. A zone plan is self-contained that identifies problems, develops strategies, and also relates realistically to the surrounding areas of the other zones.

A theme plan, however, has to link all concerned zones for application of its prescriptions. In this way, several objectives and different problems created by a combination of factors are addressed by a theme strategy under which measures can be applied for the entire area.

15.5.1 **Zone Plans:** The following zones have been identified/ visualized for management in the core zone. Detailed zone plans would be discussed in the following chapters of this document. As the proposed conservation initiatives would also foster tiger population in the core zone in a concerted manner, no specific zone or theme is necessary for the tiger. The following zone plans are proposed, and will be discussed in the forthcoming chapters:

- Barasingha conservation zone
- Eco-tourism zone

15.5.2 **Theme Plans:** The following themes have been identified for the core zone, which would be discussed in the forthcoming chapters:

- Research, monitoring and training
- Assessment of tigers, co-predators, ungulate populations & habitats
- Protection and anti-poaching strategy
- Fire protection
- Habitat management:
    - Grassland management
    - Water development
    - Habitat manipulation and meadow restoration
- Wildlife health management

CHAPTER – 16

RESEARCH, MONITORING & TRAINING

16.1 Introduction:

Research and monitoring in the core cone are of vital importance. Considering the stature and importance of the core zone, research and monitoring activities are expected to generate sound information to help wildlife resource managers deal with increasingly serious and complex problems and threats, enhance public understanding, and encourage cooperation with scientists/ researchers of other institutions and organizations. Research studies are systematic and take time to reach logical conclusions, and should be carried on continuously. Besides, they should not be expected to provide overnight solutions. In the early years of wildlife management, many resources are said to have been damaged or lost simply because managers were unaware of their existence or did not know how to manage them. The plan outline of the Project Tiger document also envisaged that the scientific staff of the reserves would undertake basic research programmes aimed at evaluating systematic factors and influences, for devising pragmatic management practices to cover specific populations and the entire ecosystems.

16.2 Objectives:

Specific objectives of wildlife research, monitoring and training in the core zone are as under:

- Undertake animal specific and habitat specific basic and applied research studies compatible with the goals and objectives of wildlife management in the protected area.
- Undertake basic monitoring of wildlife populations and vegetation, and prepare and update inventories of different wildlife resources.
- Impart relevant professional training/ skill development to the staff for effective wildlife management.

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16.3 Proposed Strategy & Management Prescriptions:

The following broad prescriptions are proposed for undertaking wildlife research and motoring activities and training in the protected area:

16.3.1 **Research & Monitoring Priorities:** Wildlife management is a mix of field craft and science based on field research. Research in the core zone should focus on the critical information needs of the Kanha management. The Kanha management should take initiatives to identify and discuss problems of the Kanha wildlife ecosystem and management with appropriate institutions and scientists. Professional researchers working in isolation on topics or species relating to their field of interest can contribute very little for fostering wildlife management. Wildlife research should be problem solving studies, based on a consultative process involving protected area management, indigenous people and overall ground reality prevailing in our tropical setting. In short, research and monitoring are required for several purposes ranging from simply identifying natural resources to deciding on appropriate short and long-term management strategies.

The following three broad purposes can highlight the importance of research and monitoring in the core zone:

- To determine presence of resources in order to protect, manage them and detect changes in them.
- To understand the natural dynamics and processes of populations, ecosystems, and other park resources.
- To assess the effects of specific threats and to devise and evaluate management responses.

Some pressure points for protected area management are common to most of our protected areas, and in addition to the ongoing small term projects, wildlife research in core zone should preferably focus on these themes and topics:

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16.3.1.1 Ecological/ Eco-regional Landscape:

- Role of native fauna in dispersal of invasive weeds in the reserve
- Habitat ecology of ungulates.
- Regional changes in species richness & diversity.
- Impact of semi-captive elephants on plant community structure.
- Diet of wild elephants in the park and its overlap with other herbivore diet.
- Impacts of carrions on vertebrate and invertebrate diversity
- Effects of natural and artificial water bodies on distribution of biodiversity
- Population status, distribution and diet of pangolin and honey badger
- Documenting species diversity, status and distribution of herpetofauna.
- Hydrological status of water bodies and its role in ensuring water security for the region.
- Identifying ways of restoring degraded corridors to enhance physical, functional connectivity

16.3.1.2 Genetic studies:

- Conducting biodiversity assessment surveys using eDNA techniques.
- Creation of a genetic sample bank of captured, dead animals for future studies.
- Investigation of presence of white and melanistic mutation in tigers.
- Population and diet assessment of vultures using genetic tools.
- Developing a genetic profile database on individual tigers for forensic use and monitoring dispersals.
- Monitoring genetic fitness of tigers and hard ground barasingha of the reserve.
- Mapping lineages of tigers through pedigree.
- Changes in species occurrence.
- Wildlife forensics DNA finger printing of all captive elephants, tigers, Indian gaur and barasingha.
- Disease surveillance metagenomics profile of all viral diseases of wild animals.

16.3.1.3 **Grassland Habitat Degradation/ Management:**

- Causes for degradation of grasslands and effective ameliorative measures
- Types of exotic infestation.
- Study of aquatic plants.
- Biodiversity conservation vis-a-vis management practices in-vogue.
- Infestation of unpalatable grass species
- Infestation of weed and shrub species
- Control methods.

16.3.1.4 **Livestock Depredation by Carnivores & Crop Damage by Wild Ungulates:**

- Reasons for livestock depredation.
- Percentage of livestock in the food-spectrum of carnivores.
- Reasons for crop damage.

16.3.1.5 **Poaching:**

- Magnitude.
- Modus operandi (variations).
- Wildlife crime intelligence and networking.
- Wildlife crime prevention.

16.3.1.6 **Wildlife Disease:**

- Compilation of database on wildlife diseases of different species.
- Study of zoonotic diseases.
- Compilation of a predator- disease database.
- Surveillance of waterborne parasitic diseases in wild animals and their habitat.
- Sero-surveillance of leptospirosis in the captive elephants and their caretakers.

- Surveillance of canine distemper in migratory animals such as leopards, jackals, hyena as well as their kill.
- Biological sampling from wild herbivores during rescue and their necropsy.
- Landscape epidemiology studies.
- Linkages between sylvatic & pastoral cycles.
- Investigate risk of spillover of paramyxovirus, canine distemper virus and rabies virus from domestic animals to wild carnivores.
- Investigate spillover risk of diseases such as tuberculosis, anthrax, babesiosis, and foot and mouth disease from cattle to wild herbivores.

16.3.1.7 **Fire:**

- Nature and efficacy of existing preventive and control measures.
- Changes in the habitat due to fire.
- Changes in animal use pattern due to fire.
- Burning regimes for grasslands

16.3.1.8 **Insects as Agents of Ecological Change:**

- Impact (magnitude).
- Ecological changes.
- Periodicity.
- Ecosystem services of pollination
- Long-term station for population monitoring

16.3.1.9 **In-situ Conservation:**

- Founder population size.
- Translocation periodicity.

16.3.1.10 **Eco-tourism:**

- Impact of tourism on the core zone.

- Involvement of host-communities.
- Mechanism of management

16.3.1.11 **Jurisprudence:**

- Morphological studies.
- Biochemical studies.
- DNA fingerprinting.

16.3.1.12 **Animal Monitoring & Estimation Techniques:**

- Effect of predation on prey population.
- Estimation procedures, indices for various species.
- Home range studies.

16.3.1.13 **Vision Beyond the PA:**

- Effects of existing land use.
- Mechanism/ strategy to mitigate ill effects.

16.3.1.14 **Interface Problems:**

- Determinants of livestock depredation by tigers, leopards in the reserve and identification of risk hotspots based on long term assessments.
- Identification of factors influencing risk of crop raiding by wild ungulates.
- Experimental evaluation of non-lethal techniques to reduce livestock depredation and crop raiding by wild animals to guide evidence based management of conflicts.
- Impact of human wildlife conflict on economical, social and psychological wellbeing of local communities.
- Role individual predators in livestock depredation and creation on conflict history database for tigers and leopards.

- Magnitude of crop damage outside protected areas, and mitigation
- Decadal population growth in impact zones outside protected areas (human/ cattle).
- Resource use pattern of indigenous people.
- Impact of protected areas on indigenous people.
- Legal status of the impact zone & related problems.
- Community role in conservation.
- Levels of sustainable use.
- Grazing impact.
- Regeneration status in right burdened forests.
- Impact of rights and concessions on habitat quality.
- Socio-economics of indigenous community.
- Resource requirements of indigenous people & dependencies.
- Traditional knowledge & occupation of indigenous communities.

16.3.1.15 **Social Studies:**

- Importance of tribal cultures in wildlife conservation
- Evaluation of impacts, benefits from departmental welfare schemes and ecotourism activities to local communities.
- Assessing dependence of local communities on the park.
- Investigating local community perceptions on ecosystem services, wildlife conservation and human wildlife conflicts.
- Documenting positive interactions between wildlife and local communities

Apart from the above researches, the Kanha management should also encourage collection of relevant information on the effects of the core zone on local economy and communities of the surrounding villages. Such social researches should also be developed into reports, status papers, micro-plans, and other documents resulting in the formation of effective policies for upliftment/ ecodevelopment of local communities. Although these social projects may sound purely academic or official, and may not have any immediate obvious management significance, they would prove to be of a great value later, as the present scenario of the park-people interface in the region is bound to go a very long way.

16.3.2 **Permission/ Permit for Research:** The Kanha management should ensure that all research scholars have requisite research permissions/ permits from the Chief Wildlife Warden of Madhya Pradesh. They must carry proper IDs while doing their work in the core zone, and their field work must also conform to the proposal approved by the Chief Wildlife Warden of Madhya Pradesh. The Kanha management should also ensure that research scholars also follow the guidelines issued by the office of the Chief Wildlife Warden of Madhya Pradesh (**Appendix-39**).

16.3.3 **Monitoring Framework:** The Kanha management should ensure that the monitoring of biological resources also form a basic routine activity in the protected area management, and it is the principal way in which the management can identify trends or changes, and so gauge the effectiveness of its managerial inputs. It is easy to collect useful biological information in a simple, systematic and scientific manner. All such data should be collected and collated and be analyzed periodically.

- The core zone should also continue with the present system of ecological monitoring of flora and fauna. All the patrolling camps have been provided with specially designed camp registers containing prescribed formats for requisite information/ data relating to the broad phenology of the vegetation type, species-wise animal sighting with their age-class and sex-class structures, females with fawns, lactating females, and others, etc.

- The format of the above camp register is given below. Each Forest Guard in-charge of the respective camp should fill in the requisite information derived from the daylong patrols of his beat. This would generate important data on the basic parameters required for managing a wildlife protected area. The data generated from such continuous monitoring should later be analyzed for trends, and bases for species-specific and habitat specific planning in the core zone. The format of patrolling camp register for routine ecological monitoring is as under:

Table-83: Prescribed Format of Patrolling Camp Register

Particulars of Patrolling			Phenology			
Date	Place & Compartment No.	Time	Flowering trees/ Plants	Fruiting Trees/ Plants	Leaf Fall	New Leafs
1	2	3	4	5	6	7

	Herd Structure of Ungulates													
Total No. of Herds (Chital/ Sambar/ Barasingha/ Gaur)	All Male Herd						Female-Fawn Herd				Mixed Herd			
	Adult	Sub-Adult	Yearling	Fawn	Total	Adult	Sub-Adult	Yearling	Fawn	Total	Male	Female	Fawn	Total
8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Various Stages of Antler Development					Birth Frequency of Ungulates (15 days Intervals)		Stages of Gestation	
Males with Fallen Antlers	Males with Developing Antlers	Males with Branched Antlers	Males with Developed Antlers	Total	Date	Total New-Borns	No. of Pregnant Female	No. of Lactating Females
23	24	25	26	27	28	29	30	31

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Data/ Evidence Relating to the Tiger										
Male/ Female Pugmark (No./ Unit Distance Walked)	**Urination (No./ Unit Distance Walked)**	**Scraping (No./ Unit Distance Walked)**	**Call (No./ Unit Distance Walked)**	**Scratches (No./ Unit Distance Walked)**	**Scat (No./ Unit Distance Walked)**	**Cattle Kill**	**Other Kill**	**Stride Measurement**	**Straddle Measurement**	**Signature Inspecting Officer**
32	33	34	35	36	37	38	39	40	41	42

Source: Kanha Tiger Reserve (2021)

16.3.4 **Long Term Vegetation Monitoring:** There are sixty plots laid out (Sykes and Horrill, 1977) at different locations in sal and miscellaneous forests in the core zone for long-term quinquennium monitoring of vegetation. The Kanha management should start it again.

16.3.5 **Inventorying Framework:**

- Good inventories in a protected area are an indication of visionary management. They provide the essential database for intelligent development, use, management, and interpretation of the protected area.
- Inventorying requires a multi-disciplinary team that should be outsourced by the Kanha management.
- The Kanha management should acquire, manage, and analyze information on natural and cultural features, including presence, distribution, and condition of plants, animals, soils, water, air, biotic communities, natural processes, and cultural values, historic records, diseases, and calamities, etc.

- This inventory should be a collection, synthesis, and analysis of information on the biological, physical, social, economic, and cultural environments of the core zone.
- Inventories should be so designed as to contribute to a statement of the present condition of core zone resources, which is best described in relation to a standard condition such as the natural or unimpaired state.

16.3.6 **Plant Herbarium:**

- The Kanha management should ensure that the current conventional herbarium at the Kanha laboratory should be periodically updated and properly identified, and meticulously maintained.
- A digital herbarium of ground flora covering species of grasses, herbs and forbs should be prepared, and provided to each forest range to facilitate easy identification of species from the management point of view.

16.3.7 **Compartment History:**

- The current format of compartment history contains adequate scope for filling a host of year-wise information. Compartment histories need to remain updated.

16.3.8 **Training Needs Assessment:**

- As wildlife management has been recognized a distinct discipline of conservation science and is growing in importance, different levels of officers/ frontline staff vitally need to acquire adequate technical efficiency. Professionalism is of utmost importance for the staff of the core zone to achieve the stated objectives/ goals of management. The lack of professionalism cannot be concealed, and it ultimately becomes the root cause of the downfall of any wildlife protected area.
- Broadly, professionalism include, besides initial and basic training, periodic exposure to skill development opportunities, special courses in wildlife

management, basic knowledge of computer and important software, and interactions with resource persons. The following training needs have been assessed for the staff of the core zone.

- Wildlife and forest laws.
- Management of man-animal conflict.
- Tourism management.
- Park/ nature interpretation.
- Population dynamics and wildlife estimation.
- Animal health and nutrition.
- Ecological monitoring/ field techniques.
- Basic ecology and population biology.
- Intelligence gathering.
- Management of semi-captive elephants.
- Wildlife crime investigation/ law and judicial proceedings.
- Basic wildlife forensics.
- Basic knowledge of relevant computer software.
- GIS and remote sensing techniques.
- Training of arms and ammunition.
- At least 15 days' training exposure to the newly posted staff in the core zone before allowing it to join the new posting.
- A training module on first-aid treatment for staff by health professionals

The above trainings/ orientation courses by resource persons should be arranged periodically by the Kanha management. There are also several institutes in the country, which can be contacted for short-term courses.

16.4 HRD Plan:

- With special reference to Kanha, a Human Resources Development Plan can be explained as a framework for the expansion experience, enthusiasm, and skills through the development of both the protected area and the individual to achieve performance improvement.

- HRD is actually the integrated use of training, skill development, capacity building, organization, and career development efforts to improve individual, group and organizational effectiveness. HRD aims at developing the key competencies to enable individuals in the protected area to discharge present and future responsibilities of jobs through systematic and planned learning activities.

- Such plans develop human resource by attaining or upgrading the skills and attitudes of employees of Kanha at all levels and maximizing Kanha's effectiveness to achieve stated objectives of management and to satisfy employees' career goals and mutual relationship.

- HRD experts should also be outsourced periodically to enhance employees' potential and promote high ethical standards in meeting the vision, goals and objectives of the protected area and also to foster camaraderie, commitment, pride and mutual trust.

- Though the management of the Kanha ecosystem itself is a learning process for the majority of the frontline staff, the Kanha management should ensure that newly inducted forest guards undergo basic forestry training conducted by the Balaghat/ Bandhavgarh/ Amarkantak/ Jhabua/ Govindgarh/ Lakhnadaun training schools.

- Park officers should also be encouraged to undergo Diploma as well as Certificate and Capsule courses in wildlife management conducted by the Wildlife Institute of India, Dehradun.

- The Kanha management should also ensure that internal workshops on monitoring/ field techniques/ wildlife crime investigation and legal proceedings are also conducted periodically, by experts/ resource persons from premier institutes.

- In-house workshops/ seminars and periodic discussions between officers and field staff should also be ensured so that the frontline staff of the core zone remains updated on new perspectives relating to wildlife management.

- The Kanha management should also request the senior officers of the wildlife wing of the state to create special provisions for awards/ rewards and out of turn promotions for the frontline staff of protected areas.

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CHAPTER – 17

ASSESSMENT OF TIGERS, CO-PREDATORS, UNGULATE POPULATIONS & HABITATS

17.1 Periodic Assessment

Periodic assessment of wildlife, specially major species, and habitats are of vital importance in the core zone. As already mentioned, though the core zone also undertakes conventional patrols and monitoring activities through the frontline staff, these methods have their logical and technical limitations. The results and inferences drawn on the basis of such patrols and monitoring exercise are not sufficiently reliable to understand trends of animal populations and identify various factors existent in the Kanha wildlife ecosystem. A standardized monitoring protocol using standard methods and new technology can help the management understand the reason of certain trends in wildlife populations and habitat conditions in the protected area, and the factors responsible for good or bad changes. There is, however, no substitute for an objective-oriented, well designed, and an easy to understand monitoring programme that defines in advance the exact standard methods for data collection and record keeping. It should be ensured that the interval between assessment and monitoring exercises should not be either too long or too short, and staff should be properly trained to observe and write things exactly as they see them during the monitoring exercise.

17.2 Objectives:

Specific objectives of the assessment of tigers, co-predators, ungulate populations and habitat conditions in the core zone are as under:

- Estimate population densities of tigers, leopards, wild dogs and principal prey species and monitor trends in their populations.
- Assess wildlife habitats and trends in vegetation.
- Monitor biotic pressure on the protected area, including natural mortality of wild animals and illegal activities.

17.3 Proposed Strategy & Management Prescriptions:

The following broad prescriptions are proposed for the assessment of tigers, co-predators, ungulate populations and habitat conditions in the protected area:

17.3.1 **Phase-IV Tiger Monitoring and Patrolling Strategy:** The Phase-IV should be undertaken for intensive annual (summer and winter) monitoring of the source population of predators and prey base using the existing methodology which requires data collection from transects and camera traps. Specially, the source populations of tigers in the core zone needs to be monitored intensively.

17.3.2 **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.

17.3.3 **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 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 forest guard, as was the practice some years ago and is currently practiced in some tiger reserves. The monthly data should be mapped and maintained to analyze trends.

17.3.4 **Monitoring by Telemetry:** Use of modern technology of VHF, GPS and satellite telemetry to study and monitor aspects of demography, metapopulation dynamics (dispersal, ranging patterns), mortality, predation ecology and behavior should be undertaken in select areas. 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.

17.3.5 **Daily Monitoring & Forecasting:** As already described in an earlier chapter, the old methodology of estimating the populations of the tiger, co-predator and ungulate species has been replaced with a comprehensive monitoring protocol, known as Monitoring Tigers, Co-predators, Prey and their Habitats. The proposed new technique was tested in a pilot project of the National Tiger Conservation Authority, New Delhi, MP Forest Department and Wildlife Institute of India, Dehradun for monitoring and evaluating tiger habitats in the Satpuda-Maikal landscape of Madhya Pradesh.

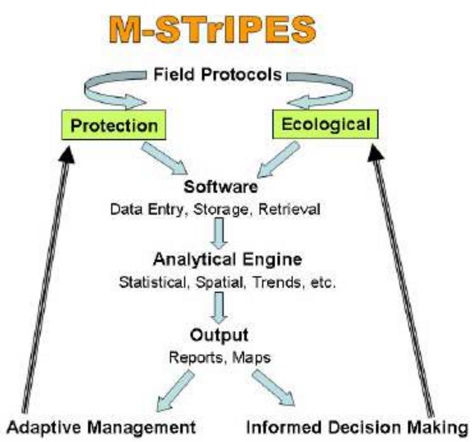
A major requirement for conserving wild tigers is to first safeguard existing source populations from further depletion (Walston *et al.* 2010). An important conservation strategy to address the threats would be to implement a technology aided patrolling system and an ecological monitoring system that would inform and guide park management of major trends in wildlife populations, illegal activities, human pressures and habitat status so as to result in adaptive management.

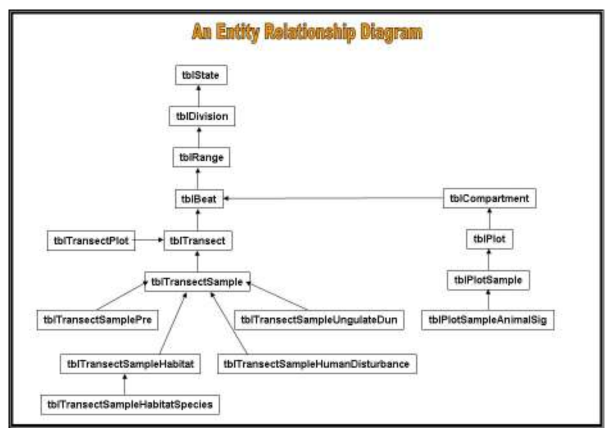
Since 2005, India has conducted a country wide assessment of tigers, co-predators, prey and their habitat once every four years (Narain *et al.* 2005). This monitoring, though important at the country level in understanding trends at large spatial scales of landscapes, is not sufficient for monitoring tiger source population sites. Single episodes of poaching can deplete source sites within months (Check 2006; Gopal *et al.* 2010) and a four-year monitoring interval is too long a period to detect trends and react with appropriate management intervention for effective conservation of these critical sites. Besides, the current patrolling regime of tiger reserves, that hold the major source populations of tigers, is archaic. There is no system in place by which the park manager can ascertain if its forest guard has actually patrolled an area, or assist in planning the spatial coverage of patrols based on field requirements and data generated by previous patrols.

The National Tiger Conservation Authority, Wildlife Institute of India and Zoological Society of London have jointly developed a customized application software, which is a computer programme tailored for generating specific information/ reports/ inferences/ maps on the basis of data inputs. This application software has been named M-STrIPES or Monitoring System for Tigers – Intensive Protection & Ecological Status. This programme has been standardized for the tiger reserves of entire country, and is based on different types of data collected in prescribed formats under the new monitoring protocol for monitoring tigers, co-predators, prey and their habitats in wildlife protected areas. Besides being most user-friendly and easy operability, the software has proved reliable, robust, and efficient. The predictability, customizability and consistency of this computer programme are also satisfactory.

Implementation of monitoring (M-STrIPES) in Kanha should consist of five components:

- Field training
- Data generation through patrols and ecological monitoring
- Data entry and storage
- Analysis and interpretation at desired spatial and temporal scales
- Adaptive management. The system depends on good field implementation and data recording while the software is a small component that serves to store, analyze, and retrieve data at desired temporal and spatial scales. It is a cultural shift from ad-hoc patrolling and monitoring to systematically planned activities that result in better and informed management decisions.





The system has been made field-friendly, and it does not add more workload to the already overworked forest guards. This has been done by utilizing most of the routine tasks of patrolling for generating data needed for M-STrIPES. The equipment needed for implementing M-STrIPES consists of one Android Mobile for every guard (leader of the patrol) and a laptop or computer for each range. The Android Mobile contains an in-built GPS unit, a camera, a mobile phone, a long lasting battery, and the data forms required to be filled while on patrol or during ecological monitoring.

Further, data generated through M-STrIPES can be used to understand the relationship between patrolling intensity and illegal activity.

The above information permits to plan on the spatial coverage and intensity of patrols that are required to combat wildlife crime in an efficient and effective manner. The track logs define patrol route photographs and way points with GPS time and date stamp which ensure that the patrol was actually conducted and the data forms not merely filled while at the base camp.

The basic information collection takes place at beat level during regular patrol done by forest guards. The information will be managed at Range and Head quarter level to assess weekly and monthly progress and effectiveness of patrol. Various components of the software are as under. Field guide for field data collection/ information are appended **(Appendix-40)**.

17.3.6 **Ecological Component:** The entire forest staff has been trained in collecting Phase-I data on 1) Tiger and other predator signs, 2) Ungulate encounter rates on line transects established permanently in every forest beat, 3) Human disturbance indices, 4) Habitat parameters and 5) Dung density. Further it is proposed to set up a minimum of five permanent pressure impression pads (PIP) in each forest beat. These PIP's will be in different compartments of a beat and a minimum of one km apart. These PIPs will be monitored once every month in summer and winter to record signs of all carnivores. Once the Phase-I data collection is implemented once in summer and once in winter, the data will be exported to M-STrIPES software to analyze and provide easily interpretable reports and maps for the management.

- **Tiger & Other Predator Signs**: Data on tiger and co-predators should be collected as prescribed in Phase-I. Three trails of 5 km. each need to be identified and permanently marked for this monitoring. Further, it is proposed to set up a minimum of five permanent pressure impression pads (PIP) in each forest beat. These PIP's will be in different compartment of a beat and minimum 1 km. apart. These PIPs will be monitored once every month in summer and winter to record signs of all carnivores. Carnivore sign surveys are analyzed in an occupancy framework (MacKenzie *et al.* 2006) that takes into account imperfect detections at desired spatial and temporal scales. Naive estimates and detection bias corrected estimates are statistically compared between desired time scales using spatially paired comparisons and time series data analysis. Since line transects and PIPs are fixed in space data generated from each of them are compared using paired statistical tests that provide better power in detecting trends. M-STrIPRS alerts its users of declines that are greater than 20% over the desired time scale. It generates tabular reports as well as maps depicting status and change in status.

- **Ungulate Density:** The line transects are already established permanently in every forest beat. These line transects will be maintained and monitored for ungulate density estimation. Reserve will procure range finder and compass for this work. Each transect will be walked five times in winter and five times in summer. Data will be analyzed by M-STrIPES and Distance Software, to map encounter rates, compare trends and analyze density.

- **Human Disturbance Indices**: Information on anthropogenic disturbance will be collected as per the Field Guide issued by the Wildlife Institute of India. This information should be analyzed using M-STrIPES to monitor trends in disturbance and its correlation with ungulates and carnivores.

- **Habitat Monitoring:** The vegetation monitoring is important to understand the dynamics of succession specifically for Grassland. Grasslands in Kanha are under arrested successional stage, they are in existence due to historical human activities and natural cycles of fire. The monitoring of Habitat will be done at two levels:

    - **Monitoring Vegetation Changes by Remote Sensing**: This will be done at five-year interval using Indian Remote Sensing Satellite (LISS-3 and LISS-4) data. Time series analysis will be done to monitor trends in vegetation change.

    - **Grassland Monitoring:** Due to vulnerability of change in grassland condition (deterioration) and possibility of natural succession to woodland, a balanced approach and appropriate monitoring is needed. We propose to have one hectare plots to be laid in different grasslands i.e. mesic, dry and on plateau. In each grassland type 5 plots of a hectare each will be laid. These plots will be further monitored in ANOVA frame work to see the effect of Burning, over grazing, moisture and nutrient.

The grassland monitoring is crucial for maintaining high ungulate population and to sustain viable tiger and Co-predator population.

- **Dung density**: Dung density data of ungulates will be collected on transect as per the field guide, every 400 m on ungulate transect 20X2 m plot will be laid for dung data collection. Data will be analyzed using M-STrIPES software.

17.3.7 **Patrol Data:** This data set is to be collected while the forest staff is on routine patrol duty. The purpose of the data is to provide the wildlife manager with information on spatial coverage of patrols, locations of crimes and illegal activities, wildlife mortality and sightings (direct and indirect) of rare, threatened and indicator species. Once data are collected and entered in the software, spatial and temporal patterns and trends for the above mentioned parameters can be analyzed for patrol effort in relation to comparable data on disturbance activity and animal abundance, and to incorporate the results of these analyses in the tactical planning for security and management purpose.

- While on a patrol (foot, vehicle, elephant etc.), use a hand hold GPS unit in "long track" mode to record the patrol route. Set GPS in WGS84 datum for data collection.
- If expertise on GPS use is not available then simply record the GPS coordinates every 30 minutes on a foot patrol. For vehicle based patrols the road travelled should also be marked on the park map using a GPS unit. This data should be downloaded onto a computer and recorded in the database with rest of the patrol information.
- Record (with coordinates) any illegal activity observed by you while on the patrol and also record approximately how long it has been since the illegal activity took place, and the action taken (if any).
- Illegal activities can include signs of wood cutting, lopping of fodder branches, grass and bamboo cutting, livestock grazing, campsite, snare, trap, poacher seen, gunshots heard, fishing, fire, NTFP collection (NTFP specify what is collected in remarks).
- Record all wildlife mortality observed (with coordinates) along with probable cause of death.

Table-84: Illegal Activities & their Codes

Poachers	P	**Fishing**	Fs	**Encroachment**	En
Suspected Criminal Campsite	SCC	**Poisoning**	Pg	**Wildlife Harassment**	WH
Snares	Sn	**Electric wire**	Ew	**Offroad Driving**	OD
Traps	Tp	**Illegal Fire**	Fr	**Livestock Grazing**	LG
Illegal Machan	IM	**Wood Cutting**	Wd	**Grass/ Bamboo Collection**	GBC
Gunshot	Gs	**Lopping**	Lp	**Human Presence (Signs)**	HP
Hunting Dogs	Dog	**NTFP Collection**	NTFP	**Excavation Marks**	EM
		Gravely Injured Animals	GIA		

Time	**Lat**			**Long**			**Animal Mortality/ Injury Records**					
	D	**M**	**S**	**D**	**M**	**S**	**Species**	**Gender (M/F/Un)**	**Age (Y/Ad/Un)**	**Carcass State/ or State of Injury**	**Probable Cause of Death/ Injury**	**Sample Taken**

M-Male, F-Female, Un-Unknown, Y-Young, Ad-Adult

17.4 Updation of Abundance Status:

The Kanha management should update the abundance status of various wildlife species occurring in the core zone. Presently, there is a wide range of wildlife species, including some endangered and endemic such as the tiger and the hard ground barasingha. The abundance status can be based on the IUCN guidelines and recorded as standard terms such as critically endangered, vulnerable etc.

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CHAPTER – 18

PROTECTION & ANTI-POACHING STRATEGY

18.1 Introduction:

Forest and wildlife protection need to be assigned the topmost priority among all conservation practices in the core zone. The Kanha management has to adopt a very stringent attitude towards protection of forest and wildlife in the protected area. The core zone faces perceptible biotic pressure along the periphery, and only strict enforcement of various Acts/ Rules, effective protection strategies and the gathering of reliable intelligence throughout the year can protect the core zone for posterity. Besides the eight forest villages inside the Kanha national park, a sea of humanity and livestock just outside the core zone is also proverbially waiting to engulf the protected area. Needless to add, basking in the glories of the past and complacency on the part of the Kanha management may prove appallingly costly as far as tiger conservation is concerned. Protection strategy also needs to incorporate various instructions/ advisories received from time to time from the Principal Chief Conservator of Forests (Wildlife), Madhya Pradesh and the National Tiger Conservation Authority, New Delhi. A detailed Security Plan sanctioned vide No. Tech-1/ 2592 dated 1.5.2014 by the Principal Chief Conservator of Forests (Wildlife), Madhya Pradesh, is already in place.

18.2 Objectives:

The broad objective of protection and intelligence gathering in the core zone is to overall secure/ guard the entire wildlife ecosystem from forest and wildlife offenders and a wide range of biotic pressure. The specific objectives, however, are as under:

- Protect the core zone from all forms of poaching and illicit MFP collection
- Control illicit grazing and protect wildlife habitats, specially on the peripheral areas of the core zone
- Protect wildlife habitats from fire hazards in the summer.

18.3 Strategy & Management Prescriptions:

The following broad prescriptions are proposed for the protection of core zone and intelligence gathering:

18.3.1 **The Tiger Cell:** A district level Tiger Cell has been constituted by the Govt. of Madhya Pradesh in each district of the state. As the tiger reserve is situated administratively, in the Mandla and Balaghat districts, both the Deputy Directors of the Kanha tiger reserve are the Members of the Tiger Cells of Mandla and Balaghat districts. The concerning Collectors, Superintendents of Police, Divisional Forest Officers, District Rural Development Officers and District Mining Officers of both the districts are also the members of the respective Tiger Cells. The importance of Kanha need not be emphasized for taking utmost interest and proper initiatives to ensure timely meetings and effective functioning of these Tiger Cells. Ideally, the Kanha management should aim at achieving the following broad objectives:

- Take initiative for regular meetings and engage the members in wildlife conservation
- Prevent and check poaching and illegal trade relating to tiger and other wildlife species
- Efficient networking and reliable information gathering to identify criminals and their nexus.
- Ensuring coordination with other government agencies.
- Creating awareness in society.
- Training of frontline staff.

The Kanha management should basically focus on the following points while working through these Tiger Cells:

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- Current status of intelligence network in the districts
- Information on apprehended poachers and smugglers
- Status of surveillance on nomadic tribes/ pardhees/ bahelias
- Evolving strategies to apprehend poachers and control the smuggling of wildlife products/ trophies
- Speedy trials of wildlife cases
- Prohibitive actions against poachers/ smugglers
- Pendency of wildlife cases and its timely disposal
- Training of frontline staff with the police

18.3.2 **Law Enforcement:** The Kanha management should ensure a close working relationship with the police and the judiciary to put across the government's point of views regarding protection of wildlife in protected areas more effectively. Besides, the law enforcing officers/ staff of the wildlife protected area need to be well-acquainted with and updated on various forest and wildlife Acts, such as the Indian Forest Act, 1927; the Indian Wildlife (Protection) Act, 1972 (as amended upto 2006) and the Forest Conservation Act, 1980.

The government has empowered various ranks of frontline staff of the core zone to take cognizance of forest and wildlife offences. The Kanha management should ensure that the frontline staff of core zone is always well-prepared with necessary documents/ proformas prescribed under the above Acts for taking appropriate actions and registering forest/ wildlife offences. The Kanha management should ensure that the staff remains trained and updated on the latest amendments to the concerning Acts, and for this, easy Hindi translation of the concerning Acts may be circulated down to the lowest level for a better understanding of the subject. Besides, periodic Legal Workshops and discussions should also be organized, involving resource persons from the judiciary and the police department to guide the staff in the proper investigation of forest offences, procedural norms, and to simplify the intricacies of the laws. The staff is expected to be benefited by such arrangements, as these close interactions point out the various shortcomings/

mistakes in the entire procedure which render the cases weak, increasing the possibility of criminals going scot-free.

The management of a tiger reserve is a great learning process, and the lesson learnt is that procedural flaws would help the offenders escape prosecution, and even the staff may find themselves facing legal proceedings for improper arrest or seizure.

In view of the above, it is all the more important for the frontline staff to attend internal periodic refresher courses and discussions, and acquire high levels of discipline and motivation. Such discussions and workshops would build the confidence of the staff in the following:

- Arrest or apprehension of persons/ offenders engaged in illegal acts inside the tiger reserve.
- Proper documentation of illegal activities for court proceedings, including evidence in the form of confiscated wildlife articles, relevant photographs, signed statements, and reports.
- Proper seizure of items prohibited under the Laws, or required as evidence to testify to an illegal act.
- Simple legal procedures in delivering the arrested offenders to the police/ court, and filing charges.

18.3.3 **Strike Force:** There should be at least two well-equipped strike forces in the core zone with adequate vehicular mobility. These well-staffed strike forces should look after their respective areas, and be provided with necessary route-chart and other logistics. Ideally, the Kanha management should ensure that these strike forces are headquartered at Garhi and at Khatia.

Detailed instructions have also been issued vide Govt. of M.P., Home (Police) Department's order No. F-16-266/ LIC/ 96-B (1) 2, dated 06/07/96, authorizing forest personnel (forest guard and above) to use firearms provided by the department for self-defense while protecting government property. Instructions have been received in this regard from the Principal Chief Conservator of Forests vide Letter No. 1856, date 16/08/96.

The progress of these strike forces should be critically reviewed at monthly meetings. The Kanha management should also ensure that these strike forces be entrusted with the following responsibilities.

- Ensuring an effective intelligence network to monitor, prevent and pre-empt illegal activities in the core zone.
- Undertaking intensive night patrols throughout the protected area, and the villages surrounding it.
- Raid and seizure of illegal wildlife products.
- Weekly market checking and general surveillance.
- Periodic checking of village level crime registers and updating crime maps.

18.3.4 **Forensics Approach to Wildlife Crimes:** Wildlife forensics is a specialized and relatively new field of crime investigation. It employs scientific procedures to identify, examine, and compare evidence from crime scenes, and to link this evidence with a suspect and a victim. The victim always is an animal killed through various means of poaching in and around the protected area. The Kanha management should ensure that forensic investigation of every wildlife crime in the protected area is carried out very carefully, especially in the case of tigers and leopards.

Each wildlife crime should be investigated forensically following normative guidelines for searches of crime scenes, required photography, collection of evidence, including poison, with its preservation and packing, and writing down various morphological and anatomical observations in standard formats. The wildlife veterinarian should be responsible for selecting and preparing suitable specimens and completing the required paper work for sending the same for analysis to different institutions. Initially, these forensics investigations can be based on Wildlife Forensic Basic Manual (Dr. DK Satpathy, Arvind Sharma and CS Dubey). The Kanha management should also upgrade forensic investigative skills of the wildlife veterinarian and staff by organizing periodic training programmes/ workshops. Standard/ prescribed formats for writing down reports on nature of crime, nature of examination and postmortem reports should be used. After the forensic formalities, care should be taken that there is no disconnect/ gap in the investigation of the wildlife crime, and it reaches a logical conclusion. A good investigation of wildlife crime broadly includes meticulous collection of evidence, adequate sampling, proper documentation and legal paper work, effective corroboration, patient tracking of leads, arrest of offenders, and pursuance of court trials.

18.3.5 **General Patrolling Strategy:** The overall patrolling strategy in the core zone should include the following features:

- Staff/ camps listed with duty allocation and route chart.
- Teams equipped with mobile wireless sets and firearms.
- Patrolling teams systematically cover the area allotted to them.
- Special instructions/ provisions for squads:
    - Surveillance: hotels, tourist points, vehicles, bus stands
    - Surveillance: bahelias, pardhis, traditional hunters, suspectes etc.
    - Coordination with local police
    - Labourers for patrolling
    - Networking
    - Issuance of special POR books
    - Preparation of daily schedule
    - Market checking
    - Surprise checking of barriers

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- Preparation of "crime maps" with periodic updating
- Monitoring cattle kill, human kill and injury incidences
- Monitoring issues relating to compensation
- Monitoring water points near habitation
- Preparation of crime gang dossiers
- Preparation of individual crime dossiers
- Conveying progress to Field Director/ Dy. Director on a daily basis through wireless
- Deviating from routine schedule during emergencies
- Taking note of offences registered in local police station
- Using tape recorder/ camera etc. to record evidences

18.3.6 **Intensive Patrolling of Beats:** The core zone has a very effective network of 120 strategically located patrolling camps. A forest guard is in-charge of a patrolling camp, and is assisted by one or two camp watchers. This staff should be made responsible for patrolling their beat intensively and for round-the-clock alertness to deal with any eventuality. Each beat should be intensively patrolled daily for snares, traps, poisoning, intrusion, illicit felling, illicit grazing, and chances for electrocution etc. The description of daily patrols should be clearly entered into the prescribed camp registers and be checked by officers from time to time.

18.3.7 **Monsoon Strategy:** This special protection strategy should be adopted during the rainy season, and its preparations, including the assignment of duties and a monsoon patrolling booklets with prescribed formats (**Appendix-41**) for the review of progress etc. should be completed by the 15th June. During the rains, most of the protected area is more or less rendered inaccessible for regular patrolling by vehicles. Villagers in and around the core zone know perfectly well about the difficulties of the Kanha management. Besides, as the economic condition of the surrounding villages comes down in the rains, more or less, to the lowest ebb, the probability of intrusion/ pilferage in the peripheral areas increases manifold. The monsoon strategy should include the following:

18.3.7.1 **Elephant Patrols:** Six headquarters in as many forest ranges have to be established for elephants in the core zone during the rains. Each elephant squad has to be comprised of, besides an elephant and mahout, around 6 to 8 forest personnel and several labourers. Each elephant squad has to be equipped with mobile sets, GPS and arms etc. These squads are required to patrol designated vulnerable areas of the core zone frequently, and submit their progress in the prescribed format. The respective range officers should ensure that the elephants have to patrol the designated area intermittently at least 15 days a month. Senior officers should also join these squads for patrolling from time-to-time.

18.3.7.2 **Surveillance of Footpaths:** Footpaths and tracks in the protected area should also be kept under continual surveillance by the Kanha management. The people of the surrounding villages tend to try their luck at sneaking into the protected area and grabbing their hands on any article/ produce of wildlife and forest saleable in the market to buy their petty requirements. Therefore, surveillance is should be conducted specially before market days to discourage the tendency. Intrusion of the people of the surrounding villages should be effectively controlled during the rains. Offenders/ criminals tend to use footpaths/ tracks to intrude into the core zone during the monsoon to spare themselves the difficulties of rain affected terrains and hindrances and obstructions of shrubs and bushes.

18.3.7.3 **Control on Illicit Grazing:** Availability of ample vegetative biomass in the core zone during the monsoon also attracts the cattle of the surrounding villages for grazing. Besides, the people of these villages also tend to drive their livestock into the core zone to make the most of this productive season. The Kanha management should enforce strict control over illicit grazing by apprehending the cattle/ sending them to *kanji* houses and recovering penalties from the owners for illicit grazing. Sufficient labourers should be engaged to assist the frontline staff for the effective control of grazing by livestock.

18.3.7.4 **Temporary Patrolling Camps:** The Kanha management should identify such far-flung areas in the core zone that become sensitive due to their relative inaccessibility and resultant neglect in protection. Temporary patrolling camps should be established in such areas during the monsoon so that no major part of the core zone is left unpatrolled/ unprotected. Officers should also ensure to stay overnight at these camps several times a month.

18.3.8 **M-STrIPES Foot Patrolling:** The importance of foot patrols in the core zone need not be emphasized. Regular foot patrols enable the frontline staff to stay close to ground realities. It is only during these foot patrols that the incidents of snaring, trapping, the poisoning of saltlicks and water pools and laying out of wires for electrocution come to light. The Kanha management should also realize the importance of regular foot patrolling by officers in the light of ever-increasing biotic pressure. Besides inspiring the patrolling staff, this also lends a psychological restraint over the surrounding villages. In view of the above, forest guards along with labourers should patrol their respective beats regularly.

All forest guards should also carry their android handsets with the M-STrIPES, customized software to strengthen their patrols and surveillance. The software programme stores, retrieves, analyzes, and generates reports for informed decision making for the management. This will capture data on animal sightings, a wide range of evidence, wildlife crimes and ecological observations. This will also record the patrol routes and generate a number of maps to enhance effectiveness and spatial coverage of patrols in the core zone. These patrols should also be joined by various ranks of officers from time to time.

18.3.9 **Night Patrolling:** The Kanha management has also learnt from past experience that in spite of obvious dangers, offenders also sneak into the protected area at nights. Therefore, if patrols are not conducted at nights, the protected area may have to incur serious losses despite effective protection in the daytime. The Kanha management should ensure that the frontline staff including officers should also remain active for a few nights every month. Night patrols in the core zone should comprise the following:

- **On Foot:** At least 3 hours per night after 9:00 pm to check all the vulnerable spot/ sites/ activities.
- **By Vehicles:** At least 5 hours per night after 9:00 pm to check barriers, watch tower, foot paths and patrolling camps.
- **Night Halt at Camps:** The Kanha management should also realize that night stays at patrolling camps not only lend confidence to the staff but also provide a chance to understand the protected area at night.
- These efforts need to be monitored next day at the Mandla head office under a prescribed proforma (**Appendix-42**).

18.3.10 **Patrolling of Sensitive Areas:** there are many identified sensitive areas that need special patrols by the frontline staff and labourers. These sensitive areas should be intensively patrolled for at least 10 days a month. The list of sensitive areas in the core zone needs to be updated for patrolling during the dry season. The identification of these areas should be based on old crime spots, problematic villages and knowledge/ experience of the frontline staff. These sensitive areas generally include natural saltlicks, areas below electric lines, shallow and small water pools and peripheral areas near problematic villages. The Kanha management should ensure that these areas are mapped out, and special patrols are carried out by the frontline staff of the respective forest ranges to preempt and counter intrusions into the protected area. Besides, as appended, senior officers should also join these patrols every month, and the strategy is reviewed periodically under a prescribed format. **(Appendix-43).**

18.3.11 **Prevention of Poaching by Iron Traps:** Though the use of iron traps (gin traps) is not common in and around the tiger reserve area, there is no scope for complacency. Several years back three iron traps were recovered in the Kisli range. These traps were very meticulously fixed to trap tigers. Fortunately, the staff found these traps during its routine patrol, and any untoward incident was averted.

This needs to be ensured that poachers, particularly nomadic tribes/ *pardhees*, dare not sneak into the core zone and set gin traps for tigers and leopards. The following guidelines are suggested to prevent the poaching of tigers/ panthers by iron traps:

- Range officers should always be in constant touch with the nearest police stations to have prior knowledge of the camp-site of nomadic tribes, the duration of stay, and total number of adult males and females etc.
- It also requires excellent coordination between the range officers of the core zone and the buffer zone division, as the nomads will try to pitch their camps outside the core zone.
- These people should never be allowed to pitch their camps in the buffer zone area as well.
- Every forest guard should have good knowledge of forest roads, tracks, and dry nullah beds recording movements of tigers.
- Generally, poachers set these iron traps in the above areas of tiger movements in such a way that there is a maximum possibility of a tiger putting his foot on the iron trap. To ensure this possibility, the poachers create such obstructions (thorns and thorny bushes etc.) that tigers/ panthers have to avoid these paths and are automatically led onto the one where the iron trap has been fixed.
- These poachers have good knowledge about the length of the step and stride of animals, and they can even set 4-6 iron traps on a single path.
- Sometimes poachers may also place a kill at the head of a "V" area whose both arms are obstructed by thorny bushes. The tiger is attracted by the kill and is led towards the kill through these thorny arms and gets trapped in the iron trap.
- Every forest guard should very cautiously look for this iron trap continuously for two days in his beat at least once in fifteen days.

- If a forest guard ever comes upon an iron trap or the above signs of leading a tiger to a specific place, he should immediately inform his higher-ups, and watch over the iron trap so that no animal may be trapped.
- The Kanha management should ensure that every forest range has an updated list of villagers whose occupation is iron-smithy.
- Monthly review of the above strategy under the following prescribed format needs to be ensured:

Table-85: Monthly Review Prescribed Format

Name of Range	Camp Site of Nomads	Date on which the Camp was Established	Probable Date of Wind-up	Type of Occupation	Date of Inspection by the Staff	Name of Beat	Dates of Checks of Tiger Tracks	Remarks
1	2	3	4	5	6	7	8	9

Source: Kanha Tiger Reserve (2021)

18.3.12 **Saltlick Checking:** The Kanha management should also update the list of natural saltlick spots where herbivores aggregate frequently. Habitual poachers have very good knowledge of such spots. Poachers urinate over these spots to enhance their odour and attract wild ungulates. They also mix poison capsules with soil. Wild ungulates either get killed by swallowing poisoned capsules or get trapped and are physically killed by poachers. Such spots should be checked frequently by the frontline staff **(Appendix-44)**.

18.3.13 **Waterhole Checking:** As the water bodies of the core zone attract all types of animal species, water samples should be frequently analyzed for poison and other fatal toxicities. The Kanha management should always have an updated map and list of all such sensitive waterholes. All these sensitive waterholes should be frequently checked in the pinch period by the staff to prevent poaching and the poisoning of these restricted waters.

18.3.14 **Checking for Electrocution:** There are several areas in the protected area across which high voltage electricity line pass over. The total length of such electricity lines all over the core zone is around 25 km., with several identified sensitive areas. Experienced poachers know about such areas where wild ungulates can be easily electrocuted. They use several methods to electrocute wild ungulates in these areas (**Appendix-45**). The Kanha management should ensure that these areas are frequently patrolled so that the poachers may not kill wild animals through electrocution. Besides, efforts should also be made at the government level to have the entire such lengths of electric line insulated.

18.3.15 **Patrolling by Ex-Army Men:** Ex-army personnel have also been deployed in the core zone for intensive patrolling. Presently, there are 15 such personnel (Supervisor, Gunmen and Jawans). They are accompanied by 60 local youths having good knowledge of the jungle. The Kanha management should ensure that the entire patrol force is divided into six units and based in respective forest ranges. Needless to add, without support of local range assistants and forest guards the force will not be able to achieve much as far as protection is concerned. Therefore, patrols should be undertaken on the basis of a well thought-out written strategy, and daily progress sought in a prescribed format for regular reviews (**Appendix-46**).

18.3.16 **Patrols by Special Tiger Protection Force (STPF):** As per the guidelines issued by the National Tiger Conservation Authority, New Delhi vide letter No. 15-5/2008-NTCA (Part-1) dated 02/07/2010, a Special Tiger Protection Force was to have been constituted to strengthen and give an effective thrust to overall protection in the protected area. In response to this, the Kanha management submitted a proposal to the Principal Chief Conservator of Forests (Wildlife), Madhya Pradesh vide letter No./DM/2641 dated 14/08/2010 for the deployment of the STPF in the tiger reserve.

In case the concept of STPF is approved by the NTCA and the state government in future, the following strategy should adopt for the deployment. The entire area should be divided into the following three STPF units:

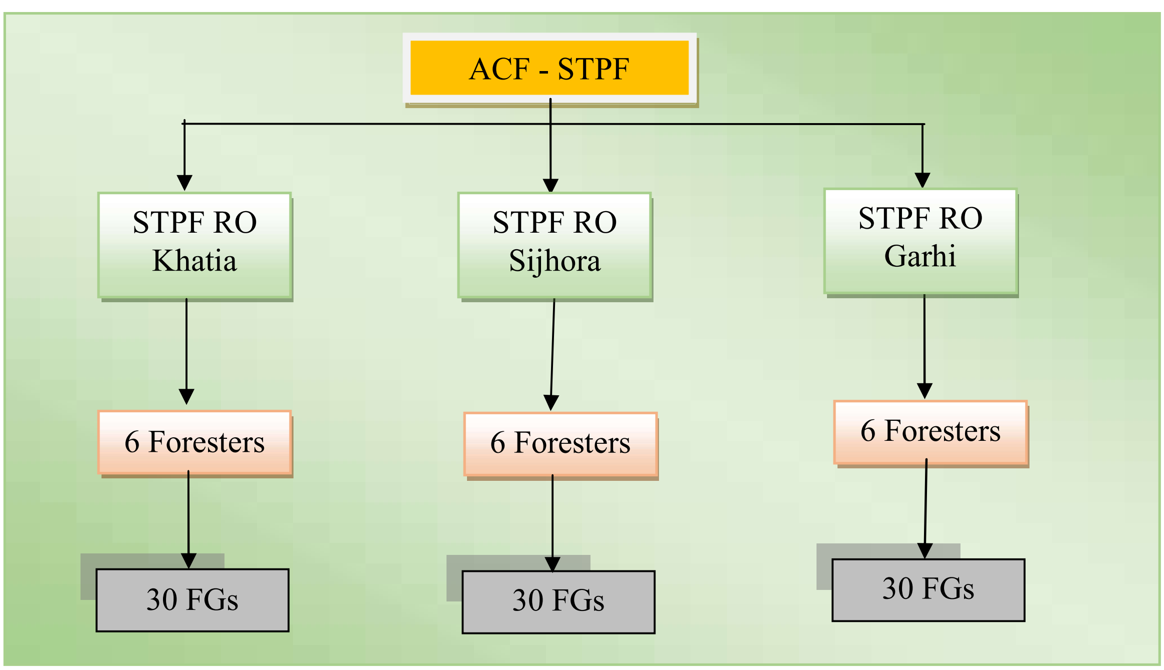
Table-86: Information on STPF Units

Sl. No.	Name of Unit	Total Area (ha.)
1	**2**	**3**
1	Khatia	728.00
2	Sijhora	728.00
3	Garhi	728.00
	Total:	**2184.00**

Source: Kanha Tiger Reserve (2020)

Each of the above three STPF units should consist of various range assistant circles of the respective forest ranges of the core zone, buffer zone and Phen wildlife sanctuary. The detailed composition of the three STPF units is appended (**Appendix-47**).

An ACF (Assistant Conservator of Forests) should be in-charge of the overall command of all the three STPF units. The ACF will have his headquarters at Garhi. Each STPF unit has to be headed by a forest ranger. The forest ranger will command a platoon of 6 Foresters and 30 Forest Guards. All the three Forest rangers will be stationed at different places in the buffer zone. The command structure of the STPF should be as under:



Kanha Tiger Reserve, Mandla (MP) 481 661, Phone: 07642-250760 (O), Fax: 07642-251266, Email: fdknp.mdl@mp.gov.in

The Kanha management should ensure that each STPF unit is provided with necessary vehicles. While the units will be required to undertake foot patrolling in their respective areas, vehicles will be used to carry personnel, tents, mess items etc. and to reach distant places of their stay within their respective areas. The progress of the STPF should be critically reviewed regularly.

18.3.17 **Special Protection along the Eastern Boundary:** The eastern boundary of the core zone is not surrounded by the buffer zone as it lies in the Chhatisgarh State. For the protection of wildlife in this part, the Chhatisgarh forest department should be persuaded to enhance the protection status in the area. The Bhoramdeo Wildlife Sanctuary is also located not far away from the core zone. There are some very good patches of forests that can serve as stepping stones for this linkage. Besides, the Kanha management and the Kawardha forest division (CG) should also make special arrangements for joint patrols along this border and sharing of information on wildlife crimes/ intelligence.

18.3.18 **E-Eye Surveillance:** The Kanha management should also think of installing a real time anti-poaching surveillance and wildlife tracking system, sometimes also known as e-eye surveillance, in the core zone. The system basically consists of long range thermal, clear vision and Infrared cameras/ devises mounted on towers or stations for live, remote and 24x7 surveillance. These stations transmit live feed using WiMax, and can be controlled remotely from a centrally located control room.

18.3.19 **Surveillance through Drones:** Taking advantage of conservation technologies, the Kanha management should also think of using drones (unmanned aerial vehicles) for surveillance activities to step up protection and prevent poaching and intrusion into the protected area. There is a wide variety of drones available in the market, and the selected ones must be of high quality equipped with excellent cameras based on finer objectives of their use in the field. The live-stream has now become an excellent tool to monitor more areas in real time. The effective handling of these drones would also require a trained team of several field personnel to operate at least 3-4 drones throughout the core zone.

18.3.20 **Fire Protection:** Fire protection is one of the many conservation initiatives carried out every year to protect wildlife habitat within the core zone. The fire season sets in around mid-February and lasts until the first showers of monsoon. During the fire season the temperature may go upto 46^{o}C in the last week of May, leaving the grasslands/ground flora completely dry and susceptible to fire. Dense ground flora and high grasses only add to the inflammability of the area. No natural fires occur in the core zone, and it also does not experience fires by lightning. Only man-made fires occur during the season.

18.3.21 **Fire Protection Measures:** In view of the incalculable damage which may be caused by the man-made fires, the Kanha management should ensure to undertake an all-round prevention/ protection strategy well in advance, involving local people, before the fire season actually sets in. Besides strict adherence to the National Tiger Conservation Authority, New Delhi Fire Audit Protocol for fire management in the tiger reserve, **(Appendix-48),** protection measures include the following steps:

18.3.21.1 **Preventive:**

- The cutting and burning of specially created firelines (1980 km.) along with strips adjoining forest roads (905.10 km.), range boundary lines and compartment lines well before the fire season **(Appendices-49 to 50)**.
- Creation of temporary fire watchtowers at strategic locations throughout the area **(Appendix-51)**.
- Early burning of grasslands on the basis of burning regime, and creation of firebreaks.
- Regular sweeping and removal of dry leaves from fire-lines throughout the fire season.
- Monitoring progress and occurrence of fire by fire watchers through round the clock wireless network.

- Deployment of fire extinguishing squads (vehicular and non-vehicular).
- Constant patrolling by the patrolling camp staff.

18.3.21.2 **Control:**

- Strip clearance by the fire extinguishing squad.
- Manual putting out of fire by fire beaters.
- Counter firing by the squads.

The protected area has experienced extremist-engineered disturbances in the past, and under the prevailing sensitive situation, constant-patrolling in-groups should also be ensured. This should be in addition to the round the clock wireless facility and patrolling from the various patrolling camps. Regular foot patrols near the peripheral area of the core zone is also utmost important. Local villagers (predominantly tribals) should be deployed for this purpose through Kanha Workers' Society in "short term fire protection projects".

Effective wireless communication plays a very important role in the fire season. This needs to be ensured that maximum number of fixed wireless sets remain operational throughout the fire season.

As there is already the Fire Alert Dissemination Status for SNPP in place (Forest Survey of India), the tiger reserve management should also continue to tap its full potential for prevention of fires.

It is pertinent to point out that all the labourers in the fire season should be drawn from the indigenous communities of the peripheral villages, and this is also a source of livelihood to them during the summer months, and hence also qualifies as an important eco-development intervention.

18.3.22 **Interaction with Judiciary:** The Kanha management should continue with the practice of periodic interaction with local and higher judicial and trainee-officers. The judiciary needs to be apprised about the constraints forest officers have to face in seizures, arrests of offenders, investigations of wildlife crimes, and filing chargesheets in courts. Efforts should be made to clear doubts on interpretations of various important sections of different Laws applied for enforcement in forest and wildlife conservation. Besides, judicial officers should also be requested to tell forest officers about various relevant important decisions/ orders pertaining to forest and wildlife conservation passed by higher courts. Such periodic interactions with the judiciary would immensely benefit the Kanha management and raise conviction rate in forest and wildlife crimes pertaining to the protected area.

18.3.23 **Intelligence Gathering & Coordination:** The Kanha management should ensure that there are six intelligence-gathering units in the core zone. The units have to be headed by the respective range officers. Smart foresters and forest guards should be given responsibility of gathering intelligence on wildlife offences and coordinating with reliable agents/ informers. Apart from building up an effective intelligence network to monitor, prevent and pre-empt illegal wildlife activities/ offences, these units should also raid and seize wildlife products, and do market checking and general surveillance, including surprise checking of hotels, barriers, bus stands and tourist points **(Appendix-52)**. The Kanha management should also judiciously and regularly spend funds received from the National Tiger Conservation Authority, New Delhi. A confidential dossier/ list of suspects/ old criminals with their photographs should also be meticulously prepared and regularly updated for continuous direct or indirect surveillance. Needless to add, the progress of these units should be regularly reviewed by the Kanha management.

CHAPTER – 19

ECOTOURISM MANAGEMENT

19.1 Introduction:

Ecotourism is always sustainable and respects nature conservation and the culture of local communities credited with protecting such areas. In a way, it also resists environmental degradation, encourages nature conservation and sustains traditional communities. As per the government policies and opinions of conservationists, most protected areas of our country can only sustain low impact tourism. The core zone, not a large protected area by international standards, is one of the finest wildlife protected areas of the country, and offers excellent opportunities to the visitors for enjoying tremendous floral, faunal and natural attributes of pristine wilderness. Needless to add, protected areas like Kanha are also credited with the responsibility of generating positive public opinions about nature conservation. In view of the above, it is important that the sustainability of ecotourism vis-à-vis satisfaction of national and international visitors and message of conservation awareness is ensured by the Kanha management.

19.2 Notified Guidelines for Ecotourism by NTCA:

The Supreme Court of India, while hearing the Special Leave Petition (Civil) 21339 of 2011 Ajay Dubey Vs. National Tiger Conservation Authority & others, had directed the Ministry of Environment & Forests and National Tiger Conservation Authority, Govt. of India to prepare effective guidelines for tourism in and around tiger reserves. Accordingly, the NTCA has duly submitted and notified the above comprehensive guidelines vide No./15-31/2012-NTCA dated 15 October, 2012 in the Gazette of India, Extraordinary, Part-III, Section-4. Part-B of the above document deals exclusively with tourism in and around tiger reserves has already been appended **(Appendix-26)**.

The guidelines also envisage that the State shall ensure that each tiger reserve prepares a tourism plan, as part of the Tiger Conservation Plan vis-à-vis the technical guidelines of the National Tiger Conservation Authority. The plan shall inter alia, include identification of corridor connectivity and important wildlife habitats and mechanisms to secure them. This site-specific tourism plan forming part of the Tiger Conservation Plan shall be approved as per the provisions of the Wildlife (Protection) Act, 1972. Prior to this approval, no new infrastructure for tourism (except for minor alterations in existing modest home stays) shall be allowed to be developed in and around tiger reserves. The ecotourism and interpretation sub-plan contained in this chapter is prescribed in the backdrop of the above guidelines issued by the NTCA, New Delhi.

19.3 Objectives:

Specific objectives of ecotourism management in the core area are as under:

- Develop facilities for promoting safe, restful and enjoyable tourism, and enhance the quality of visitors' experience.
- Complement the economy of local communities living mainly around the core zone.
- Develop/ maintain park interpretation facilities for creating conservation awareness.
- Ensure ecologically sustainable and light tourism and minimize its impact on the resources of the core area.

19.4 Proposed Strategy & Management Prescriptions:

The following strategies and management prescriptions are proposed for conducting ecotourism in the core zone under various components:

19.4.1 **Principles of Ecotourism Management:** The Kanha management has to ensure that ecotourism in the core area is being managed on some broad principles based on the NTCA tourism guidelines, government's intents, professionalism, island nature of the protected area, and tourists' interest/ aspirations. These are intended to provide a principled stand for tourism management in the core zone. Explanations and examples are also given to illustrate how best these principles can be put into practice.

19.4.2 **Preservation of Natural Values & Promotion of Conservation:**

- Importance of nature/ wildlife for tourists.
- Offering opportunities to learn about nature/ wildlife and conservation.
- No disturbance to nature.
- All areas not suited to tourism.
- Tourism permitted into areas with suitable facilities.
- Facilities designed to blend with the surroundings.
- Impacts monitored, with corrective measures taken as needed.

19.4.3 **Minimizing Pressure on the Ecotourism Zone:**

- Respect for the tranquility of wilderness.
- Complete avoidance of disturbance and damage.
- No traces of tourists to be left behind.

19.4.4 **Opportunities to Increase Understanding & Appreciation:**

- Information/ knowledge through interpretation setup.
- Attractive presentation of information.
- Excellent interpreters.
- Well trained route guides.

19.4.5 **Production of Excellent Publicity Material:**

- Updated and reliable information.
- Attractive printing and publications.
- Availability of all publications.

19.4.6 **Enhanced Recreational Facilities:**

- Need to divert tourists from “tiger centric” mindset.
- Preferably outside the core zone.

- Visitors' needs taken into account.
- World class recreational facilities.

19.4.7 **Respect for Local Traditions & Cultures:**

- Visitors encouraged to learn about local cultures.
- Guides to be familiar with local conditions.

19.4.8 **Promotion of Local Economies & Employment:**

- Local businesses relating to tourism to be supported.
- Employment opportunities exclusively for local communities.

19.4.9 **Visitors' Feedback:**

- Visitors' opinions important.
- Provision for receiving suggestions/ opinions/ complaints.
- Timely review and redressal/ action.

19.4.10 **Coordination among Stakeholders:**

- Initiatives expected from the Kanha management
- Regular meetings and healthy discussions.
- Receptivity to other stakeholders' genuine problems.

19.5 Development of Participatory Ecotourism & Visitor Strategy:

The following planning imperatives should be undertaken for the development of an overall eco-tourism strategy, and will incorporate:

- Participation of local communities.
- Sound environmental design.

- Visitor management.
- Conservation education.
- Training.
- Financial sustainability.
- Monitoring and evaluation.

The following issues need to be assessed:

- The existing tourism situation and potential.
- The desirable tourism situation and identify steps to attain the same.

The preparation of a participatory community based ecotourism strategy for the project area, involving the stakeholders through meetings and workshops, and it should address the following:

- Development of monitoring mechanisms for ecological impact of eco-tourism.
- Visitor information.
- Development of guidelines for visitors/ staff viz., visitor centre, orientation centre, brochures, handbook, signages.
- Development of mechanisms to collate visitation data for management.
- Development of guidelines/ building code for environmentally acceptable and culturally appropriate designs.
- Identification of staffing levels for tourism, future requirements & training needs.
- Identifying: institutional arrangement for eco-tourism management, mechanisms to increase long-term local participation in benefit sharing and decision-making, local training needs.
- Developing, monitoring & evaluation of plans to assess local participation & benefit sharing.
- Evolving legal framework for eco-tourism activities.

- Establishing administration and legal requirements for: zoning, entry fees, revenue-sharing with indigenous people.

19.5.1 **Rules & Regulations:** The core zone has been conducting tourism activities for a very long time, and the Kanha management already has clear code/ set of rules and regulations for the guidance of staff and tourists, and to deal with any eventuality. While some of these rules have emanated from legal obligations, others have been framed by the Kanha management to control and regulate tourist influx in the core zone. These rules and regulations should be widely publicized through every possible way.

19.5.2 **Broad Guidelines for Stakeholders:** While specific guidelines are being proposed separately under various tourism components in the core zone, some broad operational guidelines for tourism management relating to the Kanha management, stakeholders, visitors and local community in the backdrop of some important considerations are proposed as follows:

- The tourism plan should be consistent with the State Tourism and Ecotourism Strategy.
- The Kanha management shall go by the advice of the Local Advisory Committee (LAC) to discharge functions for tourism management as prescribed in the NTCA tourism guidelines.

19.5.2.1 **For the Kanha Management:**

19.5.2.1.1 **Eco-Tourism Zone & Carrying Capacity:**

- In the backdrop of the NTCA tourism guidelines, the total ecotourism zone in the core zone has been reduced to 184.74 sq. km. This ecotourism zone, in this way, now constitutes around 20.0% of the core/ critical tiger habitat area, and encompasses a total road length of 239.99 or 240 km.

- The carrying capacities of the core area has been determined at the physical, real and effective and permissible levels, and are as under:

Physical Carrying Capacity (PCC): 960 visits / day
Real Carrying Capacity (RCC): 217 visits / day
Effective & Permissible Carrying Capacity (EPCC): 178 vehicles / day

The carrying capacity of the ecotourism zone for 178 vehicles per day has been determined for the standard type of vehicles approved by the Kanha management for safari purpose. As there is no provision for tourist visitation involving elephant, boat and foot travel in the core area, no such carrying capacity has been assessed.

- The carrying capacity of 178 vehicles shall be further divided for entry in the morning and evening sessions. The ceilings of maximum numbers of vehicles in the morning and evening sessions are fixed at 100 and 78 respectively and must not be exceeded.
- The ecotourism zone has been subdivided into the following sub-zones for the purpose of maintaining low impact tourism throughout the tourism season. Unless unavoidable, the areas of sub-zones should not be changed.

Table-87: Area and Road Length of Ecotourism Zones

Sl. No.	Ecotourism Sub-zones	Road Length (km.)	Area (sq. km.)
1	2	3	4
1	Kisli	59.50	66.12
2	Kanha	61.70	40.62
3	Mukki	77.83	40.19
4	Sarhi	40.96	37.81
	Total:	**239.99 or 240**	**184.74 or 185**

Source: Kanha Tiger Reserve (2021)

- The carrying capacity for each ecotourism sub-zones in the morning and evening sessions along with eligibility of entry against online and current bookings have been fixed as under and should be strictly adhered to:

Table-88: Zone-wise Carrying Capacity

Sl. No.	Sub-Zone	Total Carrying Capacity/ Day	Carrying Capacity							
			Morning				Evening			
			Online Booking	Single Seat	Current Booking	FD Quota	Online Booking	Single Seat	Current Booking	FD Quota
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	Kisli	25	9	2	2	2	7	1	1	1
2	Kanha	59	24	4	4	4	17	2	2	2
3	Mukki	58	21	3	3	3	19	3	3	3
4	Sarhi	36	13	2	2	2	11	2	2	2
	Total:	**178**	**67**	**11**	**11**	**11**	**54**	**8**	**8**	**8**

Source: Kanha Tiger Reserve (2021)

- The Kanha management shall make efforts for the refinement of the existing online booking system to enforce the carrying capacity, and to make the rules of booking transparent to avoid harassment to the visitors.

19.5.2.1.2 **Tourism in the Core Zone:** All ecotourism activities shall take place only in delineated 'tourism zones' indicated in this document. Currently, ecotourism in the core area consists of stay facilities along with related services, interpretive facilities through which nature/ wildlife can be enjoyed and awareness gained, and interesting natural features having significant tourism values. The following generic guidelines should be followed:

- The Kanha management should ensure that ecotourism facilities, including all types of accommodations, until moved out of the core area, are maintained properly and upgraded/ updated periodically.

- All automatic/ computerized programmes installed in the museum complex and orientation centres should to be checked and inspected frequently for their optimum performance in consultation with expert organizations/ agencies.
- There is already an excellent forest road network in the ecotourism zone. The road network should be maintained properly.
- No new forest road should be constructed in the ecotourism zone. While too many forest roads give rise to fragmentation, concretized structures obstruct natural movements of tigers.
- Various signages and their inscriptions should be inspected periodically for animal damage or weather related defacement.
- Proper cleanliness/ hygiene should be maintained in the forest canteen.
- Cleanliness and hygiene must also be ensured in and around the forest canteen to reduce the nuisance of crows attracted by foods.
- Toilets should also always remain clean, with proper use of antifouling/ deodorants etc.

19.5.2.1.3 **Vehicular Excursion:** To ensure that tourists enjoy these excursions/ safaris to the fullest and appreciate moving/ grazing wildlife species and panoramic vistas in the ecotourism zone, the following guidelines are proposed to regulate and control vehicular excursions in the protected area:

- There shall be no special management of habitat with a view to inflating animal abundance for tourism purposes. Visitors shall keep a minimum distance of 25 meters from all wildlife species; cordoning, luring or feeding wildlife shall be prohibited. Minimum distance between vehicles while viewing/ spotting wildlife shall be maintained at 50 meters. Vehicles shall not monopolize a wildlife sighting for more than 10 minutes.
- Only well-inspected registered vehicles with an authorized guide should be allowed inside for excursion.
- Only registered drivers should drive the vehicles throughout the tourism season.

- No intoxicated drivers/ guides should be allowed in tourist vehicles.
- There should be a well-planned route chart at the Kisli, Mukki, and Sarhi gate to divert tourist vehicles and avoid crowding on a particular road.
- A minimum distance of 500 meters should be ensured between two moving tourist vehicles.
- Tourist vehicles must not exceed the prescribed limit of their capacity of 6 persons excluding the guide and the driver.
- Vehicles must not exceed the prescribed speed limit of 20 kmph.
- It should be ensured that all registered tourist vehicles have clear and legible code numbers written on them. This provision will help apprehend the vehicle in case of any tourism offence committed in the ecotourism zone.
- The Kanha management shall delineate adequate and appropriate areas and spots for visitor facilities in the ecotourism zone. These makeshift structures must blend with the natural surroundings, and remain clean throughout.

19.5.2.1.4 **Waste Disposal:** The Kanha management has been concerned about waste management in the protected area for a long time. Presently, new technologies like use of incinerators and waste recycling are also known to be causing environmental concerns.

Therefore, the Kanha management should continue with the past practice of repeatedly reminding all the stakeholder, especially hotel and resort owners, guides, and gypsy drivers, at regular meetings to encourage tourists to carry back, after safaris, plastic cans, bottles and plastic bags etc. in paper bags provide by the management and dispose of these items outside the national park in designated places.

Entry permits issued to visitors should also carry these instructions.

Besides, adequate garbage bins should be provided in all designated places where tourists are allowed to get down from their vehicles.

The buffer management is responsible for waste disposal outside the core by periodically collecting food wastes from hotels/ resorts and converting into marketable compost at Khatia and Khapa with the help of respective ecodevelopment committees. Proper disposal of bio and non-biodegradable wastes is also being managed.

19.5.2.1.5 **Vigilance:** It is very important for the park staff to be vigilant and to keep an eye on tourists and their vehicles so that no tourist offence may go unnoticed and the offender is dealt with accordingly. In view of the above, the Kanha management should engage a few mobile forest guards in the tourism zone to ensure vigilance on ecotourism in the ecotourism zone to ensure the following guidelines:

- Enforce dos and don'ts of ecotourism as far as possible.
- Ensure control over the speed of tourist vehicles and zone jumping through computer software/ App.
- Action should be taken promptly against speed violators and zone jumpers as per the reports generated by the computer programme.
- If a tourist vehicle stops somewhere to watch wildlife, the back vehicle has to cross over and maintain the distance of 500 meters.
- Ensure that polythene bags are not taken inside the ecotourism zone.
- No garbage/ pouch should be thrown out of tourist vehicles.
- Tourist vehicles must never surround any wild animals, giving them the right of way.
- Ensure that guides accompany the tourist vehicles assigned to them.
- Tourist vehicles must follow the routes allotted to them.
- Ensure randomly that the identities of the tourists are the same as have been registered at the entry gates and in online bookings.

19.5.2.1.6 **Requirement of Staff for Tourism:** The Kanha management should also start an interpretation programme through persons well-versed in nature education/ conservation, with a training background from premier institutions.

Most visitors generally do not know much about the importance of wildlife conservation and protected areas. If visitors are explained interestingly about the history of the protected area and the importance of wildlife conservation and its contribution to biodiversity conservation, tangible and intangible benefits of wildlife reserves, not only will it create awareness about conservation among visitors, but will also lessen their disappointments about not having seen tigers during their excursion.

The main duties of these park interpreters will be:

- To welcome the visitors and interpret the history of Kanha tiger reserve, ethnography, local culture, goals and objectives of conservation, conservation of endangered species, and wildlife management practices in the core zone.
- To answer the questions of visitors emerging out of his brief/ address on the core zone.
- To interpret the museum complex of Kanha and interact with visitors.
- To give the tourists relevant and interesting PowerPoint presentations in the evening.
- To educate the students of nature camps organized in the buffer zone.

19.5.2.1.7 **Maintenance of Interpretation Package:** The maintenance of interpretation package must include the following:

- Periodic assessment of existing infrastructure, road, electricity, water supply, law and order situation.
- The Kanha eco-tourism package should invariably include:
    - o Online booking for jungle excursion.

- Simple, adequate boarding and lodging facilities, in tune with the environment and the general setting of the landscape.
- Good road network within the identified tourism zone.
- Convenient transportation.
- Canteen for refreshment.
- Impressive interpretation centres.
- Professional interpreters.
- Way-side exhibits.
- Signages.
- Clean public conveniences.
- Garbage disposal facility.
- Accommodations for staff/ personnel.

- Structures with an exotic look causing visual pollution and non-compatible and unaesthetic architecture should be avoided.
- Provide visitor information and interpretation services (bilingual), including rules and regulations of tourism, tourism facilities, and places of tourist interest etc.

19.5.2.1.8 **Creation of Tiger Safari:** This is always a good idea to exploit some other ecotourism resource to ease tourist pressure off the ecotourism zone. Therefore, the creation of a world-class tiger safari in the buffer zone, not far from the Khatia entry gate, should be a welcome initiative. There are many such outstanding models to choose from renowned wildlife protected areas of the world. Needless to add, these biotic attributes can easily be arranged from the core zone itself. A small interpretation complex along with a well-stocked library and a reading room can also be provided in the close vicinity. As the proposal to this effect is already under submission to the Central Zoo Authority of India, after the approval of the State Government and the National Tiger Conservation Authority, New Delhi, this needs to be expedited by the Kanha management.

19.5.2.1.9 **Shifting of the Present Interpretation Complex:** The entire interpretation complex located at Kanha should be shifted to just outside Kisli. The entire complex should be upgraded excellently, made high-tech and more interactive for entertainment-cum-education. The present interpretation complex, canteen, and tourist assemblage in the morning occupy a part of the prime natural space at Kanha. This relocation will not only reclaim some more area for the zone of tranquility inside the core zone, it will also put an end to the daily crowding of hundreds of tourists and resultant anthropogenic nuisance at Kanha. This will also encourage more tourists to visit the complex, and they would get ample time to make use of interpretive facilities.

19.5.2.1.10 **Management of the *Vikas Nidhi*:** It is imperative to send periodic proposals to the government for enhancing the entry fee and tariff rates for tourism in the core zone to build up the *Vikas Nidhi*, so that ecotourism may become a self-sustaining activity without causing financial stress to the Kanha management. Further, a certain percentage of the *Vikas Nidhi* should also be used for developing roads, elephant maintenance and improvement of accommodation facilities in ecotourism management, and for the basic community needs of the relocated villages. The proposals should be prepared with due deliberations and sent to the Principal Chief Conservator of Forests (Wildlife), for discussions/ revision and approval by the concerned committee.

19.5.2.2 **For Tour Operators:**

- The Kanha management should develop suitable curricula for training of route guides and drivers. The curricula should include, besides art, craft and ethics of wildlife tourism, the history and evolution of the tiger reserve, basic ethnographic and cultural attributes of the Mandla and Balaghat districts, and information on the wildlife species occurring in the core area. Such trainings should be conducted during the non-tourism season and should result in adequate certification.

- It should be ensured that all guides and drivers compulsorily undergo a short course in park interpretation and rules and regulations for effective tourism management in the core area. This course should conclude in an oral examination, with all successful candidates being certified by either the Madhya Pradesh Ecotourism Board or Madhya Pradesh Tiger Foundation Society.
- The Kanha management should arrange, before the tourism season, a refresher course/ workshop for all certified guides and drivers to build up their capacity to identify birds and provide natural history information on other species, to slowly dissuade them from tiger-centrism. A periodic assessment of their performance should be reviewed by the Kanha management before reissuance of their licenses.
- All registered/ certified guides shall wear uniforms as prescribed by the Kanha management. They must also have their nametags and Kanha-logos and badges pinned to the shirts/ sweaters/ jackets.
- All registered/ certified drivers shall wear uniforms as prescribed by the Kanha management. They must also have their nametags and Kanha-logos and badges pinned to the shirts/ sweaters/ jackets.
- The use of battery operated vehicles need to be encouraged to minimize pollution on suitable terrains in the tourism area.

19.5.2.3 **For the Visitors:** The Kanha management should create awareness in visitors by circulating adequate pamphlets/ erecting sign boards to the following effects:

- Abiding by the rules and regulations of the core zone.
- Helping conservation and protecting all natural and cultural sites.
- Avoiding wastage of resources.
- Avoiding littering & carrying back all non-degradable litter.
- Avoiding removal of plants, seeds, drift-wood from the core zone.
- Respecting local culture/ customs.
- Respecting holy places.

- Strictly adhering to the safety precautions.
- Dos and Don'ts as prescribed by the Kanha management

19.5.2.4 **For the Host Community:** The Kanha management shall create awareness in host communities to the following effects by interacting with them:

- Respect the value of environment, conservation and cultural heritage.
- Avoid overusing the area.
- Co-operate with the authorities in ensuring healthy eco-tourism.
- Realize and react to the threat of investors against exploitation.
- Be friendly with the visitors as effective "nature guides" and "conservationists".
- Develop a participatory community-based tourism strategy, in collaboration with local communities, to ensure long-term local community benefit-sharing, and promotion of activities run by local communities
- Forest dwellers who have been relocated from core or critical tiger habitat to the present buffer zone shall be given priority in terms of livelihood generation activities related to community-based ecotourism in the tiger reserve. The Kanha management shall make a special effort in this regard, besides a periodic review to ensure its compliance.
- Ensuring training programmes to the host community in:
    - Lodge ownership/ management.
    - Basic education and awareness.
    - Health and sanitation.
    - Skill development for preparation of local souvenirs as appropriate.
    - Codes of conduct.
    - Forest and wildlife conservation.
    - Litter control.
    - Forging partnerships with tourists & tourism industry.
    - Environmental management.

19.5.2.5 **Temple & Pilgrimage Boards:** As there is no temple/ pilgrim site located inside the core zone of the tiger reserve, there is no need for any prescription. However, the comprehensive guidelines for tiger conservation and tourism as proposed by the National Tiger Conservation Authority, New Delhi and approved by the Hon'ble Supreme Court contains some prescriptions to deal with temple and pilgrim tourism inside the core areas.

19.5.3 Miscellaneous Prescriptions:

- No new tourism infrastructure shall be created in the core zone. The existing residential infrastructure inside the core zone shall be strictly regulated to adhere to low ecological impacts as decided by the Kanha management on a site specific basis.
- No area of the core zone from which relocation has been carried out, shall be used for tourism infrastructure.
- A provision needs to be made for the recruitment of 90% of the staff of hotels/ resorts from local communities.
- All the lodge/ resort owners should be encouraged for rainwater harvesting and recycling.
- Special economy tourist vehicles (mini-buses/ canters with 15-20 seats) should be introduced for day-tourists and students to reduce vehicular pressure on the core zone. This should be started with five vehicles.
- The core zone should be opened from the 1st November as used to be the practice until a few years back.
- The Kanha management shall, as far as possible, provide for subsidized visits of students for excursions in the core area and while fostering educational extension activities.
- The Kanha management shall carefully monitor and record the impact of tourism activities on the wildlife and its habitat. Consultants/ experts from premier

institutes/ organizations can also be hired for the assessment of tourism impact. Some indications are suggested as under:

- Deposition of dust on both sides of the roads
- Damage to wildlife habitats/ sites
- Disturbance to animals, specially endangered ones, in breeding season
- Changes in the behaviour of animals
- Significant shift in home ranges

- Site-specific micro–planning for community based eco-tourism should be taken up.
- Periodic training programmes on eco-tourism should be conducted for tourism administration, planners, operators and general public.

19.6 Visitors' Feedback and Action:

The Kanha management should also regularly monitor and evaluate the impact of tourism on the core zone, and visitors' reactions to and feedback on tourism management. However uncomplimentary the remarks may sometimes seem, they help to minimize the shortcomings of the management and improve upon its functioning. Visitors' books kept at different forest rest houses, hutments, dormitory, and interpretation complex, letters, and emails should form a good basis for such evaluation.

If any provision/ conditions of these guidelines is contravened in the core area of the Tiger Reserve by any person or organization, the same shall be liable of an offence under subsection (2) of 38-O of the Wildlife (Protection) Act, 1972.

CHAPTER – 20

HABITAT MANAGEMENT

20.1 Introduction:

Besides forest and wildlife protection in the wildlife protected area, habitat management is another conservation practice of vital importance. The thousands of ungulates of at least nine major species also command a bearing on the population of tigers and co-predators. The management of habitats for wildlife chiefly involves influencing the successional stage and physical structure of vegetation to benefit major herbivore species and/ or any endangered species of high conservation or other intrinsic value, for instance the hard ground barasingha in the core zone.

The core zone supports a wide range of ungulate species of different food habits and niches. The survival of these species depends solely on vegetation. Needless to add, the populations of tiger and co-predator in turn depend on a good prey base in the core zone. Interactions between vegetation and its herbivorous predators, specially larger species in the core zone, make up a plant-herbivore system. As stated above, this system commands a direct bearing on the next level system, herbivores and their predators, the carnivores. Though there are several types of wildlife habitats in the core zone as described in an earlier chapter, considering the importance of grasslands for major ungulate species, habitat management practices are mainly focused on the improvement/ manipulation of these grasslands and forest edges and water development.

20.2 Objectives:

As the grassland habitat forms the mainstay of all the ungulate species in the core zone, specific objectives of habitat management are as under:

- Restocking of grasslands.
- Create new wildlife habitats, specially in the non-tourism forest ranges where animal density has been low.

- Improve the present conditions of grasslands for increasing the population of prey base species.

20.3 Proposed Strategy & Management Prescriptions:

Based on the existing situations and current knowledge, the following broad prescriptions should be followed for the management of grasslands in the core zone depending upon financial allocations received from the state govt. and the National Tiger Conservation Authority, New Delhi. The Kanha management should also pay attention to improving/ ameliorating abandoned village sites to integrate them into wildlife habitat. Needless to add, prime grasslands should be taken up on a priority basis:

20.3.1 **Grassland Burning:** As recommended at the workshop on grassland management at Kanha, the Kanha management should take the following measures to ensure effective and less damaging burning practices on the grasslands.

- Each forest range should maintain a grassland register to record year-wise burning of grasslands or their sections/ parts. Each grassland should be identified for signs of regression, and the names of regressive and relatively normal grasslands should be clearly listed out.
- Large grasslands should be divided into four sections to burn two sections alternatively in rotation.
- Regressive grasslands should not be burnt in winters, specially in the Kanha range, and cool burning should be carried out in normal grasslands in alternate years.
- Special research and monitoring projects should be taken up to determine fire regimes for important grasslands in the core zone. It has to be a long-term project under a good methodology whereby different plots should be monitored for species composition after each burning.

- The burning practice should also take into consideration the following composition of grasslands:

  i. Decreaser species (indicators of well managed grassland) – i.e. those which dominate in grassland which is in good condition and which decline in abundance when overgrazing or degradation takes place;
  ii. Increaser I species (indicators of under-utilization) – i.e. those which are not abundant in grassland which is in good condition, but which increase when grassland is under-utilized (over-rested) or burnt on a overly low frequency;
  iii. Increaser II species (indicators of degradation) – i.e. those which are not abundant in grassland which is in good condition, but which increase when grassland is over-utilized or degraded by too much burning. Tainton (1988) states the following: "If the decline in grassland condition over a period of time is the result of a increase in the proportion of Increaser I species, then it is clear that the area is being under-utilized and so stocking rate or burning frequency should be increased; If a decline in grassland condition is associated with a replacement of Decreaser species by Increaser II species, then the area has been over-utilized and the stocking rate or the burning frequency should be reduced and if possible longer resting periods should be applied; Therefore, in order to monitor the grassland condition trends, one needs to repeat the monitoring over a period of time.

Recommendations are based on the specific objectives and direction of trends in grassland condition, which in turn can be related to the management applied or impacts from grazing or to the type of fire management or combination of fire and grazing. However, generally management recommendations in South African grasslands are based on two main aspects, namely:

- The trend in grass composition (i.e. following the condition of the grassland relating it to the Decreaser and Increaser components); and
- The accumulation of grazing volume (an accumulation of the grazing volume in relation to the burning threshold of 4 tons/ha).

Burning and grazing should follow only if the Decreaser component in the grassland is dominant and if the threshold of 4 tons/ha is exceeded.

20.3.2 **Relief Exclosure:** Due to surrounding topographical features, Kanha meadows are under severe trampling and grazing pressure of herbivores, and need to be given relief for recuperation. Heavily grazed meadows should first be identified and earmarked for reducing the grazing pressure of wild ungulates. Keeping this in view, the Kanha management should continue the ongoing practice of erecting chain link exclosures before the monsoon in some parts of the grasslands, which require this treatment, and allow them to rejuvenate for 1-2 growing seasons, until they grow rich in the heterogeneous grass species. The area of these exclosures should not exceed 15 ha. The exclosures can later be opened up for animals. This operation should be carried out every year in different degraded grasslands.

20.3.3 **Barasingha Enclosure at Sukdi:** The Sukdi-Ajanpur-Jholar grassland complex is a potential site for the conservation of hard ground barasingha. Presently, there are less than 100 animals, with low predation pressure by carnivores. This predation pressure, however, may increase in future. And to augment growth rate in this small population, an in-situ predator-proof barasingha enclosure would also be needed in future at Sukdi to secure new fawns for recruitment to adulthood. If such an eventuality takes place, the Kanha management should erect this enclosure for assured multiplication of barasingha, and gradually release them into the wild.

20.3.4 **Treatment for Problematic Grasses:** Large chunks of several important grasslands are infested with *Desmostachya bipinnata* and *Imperata cylindrica* and they need special initiatives. The sizes of these chunks are gradually expanding every year. The Kanha management should first ensure to burn parts of these grasslands and have several 3–5 feet trenches/ strips dug along them. After the removal of the rhizomes of these grass species, each alternate strip should be filled with the lumps of *Saccharum spontaneum*. The suckers of *Saccharum spontaneum* may spread in due time and replace the two problematic grass species. The management should monitor and record the changes periodically.

20.3.5 **Grass Seed Harvesting and Storage:** As the core zone needs seeds of select species to restock grassland areas for exclosure just before the rains, each forest range in the core zone should harvest adequate quantities of seed in the harvest season, usually in the winter between late November and January, and store it properly. Some important grass species to be harvested and stored are: *Bothriochloa odorata, Bothriochloa pertusa, Themeda quadrivalvis, Heteropogon contortus, Apluda mutica, Cloris barbata/ virgata, Dichanthium annulatum, and Setaria pumilla*. In the absence of any mechanical method, the hand harvesting method should be employed, and labourers need to be trained for this. Seeds should be harvested just after ripening, before they are dropped to the ground. In a patch (small area) of a certain grass species, a stem with ripened seeds is clutched below the inflorescence (group of flowers) and pulled slowly upwards to collect all flower pods/ seed heads. No more than around 25% of a grass patch should be used for seed harvesting, and the harvesting site should be kept changing to avoid over-harvesting from one particular area.

Seeds of each grass species need to be bagged separately, preferably in labeled paper containers or gunny sacks to avoid confusion. Seeds should be collected in the morning when flower pods/ seed heads are soft. The collected seed contains moisture and should be dried up immediately and properly before mold sets in. Seeds with filament and pods etc. should be spread in thin layers on clean ground or low-rimmed paper containers and covered with a thin cloth to prevent from being swept away by wind. Proper drying can take several days. The seeds can be separated from filaments, chaffs and litter before or after drying. These well-dried seeds can later be stored in labeled gunny sacks/ cloth containers with holes for proper aeration in a cool and dry place. Small pouches of calcium oxide, a basic drying agent, can also be kept in these containers to ensure dryness throughout.

Similarly, the Kanha management should also have seeds of palatable leguminous species collected and stored for grassland restocking. Speaking generally, most grasslands in India support a low legume component. As legumes have higher protein content, they also enhance fodder quality. Generally, legumes contain almost twice the crude protein found in grasses. Leguminous species also improve the soil fertility through the fixation of atmospheric Nitrogen with the help of Rhizobium bacteria occurring in their root nodules. Some of them include: *Rhynchosia minima, Atylosia Scarabaeoides, Vigna trilobata, Vigna unguiculata, and Phaseolus adenanthus* etc.

It is also a good practice to assess the viability of different seed crops in different ranges. This should be done by placing easily countable, say, 50-100 seeds, on a wet towel in a plastic bag or petri dish. This needs to be placed in sunny window sill. After 20-30 hours, the germination percentage, or viability, of the collected seed can be calculated. It should be interesting to note if germination percentages from different localities in the core zone vary. A germination rate of 95% is considered good.

20.3.6 **Restocking of Grasslands:** Severely grazed meadows also require some special inputs such as introduction of indigenous grass root-slips or the sowing of grass and legume seeds. The earmarked area should undergo ploughing/ harrowing to relieve the site from compaction, and the root-slips of palatable annual or perennial grasses be introduced just after effective showers, and the entire area fenced in for 1-2 seasons. The existing grass associations should be taken into account before the restocking operation to avoid site intolerance of the species. This operation should be carried out every year until severely grazed grasslands are recovered. The year-wise area proposed for restocking of grasslands is given in Chapter-28 of Organization, Administration & Budget.

Pelleted seed sowing should also be carried on degraded grasslands with exposed soils. Generally, these pellets are prepared by mixing grass seed, cow dung, clay and sand in proportion of 1:1:3:1, by volume. Sufficient quantity of water needs to be used for preparing round pellets of the size of about 0.5 cm. diameter. The pellets should be sown in lines 50 cm apart and placed 1-2 cm deep below the soil surface. Sowing operations need to be carried out immediately after the first effective monsoon rain.

Legume seeds, however, need not be pelleted. They can be broadcasted by mixing with grass. As per availabiltity, around 300-500 gm per hectare legume seeds can be broadcasted.

The Kanha management should also keep to the following grassland restocking calendar to ensure all the necessary arrangements/ preparations in time.

Table-89: Annual Calendar of Grassland Development

Sl. No.	Month	Preparations
1	October- November	• Demarcation of the restocking site • Burning of grasses, specially Kush grass
2	December- February	• To be ploughed thrice • After each ploughing, roots of Kush grass are collected and burnt • Collection of the seeds of palatable grass species
3	March-May	• The ploughed area to fenced in by chain-link exclosure • Laying out of one-ha. plots in the ploughed area • Selection of plots for seed sowing and grass slip plantation
4	June	• After the first showers, sowing of seeds of different palatable grass species in select plots • Grass seeds to be directly sown straight into the soil, seeds to be mixed with fine soil and sown,

		and pelleted seeds, mixed with seeds and soil, to be thrown over select plots
5	July	• In the first week, weed and unpalatable grass species to be uprooted and discarded in the ploughed area • Slips of palatable grass species to be planted in select plots
6	September	• Second weeding to be done in the slip planting and seed sowing plots of Kush eradication, and slip planting in the seed sown areas where regeneration is low

20.3.7 **Non-Expansion of Grassland Area:** The existing area of grasslands accounts for around 11% of the core zone, that includes natural small and large grasslands and abandoned village sites. Considering the successional tendency of the grasslands and their gradual degradation due to severe grazing pressure, the Kanha management should also undertake grassland improvement practices. As clearly articulated Part-I of this document, there is no need for any expansion of grassland area in the core zone for increasing ungulate population. It is reiterated that this should only be done after computing the existing carrying capacity in the context of tiger, using the computed prey density (chital, sambar, gaur, wild pig) in the 2019 country level assessment of NTCA, New Delhi / WII, Dehradun. As already mentioned in Chapter-12 of Part–I, the Wildlife Institute of India, Dehradun, has developed the carrying capacity of tigers for the core and the buffer zones in Kanha tiger reserve. As per this exposition, the potential tiger density can reach 6.77/100 km^2 at the prey density of 49.57/ km^2, and the current tiger density is 4.44/ 100 km^2 in the tiger reserve. Therefore, the Kanha management should not try to increase this tiger density/ tiger population through managerial interventions of habitat manipulations. An unnaturally high tiger density in the tiger reserve may also adversely affect co-predators, and consequently the wildlife ecosystem itself. The umbrella effect of tigers can more effectively be harnessed by increasing the area of a protected area rather than increasing the tiger carrying capacity within the same area. Besides, the core zone is now completely free from biotic pressure, with all the forest villages already relocated outside. The reintegration of these abandoned village sites already carries good potential to support the growing populations of ungulate species.

Around 2 to 3 ha. area of old clearings, which have been gregariously recolonized by woody species, should be discontinuously cleared of brushwood, shrubs and weeds in such pockets/ clearings that can be manipulated to serve as small grasslands. These open pockets would also serve as effective corridors to facilitate future dispersal of the increasing ungulate populations. This should be done by identifying and mapping such new clearings and patches that are invaded/ infested by brushy growth of *Shorea robusta*, *Butea monosperma*, *Lagerstroemia parviflora*, *Diospyros melanoxylon*, *Bombax malabaricum*, *Cordia myxa* and *Bauhinia* spp. and other shrub species in the Kanha, Sarhi, Kisli and Supkhar ranges, and removing them exclusively under this improvement programme. No forest crops should be removed in this operation. Besides increasing the quality area of grasslands in the core zone, this programme would also counter the gradual reduction of meadows by brushwood species. Such areas are listed in **Appendix-53.** While doing this operation, care should also be taken to ensure the clearings as small isolated patches. Large clearings at a stretch may foster a rapid increase in ungulate population (especially the spotted deer), which might render the entire exercise counterproductive. The cleared woody material should be allowed to remain on the forest floor for recycling of nutrients.

20.3.8 **Lantana Eradication:** Belonging to the Verbenaceae family, *Lantana camara* is an allelopathic and toxic species with a wide range of ecological tolerance. The seed viability of the species may last even a few years. Besides competing with and suppressing desired regeneration of tree species and eliminating native biodiversity in forest, the lantana shrubs also reduce the palatability of forest floor for ungulates. The species does not allow anything to grow under its clumps and also obstructs animal movement. Its gradual encroachment into grasslands is another consideration in grassland management for thousands of herbivores. Lantana shrubs are mistakenly regarded as good cover for wildlife species. It has been proved that the lantana leaves contain toxicity and is harmful to ungulates in the protected area. Ungulates are often sighted browsing on these shrubs. Prof. CR Babu on his visit to the Kanha tiger reserve several years back also spoke ardently in favour of complete eradication of lantana from the core zone. The benefits of eradicating lantana far outweigh the supposed benefit of its retention in the protected area.

Lantana eradication in piecemeal almost contribute nothing to habitat improvement, let alone reverse the condition significantly for grazing animals. In view of the above, the eradication operation needs to be undertaken in a project mode to ensure eradication of Lantana from large chunks of forest and grassland areas every year accompanied by systematic weeding/ mopping-up operations.

Identified areas infested with lantana shrubs will be taken up for manual eradication during the last spell of monsoon or just after (before seeding). The cut root-stock method as demonstrated by Emeritus Prof. CR Babu to the Kanha management will be employed for eradication. The main stem below the shoot proliferation area (at the collar level) should be chopped by labourers and these clumps be moved aside for drying up. The lantana free area should also be planted with local grass/ legume species. The year-wise area proposed for lantana eradication is given in Chapter-28 of Organization, Administration & Budget. These treated areas should be mopped up at least two consecutive years to remove the regeneration of weed due to left out roots slush and seeds.

20.3.9 **Weed Eradication:** Weeds are obnoxious plant species, which are unpalatable and invade grasslands and compete with grasses resulting in the degradation of this habitat type. The main weed species in the grasslands of the core zone are *Cassia tora*, *Woodfordia fructicosa, Parthenium hysterophorus, Pogostemon benghalensis, Hyptis sauveolens, and Sida spinosa* etc. These species mushroom very rapidly and if not controlled in a systematic and phased manner, may pose a serious threat to grassland habitat. Weed eradication practice should be done preferably with the onset of the rains, taking advantage of the already wet and soft ground to manually uproot the species. The eradicated biomass should be dumped in heaps and burnt before the fire season. The practice has to be carried out under a well-chalked out project mode for habitat improvement in all the forest ranges. The management has to ensure that the next year a thorough weeding is also undertaken in the same areas for effective eradication. Considering the juxtaposition of forest and grasslands, connectivity among grasslands should also be ensured by eradicating weed and unpalatable species. The year-wise area proposed for weed eradication is given in Chapter-28 of Organization, Administration & Budget.

20.3.10 **Eradication of Woody Species:** The management should identify such grasslands threatened by the invasion of gregarious woody species such as *Butea monosperma*, *Lagerstroemia parviflora*, *Shorea robusta, Bombax ceiba, Cassia fistula, Cordia myxa* and *Diospyros melanoxylon* etc. *Phoenix acaulis* has also been mushrooming for the past several years in several prominent grasslands. These woody species tend to encroach into the grasslands from the periphery and gradually grow in size and area, thereby not only reducing the extent of the grassland habitat but also creating obstruction to the foraging animal population. All these woody species and their associates have to be uprooted before the end of the monsoon. If the grassland is large, a few small grooves of tree should be retained to provide the much-needed shelter to the animals in the late morning and afterwards. Prime grasslands should be first considered for this uprootal programme, followed by the others and large clearings.

20.3.11 **Eradication of Unpalatable Grasses:** Barasingha habitats in all the forest ranges require continuous grassland restoration initiatives in a long-term project mode to counter their rapid deterioration. Several hardy and unpalatable grass species such as *Desmostachya bipinnata* (kush), *Pennisetum hohenckeri* (moya) and some other species of hardy and unpalatable grass species have invaded several grasslands making large homogeneous chunks. Besides, as already stated, many other weed species have also infested these grasslands. Until now, the Kanha management has been undertaking grassland improvement initiatives in the backdrop of financial constraints/ restricted allocations. The composition of these grasslands is changing rapidly and unfavourably for the ungulates, specially the hard ground barasingha, and it is vitally important that this programme is taken up under special drive to counter the pace of weed infestation and ensure restoration of grassland habitats.

All unpalatable species should be uprooted manually in identified parts of grasslands. The entire area should be later burnt and ploughed a few times to break open the compact and trampled/ cloddy soil to make it suitably granular for planting. The area should also be cleaned of old crop residues before the monsoon. After the first sufficient showers, the entire area needs to be thoroughly harrowed for planting rooted slips of local grass species generally fed upon by the hard ground Barasingha. These grass species may include *Heteropogon contortus*, *Bothriochloa odorata*, *Themeda triandra*, *Saccharum spontaneum* and *Iseilema prostratum* etc. and their associates. The entire planted areas should be fenced in for at least one full year before opening up for ungulates after the following monsoon season. The year-wise area proposed for eradication of unpalatable grasses is given in Chapter-28 of Organization, Administration & Budget.

20.3.12 **Prescriptions for Bamboo:** It is also an important cover type in the Kanha habitat, and is a common under storey (specially *Dendrocalamus strictus*). Bamboos display the phenomenon of “gregarious” as well as “sporadic” flowering. While no special intervention is normally required in the latter, the former may warrant some site-specific action. The bamboo regeneration in gregariously flowered areas hamper the growth of other forage as well as browse species, since the roots of bamboo seedlings are closely matted, thereby preventing the growth of other species. In such situations, over a limited area (in irregular patches) spacing may be created to facilitate the growth of other species and also clump formation. Dead, fallen bamboo clumps on the forest floor are used by ground nesting birds, sambar and chital for shelter. The standing growth facilitates perching of birds, arboreal species, apart from having a food value.

20.4 Site and Species-Specific Water Development:

Water development is a very important conservation input, and in the present context includes the distribution and quantity of water, not only in the dry regions, but also where it is plentiful. This includes, besides the construction of new water bodies, the maintenance of the old ones by deepening, desilting and reshaping them.

Kanha management should have the park area surveyed regularly for natural and artificial water sources of seasonal and perennial nature. This information should also be complemented by the names of wildlife species utilizing a particular habitat, and be collected at the compartment level to ensure that no water source was missed out during the water survey. It is very important for the management to know as to when a water body dries up significantly during the pinch period. On the basis of this information, the latest water-maps should be prepared for reference. Such water-maps provide very important insights into the current status of the water distribution and the requirement of artificial water sources vis-a-vis the species using the target area. On the basis of these surveys and water-maps, the feasibility and suitability of an engineering structure for artificial water impoundment should be decided for construction.

Speaking generally, approach to water should be gradual and smooth for animals, rather than abrupt and uneven. The edges of waterholes should remain shaped and smoothened throughout the year. The barasingha needs, if possible, a series of small and shoulder-deep shallow water bodies for feeding on aquatic plants, besides drinking.

As per wildlife monitoring results over the years, densities of ungulate populations are showing an increasing trend. Besides, as per one of the basic principles of wildlife management this is not wise to interfere with the natural dynamics of wildlife populations, unless a population is really small and needs some special conservation initiatives. Managers should not be carried away by anthropomorphic emotions regarding the security of wild animals in climatic fluctuations, which are natural. Wild animals have this natural in-built mechanism to cope with these environmental stressors. Ungulates fulfill part of their daily water requirement through grazing on vegetation. Besides, they also need to face these natural stressors of short durations to ensure a healthy population through survival and deaths in a natural ecosystem.

Aggressive water development through manual/ mechanical digging of soil may in future result in unforeseen complications in the management of whatever stretch of flat/ plain areas are there in the core zone. Aggressive water development will favour some animal species, but surely at the cost of some other. Let us also remember that despite the fact that the hard ground barasingha has an ontogenic affinity for water and marshes, with water playing an important role in its ecology, the highest population of this cervid at and around Kanha was recorded way back in 1938 when 3023 animals were counted. Currently, the total number of different types of water bodies in the core zone is 579, excluding wells (natural-310 and artificial-269). Of this number, 343 are perennial (Density one water body per 2.55 sq. km.) and 236 are seasonal (Density one water body per 3.89 sq. km.). In this way, the total density of water bodies in the core zone is one water body per 1.58 sq. km. Except in the pinch period, the availability of water in the core zone at present is satisfactory. Besides, the water table along the dried up streams/ nullahs are reasonably high facilitating easy digging up as and when necessary. Therefore, there is no further need of the construction of water impoundment structures in the core zone.

The saucers made here and there in the core zone to make water available during the pinch period should be recharged with the help of solar systems rather than supplying water by tankers driven by a truck or a tractor.

CHAPTER – 21

BARASINGHA CONSERVATION

21.1 Introduction:

The revival of the barasingha is a most inspiring success stories in wildlife conservation in the world. The significance of this ambitious conservation has already been discussed in a previous chapter. This conservation effort should continue to ensure a population of safe status in the core zone. Besides, in future, founders from this population may also be used to establish some more geographically separated populations in its former distribution ranges in or outside the state. This small population of the cervid has recorded an increase of around 72% in the past ten years, with 475 in 2010 to 956 in 2021. As the Kanha management has learnt many a lesson in the conservation of this species in the past so many years, it must build further on the technical expertise and successes to further improve the status of the cervid in the core zone.

21.2 Objectives:

Specific objectives of the conservation of the hard ground barasingha in the core zone are as under:

- Facilitate viable population growth for the hard ground barasingha within the habitat-prey–predator dynamics.
- Develop new habitats and connectivity between habitats to expand the dispersal of these animals.

21.3 Proposed Management Strategy & Prescriptions:

The conservation of the hard ground barasingha in the core zone requires a long-term strategy based on the past and present experiences and observations recorded by the management. Empirical data relating to the ecology of this endemic sub-species needs to be kept in mind before taking up any major habitat interventions vis-à-vis its present status and distribution within the core zone. In view of the stated objectives, the following management strategy and prescriptions are proposed for the conservation of this sub-species:

21.3.1 **Grassland Management:** The barasingha, being a food specialist and almost a total graminivore, survives on a narrow range of grass species. The cervid also feeds on aquatic plants to some extent. Consequently, the small population needs special managerial inputs involving both the species-specific as well as the habitat-specific approaches for the management of grasslands, so crucial for its survival. Though the barasingha feeds upon several types of grass species, it suffers from sympatric competition with a considerable large population of the chital. Moreover, the situation worsens for the barasingha in high summer when the dried-up habitat turns unfavorable for the species having hardly any other alternative diet for sustenance. Grassland management should include the following amelioratory practices. The year-wise area proposed for barasingha habitat management works is given in Chapter-28 of Organization, Administration & Budget.

21.3.1.1 **Weed Eradication:** This has already been discussed in a previous chapter. The prime habitats of this deer species is being invaded by many unpalatable grass and weed species. In the recent past, the menace of *Lantana camara*, *Pogostemon benghalensis* has been reported in these grasslands. Besides, the growth of *Ageratum conyzoides, Vernonia divergence, Cassia tora, Hyptis sauveolens, Malvasterum* and *Sida spinosa* etc, has also become very conspicuous. Therefore, as proposed earlier, weed eradication programme should be taken up during the monsoon in all the forest ranges supporting its populations.

21.3.1.2 **Eradication of Woody Species:** This prescription has also been proposed for the management of habitat in a previous chapter. The same prescription also holds good for barasingha habitats. The prime habitats of the barasingha should be prioritized for the eradication of woody species.

21.3.1.3 **Maintenance of Tall Grass:** The Kanha grasslands are getting devoid of tall grass cover, very essential for the fawning of the barasingha and post-natal care by females. The fawning cover protects newborns from scavengers and predators, ensuring a good recruitment to the population. Though there are patches of *Saccharum spontaneum* and *Bothriochloa odorata*, most of the other grass species are either short annuals or perennials. Efforts should be made by the Kanha management for the sowing and planting of species of tall grasses such as *Heteropogon contortus*, *Bothriochloa odorata*, *Themeda triandra*, *Saccharum spontaneum* and *Iseilema prostratum* and their associates in the areas of the barasingha populations. These operations should be carried out during the monsoon, and later such fields should be fenced in properly. After monitoring the progress 1-2 seasons, such enclosures can be opened up. These maintenance practices should be continued to restore habitat for the barasingha.

21.3.1.4 **Exclosures for Relieving Pressure:** Due to the surrounding topography, the Kanha meadows are under severe pressure of grazing herbivores, and need to be given relief for recuperation. Keeping this in view, the Kanha management should continue the ongoing practice of erecting chain link enclosures before the monsoon in some parts of the grasslands which require this treatment, and allow them to rejuvenate for 1-2 seasons, until they grow rich in heterogeneous grass species. These exclosures can later be opened up for the species. This operation should be carried out every year in different degraded grasslands.

21.3.1.5 **Connectivity between Habitats:** Over the years, many open areas in the park have been recolonized by woody species, including dense shrubs. Several such areas also lie in the vicinity of some of the prime habitats of the hard ground barasingha at Kanha, Sonf, Ronda and Sondar**,** and some areas at Supkhar. The management should undertake habitat improvement works in these areas to facilitate connectivity between grasslands for movement of these animals.

21.3.2 **Management of Aquatic Plants:** The deer also feeds on several species of aquatic plants in different water bodies of the core zone, and this food habit is important to reduce competition from a high density chital population on grasslands. This is now essential to gain more knowledge about this specific food resource for the growing population. The Kahna management should have some prime water bodies surveyed for hydrophytes/ macrophytes and microphytes by a team of aquatic plant experts from some premier institution to update the list of aquatic plants documented many years back. Expert opinions should also be sought for the management of these water bodies regarding the need to introduce propagules, such as seed or plant fragments of palatable species, required for quality vegetative colonization in the water bodies.

21.3.3 **Swamp/ Marsh Creation:** Despite adaptations to the hard ground conditions, the ontogenic instincts of a swamp deer remain with this sub-species. Therefore, the creation and manipulation of low-level temporary water bodies and swamps serve as welfare factors for this cervid. The hard ground barasingha readily feeds upon aquatic plants by entering the water bodies, and this affinity automatically reduces the competition with the chital that always avoids such ventures. In this way, the creation of small swampy and marshy habitats would provide an added advantage to the species over its sympatric competitor.

21.3.4 **Wallows:** In winters, during the rutting season, wallows play a very important role in the courtship behaviour of the barasingha. Stags display a strong liking for muddy sites, and wallowing is a common sight in this season. The management has to ensure availability of such muddy areas for better courtship.

21.3.5 **Management of Metapopulations:** As discussed earlier, the animal population is scattered/ distributed in several habitat-pockets in the protected area. The movement patterns and periodic distribution of these populations depend upon the availability of food and water, breeding season and parturition and postnatal care by the females in suitable areas. The habitats and routes of these populations are vitally important and require habitat improvement interventions to facilitate movement and intraspecific exchanges.

21.3.6 **Restoration of Reclaimed Habitat:** The core zone is now free from human habitation, with the relocation of all the forest villages. The Kanha management should now reintegrate these sites into the surrounding wildlife habitat by developing them into good grasslands. The Sukdi-Ajanpur-Jhoar complex should be emulated to introduce inputs for restoration in the core zone.

21.3.7 **Management in the Historical Range:** Hisorically, Supkhar used to harbor large barasingha populations. As already mentioned before, the presence of barasingha was recorded in the Kusera maidan of the Supkhar area in the Halon Valley, and this used to be a historical range of this sub-species until the late 1950s when the cervid went locally extinct in this range.

In future also, the Kanha management should think of facilitating the dispersal of this population into a number of interconnected grasslands in the Supkhar range itself. Presently, the build-up of the Bhaisanghat population is actually based on several splintered animals from Supkhar. Grassland at Supkhar also abound in tall grass and water points.

21.3.8 **New Conservation Sites:** The Kanha management should also explore new sites for the conservation of barasingha. They should be developed on the basis of the animals' movement, grassland area, and phytosociological surveys for palatable species. Some of these probable sites are Jholar, Role, Jami and Linga etc.

21.3.9 **Maintenance & Monitoring in the Kanha Enclosure:** The total area of this in-situ enclosure is around 50 ha., and the Kanha management should maintain the entire structure throughout and introduce all the required conservation initiatives essential for the survival of barasingha inside. Pythons may turn out to be the only predators for the cervid in the enclosure. Therefore, the enclosure should be checked daily by watchers, and pythons be physically removed out of it. Besides basic monitoring of age and sex class structures of this growing population, the health of these animals should also be monitored periodically, specially for the infestation of ectoparasites.

21.3.10 **Daily Monitoring:** Continuous monitoring forms a very important aspect of the conservation of small populations. The present Kanha population is almost entirely built up by around 80 animals released from the Kanha enclosure in July 2010. All the three indicative metapopulation structures of the barasingha should be monitored daily in the core zone. The management must ensure that the entire structures of all the populations should be reported to the head office at Mandla in the prescribed format **(Appendix-54)**. This should include all possible age and sex classes of the individuals. Such continuous monitoring of the population would facilitate effective management of this species.

21.3.11 **Mortality Survey:** Mortality and survival rates are two very important characteristics of animal populations. The patterns of mortality and survival within a population suggest a great deal about the population's strategy for survival. As far as small population is concerned, mortality, irrespective of its nature, is a serious issue from the management point of view. This calls for regular mortality surveys in the core zone. The postmortem of each dead animal, except natural kills, must be conducted, and as per protocol bio-samples should be sent to School of Wildlife Forensic and Health, Nanaji Deshmukh Veterinary University, Jabalpur. The Kanha management has to ensure that information on the mortality of the barasingha is accurate as far as the cause of death is concerned. These mortality surveys, incorporating various information such as the name of predator, disease, season and place along with the age class and sex class of the barasingha, may also suggest about the predatory regulation of the population, and help the management work out new strategies. The collection of skulls, including jaws should also be ensured for determination of the age of the dead animal.

21.4 Surveillance of Epidemics:

Though no major epidemic has been reported in the recent past in the core zone, the management should ensure a constant vigil, since the grasslands occupied by the population at present have a long pastoral history, and 35 forest villages along with cattle have been relocated outside the core zone. Some of the causative factors of pastoral diseases are known to remain dormant for many years before recurring again. Further, since ungulates frequent the village cultivation sites on the periphery of the park, mutual disease transmission cannot be ruled out. Also, 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. Therefore, prophylaxis of the village cattle surrounding the park should be done regularly, and detailed veterinary/ pathological research on the disease aspects be called for to adopt suitable preventive measures.

21.5 Reintroduction to Non-Conventional Habitats:

The problems of small populations have already been described in detail. The present population of the barasingha in the core zone has grown out of only 60 – 70 animals, and can safely be considered as inbred. Geneticists suggest that the genetic health of a population or its ability to adapt to environmental conditions depends solely upon the maintenance of genetic diversity within the population, and a loss of genetic diversity may have extremely harmful effects on the existence of this population.

The genetic load of a population refers to the amount of deleterious recessive alleles in that population. Most mammals have recessive deleterious alleles present in their genome (Wright, 1977, Charlesworth and Charlesworth, 1987, Ralls et al., 1988). These alleles have little to no effect on an individual when present in a heterozygous state. Inbreeding is thought to have a negative effect on the fitness of individuals by increasing the number of loci at which an individual is homozygous for these deleterious alleles. As inbreeding increases, so does the probability that the two alleles an individual has at a locus will be identical by descent (i.e. derived from an ancestor common to both sides of the pedigree), and therefore homozygous (Lacy, 1997).

The negative effects of inbreeding on an individual's fitness have long been known. Charles Darwin was among the first to write about a link between the level of inbreeding in domesticated individuals, and the health of these individuals. The negative effects of inbreeding include high mortality, reduced competitive ability, and greater susceptibility to disease, and lower fecundity etc. However, it is only recently that the negative effects of inbreeding have been documented in wild mammalian populations.

In view of the above, it is important that a few founder populations of the barasingha should be translocated from the core zone to good alternative areas within the State. These founders will establish large populations in new areas, and will in long-term become new genotypes with better allelic diversity. The exchange of animals between these three or four populations will also ensure fresh blood line and robustness of the cervid. While some animals have already been reintroduced to Satpura tiger reserve, and some sent to Van Vihar national park for captive breeding. Though translocations to Bandhavgarh tiger reserve has been sanctioned, the management should also think of reintroducing some animals to Phen wildlife sanctuary and Bhaisanghat range.

Phen WLS is regarded as a historic range of this deer species. The wildlife sanctuary is now completely free from the biotic pressure of cattle camps. As the sanctuary has currently very low pressure of carnivores, the founder population of barasingha may thrive here more comfortably. The management however, has to introduce some special conservation measures such as shallow water bodies and grasslands of preferred species before translocating these animals. The translocated founder populations should first be kept in an *in-situ* enclosure specially prepared for the needs of the barasingha. After suitable multiplication, the animals can be released into the wild.

CHAPTER – 22

WILDLIFE HEALTH MANAGEMENT

22.1 Introduction:

Wildlife health management has now become very important, and been taken to new heights in several protected areas of the world, with advancement in drugs, equipment and transportation vehicles etc. Its importance in the core zone has already been discussed in a previous chapter. This conservation practice has become all the more important in the core zone, as conservation in the protected area also involves the management of two endangered species – the tiger and the hard ground barasingha. Effective long-term management involves very clear objectives, meticulous planning and timely action. Besides, routine wildlife health contingencies have also to be dealt with under the prescribed guidelines issued by the Principal Chief Conservator of Forests (Wildlife), Madhya Pradesh and the National Tiger Conservation Authority, New Delhi.

22.2 Objectives:

While the broad objective of this chapter is to manage general health status of wild animals and departmental elephants in the core zone, the specific objectives are as under:

- Prevent occurrence of serious diseases, specially epidemics in the core zone, and ensure prophylaxis by vaccinating the cattle of villages around the core zone.
- Conduct postmortems of wild animals, specially endangered species, under a comprehensive protocol, and draw inferences about the cause of death.
- Treat and manage problematic as well as distressed wild animals.

22.3 Proposed Strategy & Management Prescriptions:

The following broad prescriptions are proposed for wildlife health management in the protected area:

22.3.1 **Detection of Illness:** The wildlife health staff of the core zone should periodically monitor the grazing herds of various ungulate species throughout the core zone for signs and symptoms of any disease. While it is very difficult to notice any illness in the field until an animal is too weak, the wildlife health staff should constantly look for the following signs and symptoms in free moving wild animals:

- Isolation of an animal from the herd.
- Suspension of grazing/ browsing and rumination among wild ruminants.
- Less inclined to move or difficulty in movement.
- Soiled hind quarters indicating diarrhea.
- Salivation from mouth and lethargy.

As these are easily understandable signs/ symptoms, they can be reported by the field staff to the wildlife veterinarian as soon as possible. In this way, necessary prevention measure can be taken in time.

22.3.2 **Protocol for Ill Animals:** There needs to be a broad protocol in place for sick wild animals as under:

- If an animal falls sick due to nutritional deficiency, adequate nutrition should be provided to avoid further malnutrition.
- If the illness of wild animal is detected due to deformity, then it should be properly checked. Herbivores do not need any veterinary interventions to correct deformities, and only proper monitoring is required to check the illness.
- If a deformity is found in the Schedule-I species like the tiger, leopard, and sloth bear etc., the animal should be shifted into the wildlife treatment and care centre at Mukki.

- If a departmental captive elephant is found ill, the protocol for deworming, vaccination, and treatment should be ensured as per the guidelines issued by the Project Elephant experts.
- If a disease is detected in the surrounding cattle population, veterinary officers of the concerned area should be immediately informed for timely necessary veterinary intervention.

22.3.3 **Diagnosis of Disease:** Free-living wild animals are generally found dead without showing any earlier signs and symptoms. Therefore, veterinary diagnosis mostly depends on necropsy coupled with laboratory findings of preserved material. Postmortem examinations should be performed by the wildlife veterinarian and the details of postmortems be kept in the prescribed proforma **(Appendix-55)**. The history of the incidence of disease such as area and place, affected species, sex and age groups of the affected animals and birds, number of deaths, period of death, pattern of death, signs and symptoms of dying animals, if observed closely, definitely help in proper diagnosis.

A compressive postmortem protocol for mortalities in wildlife be prepared, and the required examination should be conducted by the wildlife veterinarian. The postmortem kit and preservatives for collection of samples should be kept ready at the Kanha laboratory so that proper diagnosis of disease can be made to control the magnitude of infection **(Appendix-56)**.

22.3.4 **Body Condition Evaluation:** The health monitoring procedure of wild animals should be a regular exercise in the core zone. The commonest method employed for monitoring the appearance of free-living mammals is by the assessment of Body Condition Evaluation (BCE). The BCE is generally expressed in the form of indices, referred to here as Body Condition Index (BCI). The index can be employed to compare the mean body condition of two populations of the same species, amongst different individuals of any particular age and sex category of a population, and between populations of many sympatric species. The BCE involves judging the physical conditions of live animals, based on the visual estimation as the degree of pro-tuberance of body processes and the body surface. Instead of a mere subjective assessment of body conditions as good, fair, poor or as Class-I, Class-II, Class-III and so on **(Appendix-57)**, a value of BCI can be obtained by giving scores for different body parts. The records of BCI of different species should be maintained in the specific format.

22.3.5 **Fat Preserve Estimation:** Estimating fat reserves of naturally dead animals may not always serve the purpose of relating body condition to habitat quality, as death might have occurred due to a disease. It can, however, reveal the overall health condition of the dead animals. Fat deposits in body can be classified as subcutaneous (below the skin), perinephric (around the kidney), mesenteric (in the omentum), pericardial (around the heart) and bone marrow fat.

The wildlife veterinarian should examine the condition of the bone marrow in ungulates and other large mammals where the marrow can be sufficiently exposed for evaluation. The femur and humerus are regarded as the bones of choice for examining marrow conditions.

The Kanha management should ensure that the frontline staff of the core zone is trained by the wildlife veterinarian and other experts for the health monitoring of wild animals so that whenever any mortality of wild animals occurs, very basic and simple examination can be done and recorded for any emergence of epidemics or unwanted mortality in a particular area.

22.3.6 **Tiger Mortality:** The mortality of a tiger, whether natural or unnatural, in the core zone needs to be of serious concern to the Kanha management. Postmortems should be conducted compulsorily on each tiger mortality. It should be ensured that the postmortem examinations are conducted as per the guidelines issued by the Principal Chief Conservator of Forests (Wildlife), MP and National Tiger Conservation Authority, New Delhi. Care should also be taken to prevent the carcass of a dead tiger from being deteriorated or decomposed at the time of postmortem due to delay. As per the instructions of the NTCA, New Delhi, the carcass of the tiger should be kept in a deep-freezer to avoid further decomposition, and a proper postmortem should be conducted by the wildlife veterinarian, in presence of two representatives nominated by the State Govt. and the NTCA, New Delhi. The postmortem protocol for tiger is appended **(Appendix-58)**. It is also mandatory to send the visceral samples to the State Forensic Laboratory, Sagar for chemical/ toxicological examination, as well as to the School of Wildlife Forensic and Health, Nanaji Deshmukh Veterinary University, Jabalpur for histo-pathological and other required examinations. Detailed information on the mortality of tigers should be reported to the Principal Chief Conservator of Forests (Wildlife), Madhya Pradesh in the prescribed format within 12 hours of death **(Appendix-59)**.

22.3.7 **Treatment of Wild Animals:** The core zone supports a huge number of wild animals, both herbivores and carnivores. Wild animals often sustain injuries in sparring and serious infighting. While minor injuries/ wounds heal up on their own with time, major injuries need proper veterinary attention. The case becomes all the more important if a tiger or any other major carnivore species is involved. Infighting is very common in a high-density tiger population, and leads to serious infectious wounds on the bodies of tigers. The Kanha management should ensure that such wounded, emaciated or weak tigers are closely monitored and the supplementation of diet is followed as prescribed by the wildlife veterinarian. The wounds/ injuries of such tigers should be treated with long-acting antibiotics along with inflammatory drugs and suitable liver tonics. Needless to add, the medicine should be administered by projectile equipment operated from an elephant back or a vehicle. There is already a wildlife treatment centre/ hospital at Mukki, equipped with required squeeze cages, animal house, and operation theatre. This arrangement would facilitate the capture and shifting of debilitated animals into the enclosure where proper treatment can be administered until the full recovery of animals. The herbivore population in the core zone includes the spotted deer, barasingha, and sambar etc. Sometimes these animals are also found injured due to collisions against chain-link fences, infighting, and road accidents, and predation by carnivore or country dogs near the periphery of the core zone **(Appendix-60)**.

The Kanha management should also construct a treatment-cum-rehabilitation enclosure for injured ungulates so that proper treatment and follow-up may be ensured to save such animals. The existing operation theatre at Mukki should also be strengthened for advance critical care for wild animals.

22.3.8 **Transportation of Wild Animals:** As mentioned earlier, the Kanha tiger reserve also has a wildlife rescue squad to deal with various emergencies related to wild animals in and around the protected area. The Kanha management should ensure that the wildlife rescue squad has suitable transportation-cages for various species of animals, specially for the tiger, leopard, deer, monkey and snake. The wildlife rescue squad needs also to be equipped with various physical capture devices such as nets, snares, and the latest chemical capture devices. The squad also needs suitable trap-cages for tigers and leopards. Besides, a follow-up vehicle for the transportation of wild animals should also be made available. The indicative size of cages should be as per the transportation rules under the Prevention of Cruelty to Animal Act, 1960 **(Appendix-61)**.

All the equipment, vehicles, and cages related to rescue operations should be stocked at the Mukki wildlife treatment centre to facilitate action within quick response time.

22.3.9 **Establishment of Forensic Laboratory:** It is also imperative that a modest forensic laboratory be established in the protected area. The need of such laboratory has been felt for quite some time. Generally, wildlife cases in the state are referred to the wildlife veterinarian of the Kanha tiger reserve for the identification of and expert opinions on various body parts/ articles of wild animals. These opinions are considered as evidence on behalf of the prosecuting agency, the MP Forest Department. Therefore, it is proposed that a collection of different body parts like skin, antler, bone, teeth, hair, meat, etc. of different species of wild animals found in the state should be prepared. The physical attributes of these parts, which may serve as standard samples, should be used for diagnosis whenever any seizure is made in the core zone or in other parts of the state. The seized samples can also be later sent to the Wildlife Institute of India, Dehradun, the Centre for Cellular & Molecular Biology, Hyderabad, and the School of Wildlife Forensic and Health, Nanaji Deshmukh Veterinary University, Jabalpur for further investigations **(Appendix-62)**.

22.3.10 **Disease Surveillance:** As many species of wildlife are zoologically related to cattle, they are most likely to suffer from almost the same ailments of their domestic counterparts. Therefore, the Kanha management should ensure that a regular disease surveillance programme is adopted in the core zone so that the prognosis of any epidemic can be timely ascertained. It is also suggested that the adjacent populations of cattle be regularly screened for parasitological, hameotological, and serological examinations so that the transmission of pathogenic diseases may be checked and the wild population can be kept healthy. Besides, a research project on the existing prevalence of infectious diseases in the cattle as well as wildlife should also be taken up. The Kanha management should also establish an excellent laboratory in the core zone for conducting disease surveillance, and keep in touch with other research institutes like the School of Wildlife Forensic and Health, Nanaji Deshmukh Veterinary University, Jabalpur and Indian Veterinary Research Institute, Izzatnagar.

22.3.11 **Nutritional Analysis of Fodder of Wild Animal:** The determination of fodder quality and its nutrition value has also become a common practice in good ranches in developed countries where the main objective is to raise a huge number of cattle on grass and browse.

Likewise, to monitor mineral deficiency and malnutrition in wildlife population of the core zone, it is also proposed that the staple feed of each wildlife species, containing grasses, leaves, brushes, and barks etc. should be collected and preserved at the Kanha laboratory. The feed along with soil samples should be got analyzed from a reputed nutrition laboratory to develop a baseline data for the wildlife species of the protected area. The data can be used for the changing patterns of feed and feeding habits of wild animals, and can also complement managerial interventions for the future.

22.3.12 **Immunization Programme:** The cattle of the forest villages of the national park and those of the peripheral villages in the buffer intermingle with the wild population, and there is always a chance of the transmission of infectious diseases from cattle to wild population and vice-versa. Presently, there are 4529 cattle in the 8 forest villages in the national park. The list of various types of cattle diseases are given in a previous chapter. Needless to add, a sudden breakout of any epidemic may play havoc with the lives of thousands of ungulates in a matter of only a few days. In view of the above, the Kanha management should ensure regular immunization programmes for the surrounding cattle population of these forest villages and the villages within the periphery of the 5 km. of park boundary. The Wildlife (Protection) Act, 1972 (as amended upto 2006) also makes a provision in this regard. Besides, the Hon'ble Supreme Court of India has also given a very important directive related to the vaccination of the cattle of the surrounding areas of protected areas.

The Kanha management should ensure that the veterinary department of the Mandla and Balaghat districts be assigned total responsibility of vaccination programme. Their teams of veterinary field staff, including *gau sewak*, should work under the concerned veterinary surgeons of their respective blocks. The *gau sewak* should be given incentive or honorarium allowance for their support in the vaccination programme. Presently, each village has 1-2 *gau sewak* trained by veterinary department. These *gau sewak* should be given hands-on training during the vaccination programme, and special training programmes should also be arranged for their experience and to raise their skill levels.

The Kanha management should be responsible for providing necessary vehicles, vaccination doses, and other logistics at the time of immunization. The immunization work should be completed before the onset of monsoon.

This also needs to be ensured that the mixed polyvalent vaccine is used for immunization. The vaccine should be maintained under a suitable cold chain at the Kanha laboratory or at the concerned range office in deep-freezers. At present Raksha Triovac vaccine (HS, FMD, BQ) is available in the market, and the vaccine is manufactured by the Indian Immunological Pharmaceutical Company. The vaccine is effective against three major infectious diseases i.e. Hemorrhagic Septicemia, Foot and Mouth Disease, and Black Quarter. This vaccine provides immunity for a period of one year. In case of an outbreak, booster inoculation is recommended for effective development of immunity.

As a sporadic case of Anthrax was also reported on the periphery of the core zone, it is of vital importance that an epidemiological survey should be conducted and a blue print of this disease should be prepared in consultation with the concerned veterinary surgeons to undertake future effective control measures. The soil work of that area should be discouraged due to the long survival of spores of bacteria in the soil, and yearly vaccination of Anthrax spore vaccine should be administered with the help of the veterinary department.

Rinderpest, a viral disease, has been totally eradicated from the country on account of the availability of one-time lifelong immunity vaccine. The protected area, however, does have a past history of Rinderpest outbreak in the mid-1970s resulting in the death of a large number of gaur.

Wild animals act as a reservoir of Rabies, which was also reported in the cattle as well as human population at the periphery of the core zone on account of bites of the canids such as the jackal and wolf. The Kanha management should ensure a full course of post-bite immunization programme to be followed in the cattle as well as human population. The animals affected with Rabies should be closely monitored as per the guidelines prescribed by the wildlife veterinarian. A wild animal showing tendency of frequently biting an animated or a moving object should be closely monitored, and if suspected for Rabies, the animal should be dealt with as per the guidelines prescribed by the wildlife veterinarian.

The canine distemper disease has also emerged as a dangerous viral disease affecting felids and canids in the wild. The National Tiger Conservation Authority, New Delhi, has already circulated guideline to deal with this disease, which needs to be complied with by the Kanha management.

Basic surveillance and monitoring of country dog populations in the villages around the core zone should also be taken up from time to time. Besides, special animal birth control measures should also be tried to check this increasing population.

Measures should also be taken up to ensure that wild animal carcasses are not fed upon by country dogs. This may lead to disease transmission of the canine distemper and its spread to canids and felids in the protected area.

The occurrence of any infectious disease should be promptly reported to the higher authority so that an early attempt to control the magnitude of disease can be taken.

22.3.13 **Control of Disease Epidemic:** There are three management strategies for wildlife disease as under:

22.3.13.1 **Prevention of Disease:** An early detection of disease is very important to control the spread of any infection in wild animals. Postmortem examination, mortality survey, and morbidity survey, provide an important source of information to deal with the control of infection. The surrounding cattle population of Kanha tiger reserve should be regularly monitored by the veterinary officers posted at the periphery of the tiger reserve. The information of any illness or infection should be passed on to the higher authority for immediate necessary action.

22.3.13.2 **Control of Existing Disease or Eradication:** Mass vaccination programme should be started as early as possible to avoid further spread of contagious diseases. If the infection persists in the periphery cattle population, treatment should be started early. If any mortality is reported in cattle population, the collection of all biological samples should be sent to the district or regional veterinary labs to identify the contagious agent. Proper disposal of carcass should be mandatory to avoid further spread of infection. Cattle movement should be restricted to avoid the transmission of infection to wild animals. If the signs and symptoms of disease are identical in the cattle and wildlife populations, the experts of veterinary college should be involved to deal with the emergencies.

22.3.13.3 **Disinfection:** Premises where any cattle is found sick or has died should be thoroughly disinfected to avoid further infection. The water bodies that share both domestic as well as wildlife populations should also be disinfected. Personnel involved in the control of disease epidemic should be given proper Personnel Protection Equipment (PPE) kit, disinfecting agents, sample collection kit, postmortem conducting kit etc.

CHAPTER – 23

MANAGEMENT OF DEPARTMENTAL ELEPHANTS

23.1 Introduction:

The management of departmental elephants in the core zone is also of vital importance. While on the one hand these gracefully mammoth creatures are part of our mythology and religion, on the other, their services are immensely important to the protected area. As these captive elephants are found in a very small number in the state, their housekeeping and health management are not part of academic curriculum in veterinary colleges. The Kanha management has been performing the management of these elephants for many years, and their upkeep, medical supervision and treatment etc. are gradually learnt from experience and from the elephant experts of the north-east and south India.

23.2 Objectives:

Specific objectives of elephant housekeeping are as under:

- Optimize the use of elephant in patrolling, and to a limited extent in tourism while ensuring good health and humane treatment.
- Ensure recommended daily diets, and standard upkeep of elephants

23.3 Proposed Strategy & Management Prescriptions:

The following broad prescriptions are proposed for the health and dietary management and working of departmental elephants in the protected area:

23.3.1 **Background of Elephant Health Management:** Unlike domesticated elephants in India, the departmental elephants of the core zone do have a good veterinary support. The veterinary care of these elephants and their housekeeping are very specialized jobs and require dedicated service and serious attention of the concerned staff of the protected area. As no special training has been imparted to the wildlife veterinarian and the housekeeping staff, it is more or less adaptive management whereby skills and knowledge are gained by experience, discussions with experts, literature etc.

While semi-captive elephants tend to lose their inherent disease resistance owing to substantial change in their feeding habits, they are also found exposed to several diseases. Many diseases like Anthrax, Blue Tongue, TB, Pasteurellosis, Trypanosomiasis, and the emerging disease Herpese etc. have been reported in captive elephants (Mikota et al., 1994). Though the information regarding susceptibility and prevalence of diseases is meager, the diseases like Anthrax and BQ are very common. Semi-captive elephants are also prone to parasitic infections of alimentary tract.

23.3.2 **Visit of Elephant Experts:** While the elephants have been managed by the Kanha management for a long time, the inspection/ examination of these elephants by the scientists/ experts of the Indian Veterinary Research Institute, Izzatnagar, and also by Dr. SSMS Khadri, Assistant Director, Mysore Zoo have also added to the basic guidelines of the elephant management in the Core Zone.

Dr. Khadri visited the Kanha core zone, and the officers/ staff of the Kanha tiger reserve and the wildlife veterinarians of the Kanha, Pench, Bandhavgarh and Satpura tiger reserves also attended a training programme/ workshop on the health and management of the elephant stock at Kanha.

The participating veterinary veterinarians also joined Dr. Khadri in the examination of the park elephants and relevant discussion, and shared their experiences of treatment and health surveillance. After the conclusion of this workshop, Dr. Khadri along with the above wildlife veterinarians jointly submitted their recommendations for the health management of Kanha's elephants.

A detailed discussion was also held at the Field Director's office at Mandla. Dr. Kahadri briefed on the health check-ups and his impressions of the management of the park elephants vis-à-vis the practices prevalent in his state, Karnataka. Information and some photographic evidence on the mortalities of elephants in all the tiger reserves of Madhya Pradesh in the past 5 years were discussed at length. The service conditions of the characutters, specially safety measures, in both the states, were also discussed, and the Kanha management recalled the killing of a characutter by a tigress in Kanha. In general, Kanha was found to match elephant management practices in Karnataka as far as diet, vaccination, treatment, foraging in the wild, labour, rest and care/ grooming were concerned.

23.3.3 **Visit of the IVRI, Izatnagar Team:** Several scientists/ experts of the IVRI, Izatnagar visited Kanha and examined all the elephants and also collected necessary samples for detailed investigation of parasitic infection, microbial infection, blood profile, besides urine analysis, biochemical analysis, and nutritional analysis of feeds and fodder.

While the detailed report is appended **(Appendix-63),** general recommendations for elephant management in the core zone are as under:

- Deworming should be done at quarterly interval by changing the type of anthelmintic.
- All the elephants should be vaccinated for HS, BQ, Anthrax and FMD.
- The prescribed dietary schedule for the elephants may be followed. Mineral mixture must be supplemented to ensure proper nutrition.
- It is emphasized that minor injuries, foot cracks, wounds, and abrasions should be noticed early and treated promptly. Once unattended, such problems may become serious and unmanageable.

23.4 General Health/ Dietary Guidelines:

In the above background, there some practices that need to be refined and fine-tuned to further improve the elephant management. The same need to be implemented as soon as possible to strengthen the health management and upkeep of the Kanha elephants. The recommendations are as under:

- Elephant dung should be disposed of by dumping it into a pit some distance away and later burning it.
- Storages of elephant ration must be made rodent proof so as to avoid infection arising out of their urine and feces.
- Elephants should be given the diet in the way as prescribed by Dr. Khadri.
- A wooden platform to be provided for arranging elephants' cooked food for feeding.
- Regular massage of castor oil on the heads of elephants to be ensured.
- Regular application of the neem oil on the feet and toes of elephants.
- Regular spray of Charmill on the interdigits and cracks in the feet to prevent fungal infection.
- Clean drinking water of upstream and the bathing of elephants in downstream to be ensured near elephant camps.
- In spite of timely vaccination against HS, photographic evidence suggests that some calves might have died of it. Therefore, all the vaccines must be of high quality and specially purchased.
- Elephant calves below 5 years are very susceptible to various infectious diseases. So special care and attention for drinking water and ration should be ensured.
- Regular trimming of nails and overgrown cuticle over feet should be ensured.
- An elephant undergoing musth should be tied with a chain, and regular fresh drinking water and fodder should be provided at the site. Timely disposal of the dung of such elephants should also be ensured.
- As suggested by Dr. Khadri, annual elephant rejuvenation camp should be held for at least 15 days in the monsoon.

Dr. SSMS Khadri and the wildlife veterinarians of the tiger reserves of Madhya Pradesh proposed the following recommendations for the health management of the elephants of the core zone:

- Previous exposure to infectious agents may be demonstrated by PCR (Polymerase Chain Reaction) by applying DNA segments upto 1 million times and this can be utilized to identify the presence of viral and bacterial organisms in faces, blood and tissues, enabling retrospective monitoring of historic disease incidence to be conducted of Endotheliotrophic Herpes Virus Infection and encephalomyocarditis viral infections.
- Evaluation of a multiple antigen Enzyme Linked Immunosorbent Assay (ELISA) for detection of Mycobacterium Tuberculosis infection in captive elephants.
- Haematological and serological examination of all camp elephants may be conducted on annual basis.
- Serum prolactin level may be examined to diagnose pregnancy in Asiatic Elephants (normal range 6.9 $\pm$ 0.7 ng/ ml) increases to (50 $\pm$ 7 ng/ ml) in pregnancy.
- It is recommended that the actual body weight of all the camp elephants be measured by taking them to the weighing bridge.
- On inspecting the health conditions of elephants at Gaidhar camp it is recommended to undertake Haematological and serological examination for providing necessary treatment. It is also recommended to provide prophylactic treatment for blood protozoan with injection Berenil deep I/M with supportive treatment of IV fluid with injection Tribivet, injection Optineuron, injection Livibex I/M and injection Feltas (iron preparation) I/M and to keep the animals under observation.
- Annual elephant rejuvenation camp for 45 days may be arranged at suitable sites providing all facilities for treatment, supplementation of vitamins and minerals, deworming, foot care, nutritious food with plenty of branch fodder, seasonal fruits, sugarcane and other herbal and allopathic medication necessary for the rejuvenation of captive elephants' health.
- The elephant staff of the core cone should be provided a basic training at least once in 3 years.

- Annual medical screening of elephant staff to rule out Mycobactrium tuberculosis infections.
- The display of the feeding schedule of camp elephants at feeding points to be ensured.
- Avoidance of contamination of food through rodents.

23.4.1 **Annual Physical Examination:** All the elephants must be examined thoroughly at least once a year by the wildlife veterinarian. The following physical parameters have been decided in consultation with Dr. SSMS Khadri:

- **Actual weight** – The actual body weights of all the elephants should be measured by taking them to a weighing bridge. As presently there is no such provision, the Kanha management should establish a weighing platform of 5 tons near the Kanha laboratory. These annual weight records should be carefully maintained for each elephant to monitor any significant decrease or increase in the weight.
- **Pulse & Respiration –** The examination for body temperature, and pulse and respiration rates should also be conducted and meticulously recorded in the prescribed proforma **(Appendix-64)**.
- **Blood Profile –** Each elephant should be examined for blood profile and it should necessarily include hematology, serum chemistries and serum banking. At the time of annual physical examination, 10-20 ml. of whole blood should be collected and direct blood examination should be carried out at the Kanha laboratory. Further, the blood and its serum should also be sent to the School of Wildlife Forensic and Health, Nanaji Deshmukh Veterinary University, Jabalpur. for detailed examination.
- **Intradermal Tuberculin Test –** This test should also be conducted for each elephant. For this, administer 0.1 ml. of bovine purified protein derivative tuberculin (containing 5000 tuberculin units in the caudal fold). Evaluate by palpation at 24, 48 and 72 hours. Any evidence of swelling or induration should be considered suspect and the case should be consulted with a wildlife expert for further opinion.

23.4.2 **Routine Health Check-up:** The wildlife veterinarian should ensure that the following health conditions of the body parts of each elephant are observed carefully at least three times a month, and his findings/ prescriptions are duly recorded in the prescribed proforma **(Appendix-65)**:

- **Skin:** Warts/ Fungus/ Infection/ Ventral oedema.
- **External Parasites:** Flies/ Fleas/ Ticks/ Lice/ Mites.
- **Eyes:** Conjunctivitis/ Infected cornea (Keratitis)/ Infected eyelids/ Cataracts.
- **Ear (External):** Infection/ Lice/ Ticks/ Fungus/ Swelling/ Pus/ Smell/ Maggots.
- **Ear (Internal):** Smell/ Pus.
- **Trunk:** Warts/ Wounds/ Injury.
- **Tusk:** Cracks/ Wobbling/ Infection/ Smell/ Pus from the base/ Socket pus.
- **Leg:** Cripples/ Stiffness/ Sprains/ Twist/ Abnormal posture.
- **Feet:** Cracks in footpads/ Peeling off.
- **Nails:** Breaking/ Splitting/ Falling off.
- **Genitals/ Rectum:** Infection/ Wounds/ Other abnormalities.
- **Bath for Management of Ticks:** As suggested by the IVRI team.
- **Wound Management:** As suggested by the IVRI team.
- **Corneal opacity:** As suggested by the IVRI team.
- **Enema:** As and when necessary.
- **Cleaning, Grooming & Personal Care:** As suggested by the IVRI team.
- **Physiological Status:** Pregnancy/ Musth.

23.4.3 **Vaccination:** The importance of the vaccination of departmental elephants needs no elaboration. The Kanha management should ensure that all the elephants are appropriately and timely vaccinated for major and fatal diseases. The following schedule of the vaccination should be strictly adhered to by the Kanha management:

Table-90: Schedule of Vaccination

Disease	Dose of Vaccine	Proposed Date of Vaccination	Repetition of Vaccination
Anthrax	5 ml. spore vaccine - s/c at the root of tail or between the folds of hind legs and abdomen	Every year before the onset of monsoon, in the month of May or June	Every year
HS	5 to 10 ml. alum precipitated vaccine - s/c at the root of tail or between the folds of hind legs and abdomen	Every six months before the onset of the monsoon, in the month of May or June, and in December or January	Every six months
Tetanus	6 to 10 ml. tetanus toxoid vaccine - i/m at the gluteal or rump region as a prophylactic	At the time of the transportation of elephant by a vehicle or at the time of a surgery	-

Source: Kanha Tiger Reserve (2021)

23.4.4 **Fecal Examination for Parasites & Deworming:** It should also be ensured that fecal examination and medical intervention for deworming are carried out at least once in six months for all the elephants. However, as per the technical report of the Indian Veterinary Research Institute, Izzatnagar, the deworming schedule should be repeated every three months. Every year the deworming medicine should be changed as per the prescription of the wildlife veterinarians to avoid the development of resistance.

Table-91: Fecal Examination and Medical Intervention for Deworming

Name of Deworming Medicine/ Dose	Month of Deworming				Remark
	January	March	June	September	
1	2	3	4	5	6
Oxyclozanide (Distodin) @5-7.5 mg/km. body weight	First week	First week	First week	First week	This medicine should be used against flukes
Albenazole (Analgone) 3-5 mg./kg.	Second week	Second week	Second week	Second week	This medicine should be used against round worms

Source: Kanha Tiger Reserve (2020)

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23.4.5 **Foot Care:** Routine foot trimming of these elephants is also very essential. The mahout of each elephant should be instructed for routine trimming of over-grown cuticles, nails, and skin to maintain good health of the feet. This intervention helps avoid the diseases of foot such as cracked soles, over-worn sole, overgrown sole, cracked heel, overgrown nails, split nails, ingrown nails, overgrown cuticle, and penetrating injuries etc. It is suggested that elephants should not be made to walk over hard rocky areas, and daily movements of elephants must be restricted to less than 30 km. per day. The mahout of each elephant should be trained for trimming the skin, toes and be equipped with a trimming knife and a heavy wood rasp with changeable blades, and a drawknife for shaping and trimming the cuticles and pads. It is also suggested that routine footbath also be carried out under the supervision of the wildlife veterinarian. The elephants should be kept in dry places with good sanitation.

23.4.6 **Trimming of Tusk:** The elephant tusks are actually modified incisors, and are ever-growing structures. The Kanha management has to ensure that the tips of tusks are trimmed annually beyond a measured distance from its base, which is equivalent to the distance between the inner canthus of the eye and the base of tusks of the respective side, maximum $1/3^{rd}$ of the distal length of the tusk seen outside. However, the management has also to be careful that these tusks should not be pointed/ sharp enough to injure other elephants at the time of infighting and musth. Accordingly, these tusks have to be trimmed form time to time as and when necessary. The records of trimmings should be kept in the prescribed format.

23.4.7 **Feeding/ Diet Schedule:** The diet of each elephant should be followed as per the prescription given by Dr. SSMS Khadri and the Scientists of IVRI, Izzatnagar as under:

Table-92: Captive Elephant Diet Prescription

Age of Animal	Sex	Physiological Status	Wheat Floor	Rice Floor	Pulses Floor	Soya Floor	Jaggery	Salt	Mineral Mixture
1	2	3	4	5	6	7	8	9	10
Adult	M/F	Working	4 kg.	5 kg.	0.5 kg.	0.5 kg.	0.5 to 1 kg.	-	-
Adult	M/F	Resting	3 kg.	4 kg.	0.2 kg.	0.1 kg.	0.5 kg.	50 gm.	-
Lactating	F	-	4 kg.	5 kg.	1 kg.	0.5 kg.	1 kg.	50 gm.	-
Calves (3 to 5 yrs.)	-	-	1.5 kg.	2 kg.	0.2 kg.	0.2 kg.	0.3 kg.	20 gm.	-
Calves (1 to 3 yrs.)	-	-	1 kg.	1.5 kg.	0.2 kg.	0.1 kg.	0.3 kg.	10 gm.	-
Infants (6 months to 1 yr.)	-	-	0.75 kg.	1 kg.	0.1 kg.	0.1 kg.	0.1 kg.	5 gm.	-

Source: Kanha Tiger Reserve (2021)

23.4.8 **Rejuvenation Camp:** As per the suggestion of Dr. SSMS Khadri, an elephant rejuvenation camp should be arranged every year in the rains. A large and flowing water body should be close by where the camp is being arranged. An annual rejuvenation camp is very important for the physical, psychological and social health of these animals. The Kanha management has already arranged such camps during the monsoon the past several years. If a rejuvenation camp of a longer duration is not possible, at least a-week long camp should be arranged. The following initiatives are proposed for this rejuvenation camp:

- All the mahouts and characutters along with their elephants should be instructed to assemble at a pre-decided camp.
- As stated above, there should be a large and flowing water body close to this rejuvenation camp.
- Temporary shelter should be erected to ensure the safe storage of elephant ration and cooking for the elephants.
- Duty assignment of officers should be preplanned so that each day at least 2-3 officers may attend the seven-day rejuvenation camp.

- The wildlife veterinarian should examine each elephant carefully and administer/ prescribe necessary medicines. All the elephants should also be dewormed.
- The feet of each elephant should be thoroughly examined for injuries/ cuts/ wounds and treated accordingly.
- Special and healthful diets should be given to the elephants during the rejuvenation camp, and the following diets of food and fruits are proposed:

    - Wheat flour.
    - Soybean flour.
    - Gram flour (*Channa*).
    - Bananas.
    - Sugar cane.
    - Corn or *Bhutta*.
    - Raw coconuts (with water).
    - Jaggery (G*ud*).
    - Papayas.
    - Pineapples.

- Each elephant should be thoroughly massaged with castor oil (50 gm.) and neem oil (250 gm.) every day by mahouts and characutters under the supervision of officers and mahouts.
- During the rejuvenation camp the Kanha management should ensure that the elephants follow the following daily routine: Every day the respective mahouts/ characutters should bring back their free-ranging elephants from the forest and give them a thorough and enjoyable bath. Elephants should then be massaged properly with oils and given a diet of fruits and corn at the camp, and released into the forest. Again in the afternoon, the elephant should be brought back, bathed and given a diet of cereals and fruits, and be released into the forest for overnight foraging.
- It is very important that during the course of the elephant rejuvenation camp, all the officers should interact among themselves and with the mahouts and

characutters every day to discuss the problems of elephant management and new suggestions/ ideas to strengthen and improve the present system. The Kanha management should ensure that all these discussions should be properly documented, reviewed, and if found suitable, implemented.

23.4.9 **Benefits of the Rejuvenation Camp:** The following benefits are derived from the elephant rejuvenation camp:

- All elephants are given a special diet that is good for their health.
- They are daily examined very closely by the wildlife veterinarian.
- Daily massage and enjoyable bath are very beneficial for their physical and mental health.
- It is well known that elephants are wise and social animals, and this rejuvenation camp is an excellent opportunity for them to feed and live together and interact among themselves. This is psychologically very beneficial.
- Elephants are completely relaxed during this period, and this also gives them a good opportunity for mating.
- This is also a good opportunity for the mahouts and characutters to know and understand other elephants and to control them later in emergencies.
- Discussions among mahouts and characutters also increase their knowledge and understanding about elephants.
- This is also a good opportunity for the officials to interact closely with the mahouts and characutters and know about their problems and intricacies of their profession.

23.4.10 **Staff Health Monitoring:** The staff responsible for elephant management, including mahouts and characutters, are regarded as prone to contracting various zoonotic infections, including tuberculosis. Therefore, the Kanha management should ensure that the staff is periodically tested for tuberculosis.

23.4.11 **First-aid/ Treatment Kit for Elephants:** The Park Management should also ensure that each elephant is equipped with a first-aid kit for routine and general treatment of wounds, cuts, minor injuries etc. The elephant mahout/ characutter should be trained for routine dressing and care of elephants. The kit should contain antiseptic lotion, ointment, spray, tinctures etc. It should also include a trimming knife, rasp and dressing material. The medicines of the kit should be routinely inspected and maintained by the wildlife surgeon **(Appendix-66)**.

23.4.12 **Elephant Hospital & Primary Laboratory:** The Kanha management should also extend the wildlife treatment centre at Mukki for the treatment of elephants, with necessary trained veterinary staff under the wildlife veterinarian in the core zone. The hospital should include the latest surgical diagnostic equipment and sufficient availability of medicine. Therefore, an elephant treatment enclosure should be erected near the elephant hospital so that the administration of medicine may be carried out as and when required. The establishment of a primary laboratory for the collection and preservation of various body samples and primary hematological and parasitological examination is also very important **(Appendix-67)**.

23.4.13 **Para-Veterinary Staff:** Presently, there is only a wildlife veterinarian responsible for wildlife/ elephant health management at Kanha. He needs to be provided with at least four trained para-veterinary personnel for assistance in the handling/ treatment of wild animals and elephants.

23.4.14 **Management of Musth:** Adult male Asian elephants annually manifest a physiological and behavioural phenomenon known as musth. This condition is characterized by the enlargement of temporal glands with copious flow of secretion and aggressive mood swings. Presently, the Kanha management is maintaining 8 different male elephants, and the manifestation of musth is very common in them. Therefore, the staff must be well prepared for the control of aggressive elephants. The musth elephant should be kept isolated from the other camp elephants and restrained with a strong chain. The feeding should be reduced gradually and provided at the site itself. The provision of *ad libitum* watering should also be made at the restraining site. The mahouts and charactutters should be instructed to keep vigil and watch over the behaviour and body conditions of the musth elephant until it becomes normal.

23.5 General Elephant Working Guidelines:

Some practices need to be refined and fine-tuned to further improve the working of departmental elephants. Broad guidelines are as under:

- In the light of the death of a characutter in the past, they should not be allowed to go into the forest before daybreak for searching their elephants.
- The characutters should be provided with electrically charged staffs for minimum self-defense against carnivores.
- Preferably more than three elephants should be kept at one camp so that the characutters can move around in a group.
- The duration of work for working elephant should not be more than 6 hours / day, and at least one day a week rest should be given.
- Only two persons should be allowed to ride the elephants below 20 years.
- Mahouts/ characutters should be imparted training in the upkeep of elephants at least once in 3 years.

23.5.1 **Work Schedule of Elephants:** In the core zone, elephants are used mainly for patrolling and tourism purposes. The Kanha management should ensure that these elephants, specially the aged ones, should not be overworked. The following work schedule is proposed:

- Generally, the animals should be put to work only during the cool hours of the day.
- In the summer, the elephants should be used for tourism from 6 am to 10 am. and in the winter, from 6 am to 11 am.

- The aged elephant should not be carrying more than two persons (around 150 kg. load) while working for tourism activities.
- Animals should not be made to walk more than 3 hours continuously. Every elephant should be given complete rest for one day in a week, if they are engaged in tourism activities in the future.
- Elephants should be given as much rest as possible during non-tourism season, if they have been used for tourism, and should not be used for carrying load during patrolling.

23.5.2 **Record Keeping:** The Kanha management has to ensure that a separate and permanent record of vaccination, disease, treatment, movement, and feeding is also maintained for each elephant. The record has to be kept at each elephant camp and produced as and when demanded by the wildlife veterinarian for inspection **(Appendix-68)**.

23.5.3 **Service Book of Elephant:** Each elephant must have a separate service book. The service book contains, among other details, the history of the elephant, physical characters, body measurements, record of diet charts, medical summery, movements of elephant, and its accouterments etc. The service book must be annually updated by the wildlife veterinarian and verified by the Field Director/ Deputy Director. **(Appendix-69).**

23.5.4 **Elephant Mortality:** It should also be ensured that the postmortem record of each mortality should be maintained in the prescribed format. Necessary tissue samples should be collected and preserved in suitable preservatives. The samples should be sent to the School of Wildlife Forensic and Health, Nanaji Deshmukh Veterinary University, Jabalpur. The postmortem kit should be well-maintained for all emergencies. A person should also be trained to open the carcass of elephant under the supervision of the wildlife veterinarian. The cause of the mortality should be established and preventive measures adopted to control the mortality in elephants. In case of complicated disease conditions, the elephant experts of Assam/ South India should be consulted immediately. The carcass of elephant should be deeply buried or burnt as per the prescribed rule. Necessary permission should also be obtained from the concerned authority for the collection of bones for scientific and educational purposes. The management may also think of preserving and displaying full skeletons of elephants.

23.5.5 **Elephant Movement:** The Kanha management should ensure that whenever an elephant is shifted from one campsite to another or to another tiger reserve of Madhya Pradesh, the concerned mahout/ characutter also takes all the relevant records, first-aid treatment kit along with accouterments along with the elephant. The health examination of the elephant should also be conducted before allowing it to leave for another destination, and all precautions should also be taken as prescribed by the wildlife veterinarian.

23.5.6 **Rotational Grazing of Camp Elephants:** Presently, the elephants are kept in the Kanha, Kisli and Mukki ranges. As elephant need very large volume of fodder for their maintenance, the forest area begins to show signs of over-grazing and degradation. Therefore, the foraging sites of elephants should be changed every two months as per the availability of fodder so that degradation of forest may be avoided.

23.5.7 **Disposal of Elephant Dung:** The Kanha management should also think of constructing several gobar-gas plants for adequate disposal of elephant dung in the Kanha, Kisli and Mukki ranges.

23.5.8 **Retirement Age of Elephant:** The age of elephant should be verified based on available records. Physical health status should also be taken into consideration while deciding on the age of retirement. The Park Management should fix the age of retirement for elephants at 65 years, and retired animals should be given very light work.

23.5.9 **Chaining:** It is a useful tool in the management of captive elephants. Chaining can facilitate footwork, feedings, veterinary procedures, animal introductions, and scientific investigations. The elephant should be chained by one front leg and one rear leg or by one front leg only. The chain should be alternated every other night to prevent injury to the leg. The chains must be long enough to allow the animal to lie down and get to its feet easily.

CHAPTER – 24

MANAGEMENT OF WILD ELEPHANTS

24.1 Introduction:

The Kanha management should also be prepared to manage wild elephants in the core zone. Wild elephants travel long distances, and would most likely to move through/ out of Chhattisgarh forest areas. These wild pachyderms need to move constantly from one habitat to another through fragmented forests for food, water and cover. While the Kanha core is not necessarily a preferred habitat or historical distribution range of natural populations of wild elephants, the eventual arrival of a long-ranging fragmented cluster or a clan may find the protected area habitat suitable for staying back/ settling down for some time. Such clusters may range from 15 to 50 animals. During their stay in the core zone, they are also likely to stray into surrounding villages, leading to human-elephant conflict and causing serious disturbances. These conflicts may also include human deaths, creating unprecedented panic among villagers so far unfamiliar with serious rampaging of wild elephants. During their stay in the protected area, the Kanha management would be required to undertake a wide range of initiatives. Besides, some preparations would also need to be made in anticipation of their arrival and rampage.

24.2 Objectives:

Specific objectives of the management of wild elephants in the core zone are as under:

- As far as possible, security/ protection of the villagers and their properties in surrounding villages
- Security/ protection of the entire forest employees/ staff, govt. properties and tourists against elephant attacks
- Monitoring of the elephant cluster for their movements and poaching
- Full-fledged veterinary facility to deal with eventualities in or outside the core zone

24.3 Proposed Strategy & Management Prescriptions:

The following broad prescriptions are proposed for the management of wild elephants in the protected area:

24.3.1 **Issuance of Guidelines to Line Departments:** The Kanha management should ensure that State-level instructions issued by the Chief Wildlife Warden, Madhya Pradesh should be followed by relevant line departments, including the Mandla and Balaghat district administrations, for the conservation of elephants and mitigation of human-elephant conflicts, and extending their full cooperation to the Kanha management in dealing with different situations.

24.3.2 **Sharing Knowledge with Villagers:** The Kanha management should arrange periodic workshops for the villages by elephant experts to share knowledge about effective ways to ward off elephants, protect lives and properties in case of pachyderms entering human settlements/ villages. Experienced sociologists also need to be engaged to interact with villagers for confidence building measures. Such workshops are effective in mitigating human-elephant conflict and reduce the loss of human lives and properties.

24.3.3 **Workshops for Staff, Guides, and Gypsy Drivers:** The Kanha management should periodically hold training workshops to train the staff, route guides, and gypsy drivers in dealing with these unpredictable megafauna by experienced wildlife managers and elephant ethologists. These experts will share their on-field experiences to help the staff learn about proper identification of animals, their habits and behaviors, a wide range of dos and don’ts while moving around in an elephant country, precautions, and proper communications with others to mitigate human-elephant conflict in the protected area. Route guides and gypsy drivers should also be trained at these workshops about safe safaris, quick response to tricky situations, and maneuverability of vehicles for safety of tourists. Efforts should also be made to provide the staff interesting reading materials in Hindi covering, but not limited to, all the above as permanent reference.

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24.3.4 **Effective Communication:** A WhatsApp group should also be created connecting villagers of all the target villages to the Kanha management and also among themselves to effectively communicate and alert others about elephant movement in or near their villages. Local officers should train select villagers from each village in effective communication of simple but standard phrases/ messages to avoid confusion.

24.3.5 **Monitoring:** Elephant population monitoring has many constraints, including those of terrain, visibility, and field logistics. While knowing only elephant numbers is important for managing local populations, demographic parameters and distribution patterns are important to know about long term trends for conservation. As far as possible, the elephant herd should be monitored for its sex and age class structure and movement for the security of the staff, tourists and villagers, and also for knowledge of any death/ poaching. While photography of visually identifiable and recordable morphological features is initially a safe method, elephant experts should be consulted to finalize a monitoring protocol suited to field conditions in the protected area. Such monitoring protocol and proper communication can alert the others and minimize human-elephant conflict in the area. If possible, a few elephants should also be radio-collared to study their movement patterns.

24.3.6 **Security of Tourists:** Proper monitoring and timely communication about spatial and temporal movement of wild elephants can help the Kanha management anticipate/ predict probable timings of their presence/ movement in different parts of the protected area. This information can be used to alert tourists in a particular area for the time being, and divert their vehicles to safer parts of the tourist zone, securing them from any mishaps/ accidents.

24.3.7 **Vigilance in Bordering Territorial Divisions:** Wild elephants have to cross the Dindori, East Mandla, and North Balaghat territorial divisions on the Madhya

Pradesh–Chhattisgarh border to reach Kanha tiger reserve. This is important that the moving elephant herd should first be deflected/ turned back from these areas by the local staff and villagers. Accordingly, they also need to be trained in/ educated on dealing with these animals by elephant experts at periodic training workshops. The Kanha management should request the Chief Wildlife Warden and the Principal Chief Conservator of Forests & Head of the Forest Force, Madhya Pradesh to issue necessary instructions to the respective divisional forest officers for arranging these training workshops and coordinating with the Kanha management during any such eventuality of elephant intrusion.

24.3.8 **Construction of Additional Kraals:** As the construction of kraals takes time, if required, additional kraals, a type of stockade, need to be built in the core zone for the taming and training of some wild elephants to minimize rampage in and around the core zone. The Kanha management has already built two kraals at Kisli along the lines of those at Bandhavgarh. Strong wooden poles are used with cement concrete to erect such structures, which are common in elephant states.

24.3.9 **Protection of Camps:** It is seen that elephants also enter camp buildings in search of food. These buildings and residents that are vulnerable to elephant attacks in the core zone need to be protected by digging standard elephant proof trenches around them. Also need to revise the building plan in order to make safe from elephant attack.

24.3.10 **Standing Operating Procedure:** The Kanha management also need to prepare a Standing Operating Procedure to deal with wild elephants strayed into villages/ habitations. The SOP should provide basic and minimum steps that need to be undertaken for dealing with incidents of elephants straying into human dominated landscape so that their intrusion and loss of human lives and agricultural crops/ properties may be mitigated. This can also serve as a guideline for preparing a detailed standing operating procedure for the entire state.

24.3.11 **MIKE Reporting:** The tiger reserve never supported wild elephant population in the past. However, strayed wild elephants have started crossing the Chhatisgarh border for the past 2-3 years, and a few elephants were reported in the core zone. In case of any illegal killing/ poaching of an elephant, the Kanha management should follow the MIKE reporting protocol (http//citesmike.org). MIKE or Monitoring Illegal Killing of Elephants is a programme developed by the CITES to provide information for elephant range states to make appropriate management and enforcement decisions, and to build institutional capacity within the range states for the long-term management of their elephant populations. MIKE aims to improve their ability to monitor elephant populations, detect changes in illegal killing levels, and use this information to provide more effective law enforcement and strengthen any regulatory measures required to support such enforcement. At the core of this programme is the site-based monitoring of elephants under a comprehensive prescribed protocol.

24.3.12 **Comparing Notes with Other States:** The Kanha management should also compare notes on wild elephant management with some other experienced states like Chhattisgarh, Tamilnadu, Andhra Pradesh, Karnataka and Kerala. These exchanges of on-field experiences will also benefit wild elephant management on ground. This aspect should be ensured by inviting a small team of officers from these states and also by sending a team, including the wildlife veterinarian, from Kanha there alternately at least once in six months.

24.3.13 **Full-fledged Veterinary Facility:** The Kanha management should also ensure the following initiatives towards establishing full-fledged veterinary facility at Kanha.

- A hospital needs to be established with all the latest specialized diagnostic tools, surgical instruments and drugs, specially narcotics for all eventualities.
- Initially, at least two specially designed heavy trucks with in-built hydraulic systems need to be arranged for hassle-free loading and transportation.

- Long range projection darting equipment along with transportation cages, loading cranes, offloading cranes, chains, ropes, hobbles, belts, etc. need to be procured and kept ready to deal with any emergency.
- The wildlife veterinarian vitally needs professional assistance of at least one junior veterinarian and three paraveterinarians for effective controlling, handling and treatment of wild elephants.
- An elephant rapid response team would be required for keeping tabs on the movement of wild elephants inside the park. The team would be equipped with good communication system and all necessary equipment etc. The team would monitor movement of wild elephants on the daily basis, and maps should be prepared accordingly.
- The Kanha management should also ensure a well-trained kumki elephants-squad along with trained mahouts to deal with eventual rampage by these elephants.
- A separate cell at headquarters also needs to be developed to coordinate with different working units and to monitor the elephant movement.

24.4 Draft Recommendations on Human-Elephant Mitigation in MP:

The problem of human-elephant conflict was discussed at the 20th meeting of the MP State Wildlife Board on the 27th May, 2021. The Board decided that a core team of elephant specialists be constituted and based on the recommendations of this core committee suitable mitigation measures be taken up to reduce human-elephant conflict in areas of elephant presence in the State. The Govt. of Madhya Pradesh, Forest Department constituted the core committee vide order No. 1604 dated05/10/2021. The core committee met at Bandhavgarh tiger reserve on the 6th and 7th December, 2021 to discuss the issue, and prepared draft recommendations determining the nature of human-elephant conflicts and proposed mitigation measures, both preventive as well as remedial. These draft recommendations are appended **(Appendix-70).**

The Kanha management should also follow these draft recommendations on the basis of their administrative and budgetary feasibility and relevance to Kanha tiger reserve under the instructions of the Chief Wildlife Warden, Madhya Pradesh.

CHAPTER – 25

SUPPORT TO THE VILLAGE COMMUNITY

25.1 Introduction:

Generally, people living inside the protected area want to be relocated outside with an attractive package. Forest villagers in the core zone have shown considerable willingness for relocation under the options offered by the NTCA. This has resulted in complete relocation of all the villages from the core zone. Technically, there is now no settlement/ village inside the core zone. There are, however, 8 forest villages in the national park area contiguous to the core zone boundary. The Kanha management now feels that until these 8 forest villages are not included in the buffer zone as per a recent proposal of reorganization sent to higher offices, the villages need development inputs for basic support. These initiatives will only strengthen trust between the Kanha management and the people, and help the management gain their support to wildlife conservation.

25.2 Objectives:

Specific objectives of village development in the national park close to the core zone boundary are as under:

- Reduce dependence of local communities on natural resources of the core zone.
- Garner support of the local communities of the forest villages for wildlife conservation.
- Support the local communities with basic amenities till they are relocated outside.

25.3 Proposed Strategies & Management Prescriptions:

The strategies and management prescriptions for village development in the national park area are as under:

25.3.1 **Essential Framework:** All forest villages, even those due for relocation, need to be included for village development. As per section 18A (read with section 36A) of the Wildlife (Protection) Act, 1972, until the rights of affected persons are finally settled, the State Government should make alternative arrangements for making available fuel, fodder and other forest produce to affected persons in terms of their rights as per record.

These forest villages are already affiliated to several ecodevelopment committees with Panchyat Raj Institution representation confederating such EDCs, ensuring benefits to local people for protecting forests on a quid-pro-quo-basis etc. The agricultural practices, if intensive, require monitoring in the context of cropping patterns and ensuing change in cover values. Likewise, sale of agricultural land resulting change in land use pattern should also be monitored so that the corridor values are not affected. Since livelihood is a big concern and dependency of local people on forests is considerable, the district level welfare schemes, if required, should be factored in the village development to benefit local people.

25.3.2 **Constitution of District Coordination Committees:** The constitution of district level coordination committees at the Mandla and Balaghat districts for ensuring ecodevelopment interventions in the forest villages of the national park is of utmost importance. As the area of the core zone falls into the Mandla and Balaghat districts, two such committees need to be constituted. There are a host of the State and Central Government's schemes for the development of villages, which are implemented through district administration. The constitution of these district level committees shall ensure required funds for ecodevelopment in the core zone. The proposed structure of the district level coordination committees is as under:

Table-93: Structure of District Level Coordination Committees

District Collector	Chairman
CEO	Member
Representative officials from PWD, Social Welfare, Tribal Department, Health Department, Agriculture Department, Education Department, Power & Irrigation Departments	Member
Representatives of various Government/ private production sectors	Member
Deputy Director of the Core Zone	Member
Deputy Director of the Buffer Zone	Member Secretary

Source: Kanha Tiger Reserve (2019)

25.3.3 **Mechanism of Fund Raising:** The Deputy Director shall be responsible for preparing the Annual Plan of Operations (APO) for various village development works to be undertaken in the national park under the guidance of Field Director, Kanha tiger reserve. The APO shall be strictly based on the proposals/ recommendations/ needs contained in the various microplans of the national park. All the microplans have been revised for the entire plan period. Local communities attach much importance to several types of developmental works, and these initiatives should be prioritized in the microplans. The Deputy Director shall submit the APO to the District Coordination Committees and pursue the same to ensure the timely release of funds. Sometimes, it may not be possible to receive the entire fund from the Collector Sectors, and for the rest of the funds, a separate APO under the guidelines of the National Tiger Conservation Authority, New Delhi shall be prepared and submitted through the Principal Chief Conservator of Forests (Wildlife), Madhya Pradesh.

25.3.4 **Village Development Initiative:** As no funds are granted under the ecodevelopment schemes, these villages need to be supported until their relocation through the Kanha Vikas Nidhi. Proposed initiatives need to be high priority works for the local communities based on demands raised at periodically held meetings of ecodevelopment committees. Besides, field officers also need to be satisfied that no ambitious structures are built in these villages.

25.3.5 **Provision of Soft-Loans:** There shall also be a provision of giving soft-loans to identified beneficiaries for the purchase of agricultural requirements, including implements, improved seeds, cattle etc. through the respective ecodevelopment committees.

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CHAPTER – 26

VISION BEYOND THE BUFFER

The protected area is almost completely surrounded by a buffer zone, and the tiger reserve is managed under a core-buffer strategy to provide an additional impetus to wildlife conservation. The tiger reserve lies in the middle of an extensive forest belt stretching from the forests in and around Achanakmar tiger reserve (Chhattisgarh) in the north-east to Pench tiger reserves in the south-west (Maharashtra and Madhya Pradesh), and to Nawegaon-Nagzira (Maharashtra) in the south. All these three corridors have been indentified and recognized by the Wildlife Institute of India, Dehradun. This forest block includes widespread forest patches in the Bilaspur, Kawardha, Dindori, Balaghat and Seoni, districts under traditional forestry operations and different local land uses. Most of these forests are under tremendous biotic pressure and the land uses immediately adjacent to these forests in many areas are detrimental to wildlife conservation, especially tiger conservation. This extensive forested landscape is extremely vital for tiger conservation in India as it forms one of the three main tiger inhabited landscapes still in existence. The region has four tiger reserves and the intervening landscape varies from good to extremely fragmented, with several revenue or privately owned forest patches. These forest blocks have to be managed assiduously as they also form the habitats that support the spill-over wildlife populations, specially tigers, of the high-density areas of the Kanha and Pench tiger reserves. All the three corridors need to be strengthened to ensure safe movement of tigers and dispersal of prey base. This aspect will be dealt with in the corridor conservation plan for Kanha tiger reserve.

Now to focus on the immediate environs, the eastern most boundary of the core zone is not surrounded by the buffer zone as it lies in the Chhatisgarh State. The Chhatisgarh forest department needs to enhance the legal status of the Chilpi forest range, increasing the possibility of good connectivity upto the Bhoramdeo wildlife sanctuary. The Chhatisgarh forest department, however, has also introduced several important conservation initiatives to strengthen the overall ground situation. These initiatives will also add to the restoration of some part of the Kanha-Achanakmar corridor. The Kanha-Achanakmar forest corridor is contiguous almost throughout. However, at several places it is extremely thin and degraded, and in between there are several relatively good blocks. These can function as potential stepping-stones on the landscape between the tiger reserves.

Besides, the Kanha management and the Kawardha division (CG) can also make arrangements for joint patrolling along this border and sharing of information on wildlife crimes/ intelligence.

Currently, the Phen wildlife sanctuary stands more strengthened with the recent expansion of the buffer zone area. There is now good connectivity between the Supkhar range and the Phen wildlife sanctuary through the buffer zone. Besides, Sajalagan, the only forest village inside the wildlife sanctuary, shall also be relocated in the near future. Now it is logical that the wildlife sanctuary should also be declared a Critical Tiger Habitat to ensure a promising linkage from the core zone to the Phen wildlife sanctuary and beyond in the Chhattisgarh State. Some basic wildlife improvement practices such as developing good water bodies and grasslands in these areas shall add to the movement of animals in the region.

The Kanha-Pench corridor on the western side is probably the most promising connectivity. Though fragmented in between, this is reported to be used by tigers frequently. The strengthening of this corridor at the Kanha end has already been proposed in the Tiger Conservation Sub-Plan for the buffer zone. Besides, the management plan for the Kanha-Pench corridor has also been prepared by the Forest Department, and will play a very effective role in the restoration of this important ecological connectivity. The proposed corridor passes through four territorial and three MP Forest Development Corporation divisions of Mandla, Balaghat and Seoni districts. As per Mr. Sunil Agrawal's corridor plan, the total area of the corridor is 3162 sq. km., with 248 villages falling within the boundary of this corridor. The corridor is very narrow in some places, and these weak links harbours 43 critical villages. The corridor needs to be strengthened for ecological sustainability, with site specific measures. Restoration works also need to be taken up based on the Disturbance Indices of the areas. Conservation of natural resources is regarded an integrated biological and social process and needs understanding target communities, specially their socio-economic aspirations and cultural propensities. Past experience suggests that peoples' livelihoods and their ability to be meaningfully involved in conservation planning and practice are vital to nature conservation. The restoration of this corridor may also require new approaches to dealing with the human aspect of this enterprise.

On the northern side, the buffer zone borders the east Mandla (T) division, and the region has many weak links. It should be ensured that the staff is gradually oriented for the enhanced protection and monitoring of the movement of tigers. Basic habitat improvement measures such as developing water holes and grasslands for ungulates should also be taken.

The same recommendations are also made for the part of north Balaghat (T) division bordering the southern boundary of the buffer zone. Harbouring many weak links in ecological passages, this area also needs basic habitat improvement inputs. More importantly, the professional skill of the staff should be developed for a high degree of protection of wildlife and its monitoring in the area.

Intensive land use patterns in the landscape, which are hostile to tiger conservation, should be curtailed. All linear infrastructures like highways and Major District Roads and railways need to be mitigated with smart green technology, permitting unobstructed wildlife movement.

The human-tiger interface problems should be addressed at the earliest as per Special Operating Procedures (SOP) as laid down by the NTCA. Requisite rapid response teams should also be prescribed in sensitive areas to address such situations. Forestry and other land uses in the corridor area need to be governed by the strategy as suggested for the buffer, and a detailed management strategy should be reflected in the respective working plans of forest divisions falling in the corridor, as delineated at the 'macro-level' in the 2010 country level assessment. The 'micro-level' appraisal of the ecological linkages need to be done to understand the human-wildlife interface and the existing land use patterns. Special retrofitting measures are also required for intensive land uses like mining/industry etc.

Field protection and wildlife monitoring are important in the corridor linkages, and hence the tiger reserve management should become the nodal agency for mainstreaming the protocol in the concerned forest divisions. Besides, movement of traditional gangs/ habitual offenders involved in poaching of wild animals should also be closely monitored and there should be a regular exchange of data relating to wildlife crime between the forest/ police departments of areas falling in the corridor and the tiger reserve.

The Collectors of concerned districts harbouring these corridors should also be apprised of the corridor plans to integrate livelihood investments from various developmental schemes in these areas.

CHAPTER – 27

MISCELLANEOUS ISSUES

The chapter deals with some miscellaneous issues relating to management in the core zone. These issues are also important, and merit prescriptions:

27.1 Honing of Proactive Management Skills:

The Kanha management needs to keep honing proactive management skills, specially capture, restraint and translocation, acquired through extremely hard work and over so many years. It should not go waste, and managers and veterinarians should stay in practice. With sizeable populations of different wildlife species to share with some other protected areas, and its own need to reintroduce some species into the core zone, Kanha is expected to play an important role in active wildlife management in future also. As already described in an earlier chapter of Part-I, the Kanha management has successfully captured, restrained and translocated gaur, barasingha, and tigers to some other protected areas. Even within the core zone, over one thousand chital have also been shifted from the Banjar valley to the Halon valley areas. Some blackbucks were also reintroduced to Kanha several years back. In this way, these hard-earned skills should not get blunted though complacency and neglect.

27.2 Reintroduction of the Wild Buffalo:

As already mentioned, the proposal to this effect has already been submitted by the Wildlife Institute of India, which needs to be pursued by the Kanha management. The proposal cites the following outcomes:

- Feasibility of wild buffalo reintroduction in Kanha Tiger Reserve
- Genetic analysis to identify the correct source population for reintroduction, and
- Site-specific management strategies for the reintroduction.

Needless to add, the reintroduction would first require habitat suitability study by the Wildlife Institute of India, Dehradun. Besides, we also need to keep the NTCA, New Delhi in the loop, as the reintroduction site happens to be a tiger reserve, and the Authority may have to take this matter to its technical committee for necessary sanction.

27.3 Erection of Chain-Link Fencing against Crop Raiding:

The Kanha management needs to be very judicious while deciding on erecting chain-link fences in the core zone to reduce biotic pressure. Besides being expensive and unmaintainable, the importance of fencing needs to be offset against negative impact on conservation, and controversies arising out of this initiative. Fencing in one area may also lead to intensification of park-people conflicts and overuse of habitat in some other areas within the core zone. Fencings are also known to have an adverse impact on movement of tigers and other wildlife species. Therefore, it needs to be cautiously planned taking into account such factors as forest contiguity, dispersal potential of tigers and other species etc. The erection of a long-running fence would, to some extent, minimize disease transmission and man-animal conflicts, and will also cause obstruction to free moving wild animals for crop raiding and also prevent their deaths from slamming into the fence.

27.4 No Felling/ Removal of Trees:

As already prescribed in the Chapter of Habitat Management, no forest crops should be felled or collaterally removed in these operations. If under exceptional circumstances such fellings/ removals are inevitable in the core zone, proper permission should be obtained from the Chief Wildlife Warden of Madhya Pradesh and National Tiger Conservation Authority, New Delhi.

27.5 Payment of Crop Compensation:

Currently, compensations for crop raiding by wild animals in the forest and revenue villages of the tiger reserve are paid by the revenue department under the Madhya

Pradesh Public Service Guarantee Act, 2010. The Act has been notified and provides for time limits and designations of responsible officers and appellate officers for these payments. The Kanha management should coordinate with the revenue department in the registration of and expeditious payments in such cases. A smooth mechanism of crop compensation is also in Kanha's interest, and will also prove to be a good confidence building measure in cooperation with the local communities.

Nevertheless, the Kanha management should, at the same time, also strive for a single channel mechanism for the payment of crop damage compensation. The forest department needs to be made the nodal agency for avoiding delay in payment. Besides, this would also foster greater tolerance of local communities toward wildlife, specially elephants now present in the landscape. The National Tiger Conservation Authority, New Delhi appointed Management Effectiveness Evaluation (MEE) team also raised this issue on a recent visit to Kanha.

27.6 Wildlife Week Celebration:

The importance of conservation awareness in public has already been discussed in a previous chapter, and students, specially those living in the buffer zone, form a very important target group for creating this awareness through celebrating wildlife week programmes every year. This generation living close to Kanha needs to be constantly growing up amid conservation awareness with special reference to Kanha tiger reserve. The Kanha management should take up the following activities during the wildlife week.

- Essay, drawing, quiz competitions.
- Holding of exhibitions at range headquarters.
- Wildlife film shows at villages.
- Distribution of stickers/ posters/ brochures to schools.
- Rewards to the winners of the above competitions.
- Park excursions for the winners.

27.7 Training for Skill Development:

The Kanha management should also continue with training select youths of the buffer zone in skill development for creating job opportunities for them. As already mentioned in an earlier chapter, it is also an excellent confidence-building measure to tap on the potential of villagers for an effective buffer zone in the tiger reserve.

27.8 Management & Upgradation of the Kanha Bhoorsingh Public School & Study Centre at Mukki:

This school, over the years, has achieved its rather limited objectives efficiently. The Kanha management should now think of upgrading its classes still further in the next ten years, with all the necessary infrastructure and teaching resources vis-à-vis the current trends in school education in any district place.

27.9 Staff Health Management:

A huge human capital – experience and skills - has been invested in the making of Kanha. Needless to add, the credit of the renown and fame of the protected area also goes to the hard working and dedicated frontline staff of the core zone. Service conditions in the core zone are comparatively very difficult owing to the sheer responsibility of protecting forest and wildlife in the protected area. Local officers and frontline staff always have to stay inside the core zone. There is a good network of remotely-seated patrolling camps, which also poses typical psychological problems. Most are non-family postings, and living continuously in frightening isolation and away from families do take their toll on the mental health of the frontline staff. The Kanha management has to face many such cases of medical emergencies in the core zone. Generally, the staff suffers from the following diseases/ ailments:

Gastroenteritis	Infective hepatitis	Malaria and dengue	Typhoid	Pneumonia	Gastritis
Tuberculosis	Hypertension	Allergies	Snake and insect bites	Skin infection	Cold & cough

The Kanha management should ensure to take care of general health of the staff of the protected area. The following broad guidelines are proposed:

- The Mukki hospital should always be kept well-maintained, with all necessary equipment and medicines. The physician should be periodically consulted for his professional advice and requirements.
- All the ambulances should always be kept well-maintained and in readiness for any medical emergency.
- The practice of supplying the frontline staff with annual first-aid kits should continue. Medicines for the first-aid kit and their dosages need to be prescribed by a senior physician of the district hospital of Mandla. The proposed medicines for first-aid kits are appended **(Appendix-71)**.
- The entire Kanha management should be medically insured either through the Kanha Workers' Society or an NGO/ NGI.
- The Kanha management should also make efforts to arrange special medical camps through NGOs/ NGIs for the frontline staff for special check-up and treatment for a wide range of lifestyle and genetic diseases.
- The health of villagers of forest villages around the core zone is also the responsibility of the Kanha management. The outbreak of any epidemic should immediately be reported to the chief medical and health officer and collector of the concerned district
- The Kanha management should also ensure timely vaccination of the frontline staff against diseases such as flu, typhoid, pneumonia, and hepatitis-A and B, etc.
- The entire field staff should be provided with a good quality water filters.

27.10 Disposal of Stocked Antlers:

The male animals of cervidae (deer) in the core zone drop their antlers annually and re-grow them. The antler growth coincides with the overall growth period of the habitat in the monsoon. Antler is a simple extension of bone and it is reported to have a calcium-phosphate matrix of hydroxyapatite integrated with calcium carbonate, and its

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composition is similar to that of human bones. Besides, it also contains related mineral compounds and organic material derived from the habitat through food. Thus, this phenomenon may also cause calcium depletion in the habitat to some extent, and the natural cycle ensures recycling of the same through the fallen antlers. Besides, deer also sometimes take bites at fallen antlers to benefit from the mineral salts contained in them. Rodents also nibble away the fallen antlers. However, based on past experience, fallen antlers are collected by the Kanha management to avoid pilferage and illegal sale, and used to be disposed off by incineration as per instructions. Besides, apart from the risk of pilferages, fallen antlers also lure miscreants to sneak into the protected area, who set fire to the grasslands to collect the same in dry summer months.

Deer antler is a common constituent in the Chinese pharmacology. China is also a major producer and consumer of deer antler products and has probably the longest history of medicinal use of deer antler as well as production through deer farming. It is, however, surprising, that New Zealand is probably the largest producer of deer antler in the world, followed closely by Australia and Canada. Besides, Korea is also reported as the world's largest user of antlers of almost all species.

Presently, there are huge stocks of these antlers dumped in various buildings in the core zone. Needless to add, this stock should be disposed off at the earliest so that the buildings may be used for more important purposes. The Kanha management also wrote to the Principal Chief Conservator of Forests (Wildlife), Madhya Pradesh, requesting its disposal by having it grinded/ crushed and spread all over the grasslands for natural recycling, and the permission has been accorded to go ahead as proposed. Now the Kanha management should see to it that the huge stock of antlers is disposed of properly.

27.11 Mortality Survey:

The camp staff should be suitably instructed to collect all skulls and mandibles from the field. Under a consultancy/ project mode, assessment of species specific/ age-specific mortality needs to be assessed by wildlife biologists of some premier institute.

27.12 Management of Forest Road Network:

The core zone already harbors an excellent network of forest roads for vehicular patrols and tourism. Roads and firebreaks/ fire-lines are regarded as man-made linear infrastructures tending to cause linear openings, forest fragmentation, and breakage in habitat connectivity. They are also recognized to have detrimental ecological impacts on natural ecosystems. As the core zone is not a large area, the Kanha management should not construct any new forest road. The present road network, however, should be repaired/ maintained every year for tourism and patrolling.

27.13 No Construction of New Buildings:

The Kanha management has over the years fulfilled the requirement of different types of buildings in the core zone. Any new concrete structure, with all the associated anthropogenic disturbances, also encroaches upon tranquil space, which goes against conservation philosophy. The Kanha management should only construct a new building in lieu of the demolition of an old/ dilapidated building. This also holds good for the construction of a few buildings proposed in this document.

27.14 Demolition of Old Buildings:

All old buildings no longer required should be demolished and debris cleared off to allow these cleared sites to undergo natural succession processes and reintegrate into the surroundings.

27.15 Management of the Kanha Workers Sahkari Sakh evam Kamgar Samiti Maryadit:

The continuance of this Society is of vital importance for the staff of the Kanha tiger reserve, and the Kanha management should ensure its proper functioning and intended benefits to the field staff. The Deputy Director, core zone is presently the president of the

Society, and a few officers and field staff as directors assist her/ him. There is already a code of bylaws in place to ensure timely elections of office bearers, periodic meetings, auditing of the Society's account, membership fees and other related issues.

CHAPTER – 28

ORGANIZATION, ADMINISTRATION & BUDGET

28.1 Present Setup:

The tiger reserve consists of two conservation entities, namely the core zone and the buffer zone. The tiger reserve is headed by Field Director of the rank of a Chief Conservator of Forests, with headquarter at Mandla. Deputy Directors of the rank of a Deputy Conservator of Forests, are in charge of the core and the buffer divisions, with their headquarters also at Mandla. There is also a Research Officer and a Wildlife Veterinarian headquartered at Mandla.

The core zone, legally a protected area, consists of three sub-divisions, each headed by an Assistant Director of the rank of an Assistant Conservator of Forests, with their respective headquarters at Mandla, Kisli and Mukki. There are six forest ranges, with as many Range Officers in the core division. The headquarters of all the Range Officers are located either inside the core zone or just close to it.

Below Range Officers, the staff in the core zone includes: Deputy Rangers, Foresters, Forest Guards, mahouts, some permanent employees, and a number of daily wagers discharging different duties to assist in the management of the core zone. Ministerial staff at the Mandla office consists of: Account Superintendent, Accountant, Draughtsman, Assistant Grades I, II, and III, Forest Guards, Assistant Programmer and Computer Operators, some permanent employees, drivers, and daily wagers etc.

28.2 Coordination with Line Agencies/ Departments:

The Kanha management understands perfectly well that the contribution of the district administration of Mandla and Balaghat districts is of utmost importance for the successful management of the core zone. The Kanha management ensures to hold periodic formal and informal meetings with the officers of district administration and other government departments and discuss various issues of the protected area. The major inputs generally received from the departments of these two districts are as under:

28.2.1 **District Administration:** Generally, the district administration plays a coordinating role between the core zone administration 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 Kanha management also work in close cooperation during the visits of State Guests and VIPs.

28.2.2 **Police Department:** The police also lend full support at the request of the Kanha management in various eventualities. If required, they help field 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 park administration and government policies. At the district level, important intelligence relating to wildlife offences and offenders is also shared between the Kanha management and police department.

28.2.3 **District Planning Committee:** Sometimes the Kanha management also requests the District Planning Committee to allocate funds for some important field works in the core zone to supplement budgets received from the NTCA, New Delhi and State Govt. The core zone received funds from District Planning Committee/ District Rural Development Agencies, Mandla in the past years for wildlife and fire protection, and also under the Mahatma Gandhi National Rural Employment Guarantee Act.

28.2.4 **Health Department:** The core zone has remotely located patrolling camps with staff and 8 forest villages with a population of 6095 people. The Kanha management also regards itself responsible for dealing with health related issues of its staff and villagers. At the request of the 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.

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

28.3 Staff Development:

The central and state governments have been at the forefront of nature/ wildlife conservation for many years, and have also drawn considerable accolades from international community from time to time. There is hardly any need to emphasize the significance of wildlife protected areas in the country. The importance of the protected area network of our country has also ensured a permanent focus of national and international communities/ watchdogs on the performance of, and even day-to-day activities, in these protected areas, specially those harbouring rare and endangered floral and faunal attributes and threatened ecosystems. Our commitments to transparency and media activism have also added to our responsibility of managing the protected areas for the posterity.

Achieving the conservation objectives/ goals of a world class protected area like the core zone and its consistently successful management requires a clear and futuristic policy of staff development. It is a foregone conclusion that service conditions in the core zone are comparatively very difficult owing to the sheer responsibility of protecting forest and wildlife in the protected area. The local officers and frontline staff always have to stay inside the core zone. There is a good network of patrolling camps and most are remotely seated, and pose typical problems of living in isolation. Most are non-family postings in the core zone, and living continuously in frightening isolation and away from families and physical exertion of daily patrols do take tall on the mental health of the frontline staff.

Needless to add, the efficiency of the field and office staff is reflected in the way in which the whole protected area is managed. The top management has to build-up a disciplined, efficient and well-motivated staff for the protected area. The following points are proposed to form guidelines for staff development in the core zone:

28.3.1 **Filling-up of Vacancies:** The current position of staff in the core zone is has already been appended **(Appendix-14)**. While the staff position is more or less satisfactory, it has to be accepted that vacant posts of frontline staff in the core zone affect overall protection very adversely. Besides, several posts need to be increased in the light of new initiatives in tourism management, park interpretation etc. Similarly, the growing demand/ pressure of prompt communication and expeditious exchange of information with the higher offices of state and central governments, and routine work at the Mandla head office also underscore the vital need of creating new ministerial positions.

28.3.2 **Staff Training:** There is no need to emphasize the importance of forestry and wildlife training at all levels of field personnel in a protected area of the renown of the core zone. The Kanha management should also ensure, as far as possible, that all untrained forest guards should be sent to training schools every year for the six-months training. Similarly, foresters and deputy rangers should also be sent for refresher training. Efforts should also be made to have wildlife trained officers posted to the protected area for better coordination in management. As there is now no special wildlife training for forest guards and foresters, special in-house classes/ sessions should be organized by the management to impart them the basics and day-to-day field exercises of wildlife management. Resource persons should also be invited from premier institutes to help officers build and develop capacity in wildlife management, and make them aware of the latest concepts. Study tours of frontline staff and officers should also be ensured by the Kanha management. The office staff should be trained in basic computer operation and also in relevant official software of their branches for speed and efficiency. The proposed monthly calendar of basic trainings for the field officers and frontline staff is as under:

Table-94: Proposed Monthly Calendar of Basic Training for Officers and Frontline Staff

Sl. No.	Name of Training	Month	Division
1	Special monsoon patrolling	June	Core and Buffer
2	Habitat improvement	July	Core
3	Computer software and data entry	August	Core and Buffer
4	Tourism: Route guides and drivers	September	Core and Buffer
5	Tourism: Park entry permits and online reservation	September	Core and Buffer
6	Legal (Judicial department)	October	Core and Buffer
7	Grass seed collection	November	Core
8	Anti-poaching, forensics and investigation (Police department)	December	Core and Buffer
9	Phase IV monitoring	December	Core and Buffer
10	Legal (Judicial department)	January	Core and Buffer
11	Fire management (preventive and control) for staff and EDC members	January	Core and Buffer
12	Basic field equipment and camera-trapping	February	Core and Buffer
13	Legal (Judicial department)	April	Core and Buffer
14	Phase IV monitoring	April	Core and Buffer
15	Ecological monitoring	May	Core

Source: Kanha Tiger Reserve (2021)

28.3.3 **Posting of Young Staff:** It is very difficult for elderly field staff to do justice to their conservation duties in the core zone. Besides involving a lot of leg work in daily patrols, duties also include night patrolling, intelligence gathering, and apprehending offenders etc. These protection activities take a considerable toll on the physical and mental health of the staff. In view of this, the Kanha management should develop a mechanism wherein older staff is gradually replaced with younger once.

28.3.4 **Staff Welfare:** The Kanha management should also ensure the welfare of the frontline staff of the protected area. Besides medical facilities throughout the year, residential facilities for their families and education of children should also be provided. Periodic provision of a good support package of their daily needs, including cycle, uniforms, field equipment, water filter, solar light, torch with batteries, jungle boots, rain-proof and warm clothing etc., should also be given. Ministerial staff and computer personnel and their families at Mandla should also benefit from this welfare programme. This generous gesture of the management would further strengthen cohesion in the Kanha family.

28.3.5 **Rewards & Incentives:** The Kanha management should also develop a fair system of rewards and incentives to encourage good performance of the frontline staff. Such rewards and incentives may include commendation, speedy promotion, opportunities for special trainings, and cash remuneration etc. Money from the Kanha Vikas Nidhi can be utilized for this purpose every year.

28.4 Tiger Conservation Foundation:

Under section-38X of the Wildlife (Protection) Act, 1972 (as amended upto 2006), the State Govt. has to establish Tiger Conservation Foundations in tiger reserves in order to facilitate and support their management for conservation of tiger and biodiversity, and to take initiatives in ecodevelopment by involvement of people in such development process. Section-38X (2) of the above Act states several objectives of the establishment of Tiger Conservation Foundation.

The MP State Govt. already has an almost similar body constituted at the state-level. The Madhya Pradesh Tiger Foundation Society was registered on 15-01-1997 under the Madhya Pradesh Society Registration Act, 1973 (No. 44 of 1973). The Society is chaired by the Forest Minister of Madhya Pradesh, with the Chief Wildlife Warden of the State as Secretary of the Society. The other members of the Society include Principal Secretary/ Secretary (Forest), Secretary (Finance), Principal Secretary/ Secretary (Public Relations), Principal Secretary/ Secretary (Tourism), Principal Chief Conservator of Forests & HoEF (MP), Addl. Principal Chief Conservator of Forests (Development), Addl. Principal Chief Conservator of Forests (Protection), Chairman, Tiger Cell (Addl. Director General of Police/ Inspector General of Police), and four prominent individuals working for wildlife conservation and nominated by the State Govt. Besides, the Field Director/ Director of each tiger reserve/ national park has been made an Executive Director. These Executive Directors have been assigned responsibilities and empowered accordingly.

The sole objective of the MP Tiger Foundation Society is to conserve tigers and protect wildlife and biodiversity in the state. As the Society strives to achieve almost the same goals/ objectives as are set for the Tiger Conservation Foundation, it is felt that there is currently no need to establish such Foundations as envisaged in the Wildlife (Protection) Act, 1972 (as amended upto 2006). The rules of Madhya Pradesh Tiger Foundation Society are appended **(Appendix-72)**.

28.5 Tiger Steering Committee:

As per provision under Section 38U of the Wildlife (Protection) Act, 1972 (as amended upto 2006) the Govt. of Madhya Pradesh has constituted a state level steering committee for three years for ensuring coordination, monitoring, protection and conservation of tigers, co-predators and wild animals in the state. The constitution of the steering committee was first notified vide No. F-15-2-2009-X-2, Bhopal dated 20-03-2009. Currently, as per the latest notification vide No. F-15-02-2009-X-2, Bhopal dated 19-08-2014, the structure of this steering committee is as under:

(A)	Chief Minister, Govt. of MP		Chairman
(B)	Forest Minister, Govt. of MP		Vice-Chairman
(C)	Govt. Officers (Five):		
	(C-1)	1. Chief Secretary, Govt. of MP	Member
		2. Addl. Chief Secretary/ Principal Secretary (Forests)	Member
	(C-2)	Addl. Chief Secretary/ Principal Secretary (Department of Tribal Welfare)	Member
	(C-3)	1. Field Director, Kanha Tiger Reserve	Member
		2. Field Director, Bandhavgarh Tiger Reserve	Member
(D)	Wildlife Experts (Three):		
	1.	Shri HS Panwar	Member
	2.	Shri Anish Andheria	Member
	3.	Shri Ujjwal Sharma	Member
(E)	Members of the Tribal Advisory Board (Two)		Member
(F)	1.	Addl. Chief Secretary/ Principal Secretary (Department of Panchayati Raj)	Member
	2.	Addl. Chief Secretary/ Principal Secretary (Department of Social Justice & Empowerment)	Member
(G)	Chief Wildlife Warden		Officiating Member Secretary

Source: Kanha Tiger Reserve (2020)

28.6 Funding & Schedule of Operations:

The core zone is one of the first nine national parks where the scheme of Project Tiger was launched by the Govt. of India on 01-04-1973. This ambitious scheme was started as Central Sector Scheme and later came to be known as Centrally Sponsored Scheme. On the recommendations of the Tiger Task Force constituted by the Prime Minister in 2005, Project Tiger was also upgraded as a statutory body under the ministry of Environment, Forests and Climate Change, Govt. of India, and renamed as National Tiger Conservation Authority.

Kanha tiger reserve receives funds from the Govt. of India through the National Tiger Conservation Authority, New Delhi under the Plan budget viz. Non-Recurring (60%) and Recurring (50%), on the basis of the Annual Plan of Operations (APO) submitted through the Principal Chief Conservator of Forests (Wildlife), Madhya Pradesh and the State Government. The APO has to be submitted in a prescribed format every year in the month of March or April.

For the recurring items of expenditure, the matching grant used to be borne by the Central and the State Government (50-50%). In addition, 100% non-recurring grant used to be provided from the Central sector for ecodevelopment and village relocation till 2014-15. Afterwards, for the non-recurring items, 60-40% matching grants are borne by the Central sector and the State sector respectively.

The details of budgetary allocations and expenditure incurred under the State and Central sector from 1991-1992 to 2020-21 in the core zone, including Phen wildlife sanctuary, are as under:

Table-95: Details of Budget Allocations (Rs. in Lakhs) from Project Tiger, Govt. of India

Sl. No.	Year	Allotment		Total	Expenditure		Total
		Recurring	Non-Recurring		Recurring	Non-Recurring	
1	2	3	4	5	6	7	8
1	1991-92	54.600	34.691	**89.291**	55.642	25.095	**80.737**
2	1992-93	52.310	44.200	**96.510**	67.481	40.352	**107.833**

3	1993-94	77.100	27.340	**104.440**	76.968	25.403	**102.371**
4	1994-95	80.550	27.120	**107.670**	78.647	26.373	**105.020**
5	1995-96	92.450	32.350	**124.800**	89.657	27.944	**117.601**
6	1996-97	91.500	35.250	**126.750**	89.241	23.467	**112.708**
7	1997-98	114.100	36.000	**150.100**	107.004	28.259	**135.263**
8	1998-99	105.600	38.000	**143.600**	104.398	35.572	**139.970**
9	1999-00	167.650	84.100	**251.750**	159.078	68.891	**227.969**
10	2000-01	159.00	113.95	**272.95**	157.08	64.57	**221.65**
11	2001-02	191.45	59.30	**250.75**	183.17	55.00	**238.17**
12	2002-03	121.50	81.85	**203.35**	116.80	48.00	**164.85**
13	2003-04	107.10	84.49	**191.59**	107.61	70.00	**177.61**
14	2004-05	162.85	46.60	**209.45**	153.41	42.84	**196.25**
15	2005-06	174.50	59.85	**234.35**	171.20	57.30	**228.50**
16	2006-07	151.50	49.00	**200.50**	146.42	46.38	**192.80**
17	2007-08	156.53	79.96	**236.49**	156.16	76.17	**232.33**
18	2008-09	264.58	1479.39	**1743.97**	1743.97	1470.08	**1730.665**
19	2009-10	247.69	263.15	**510.84**	209.05	112.60	**321.65**
20	2010-11	458.44	384.56	**843.00**	416.41	315.27	**731.68**
21	2011-12	489.33	11159.56	**11648.89**	431.31	1775.89	**2207.20**
22	2012-13	555.35	244.50	**799.85**	506.34	191.84	**698.18**
23	2013-14	628.10	227.65	**855.75**	571.78	185.11	**756.90**
24	2014-15	600.21	254.03	**854.24**	500.89	191.10	**692.00**
25	2015-16	433.35	170.40	**603.75**	378.73	137.53	**516.27**
26	2016-17	764.97	465.11	**1230.08**	650.27	344.51	**994.78**
27	2017-18	832.78	336.34	**1169.12**	720.96	296.01	**1016.98**
28	2018-19	926.80	614.08	**1540.88**	771.32	341.07	**1112.40**
29	2019-20	1464.26	650.00	**2114.26**	950.63	450.60	**1401.24**
30	2020-21	1357.52	486.44	**1843.96**	928.37	332.23	**1260.60**

Source: Kanha Tiger Reserve (2021)

As per the Project Tiger guidelines (GOI), Kanha tiger reserve is constituted on a core – buffer strategy. Both the units have a separate complement of field staff and Deputy Directors, who are also Drawing & Disbursing Officers (DDO) for their respective conservation units. Though, the Phen wildlife sanctuary has a status of its own, it is administratively treated as a part of the core unit, and all the three units (core, buffer and Phen wildlife sanctuary) are under the administrative control of the tiger reserve management. The allocations under Project Tiger are utilized in all these units. Since Sectoral Integration is the underlying principle in the buffer zone management, allocations from various sectors complement the Project Tiger funding, which should be continued.

Table-96: Details of Budget Allocations from State Govt. Non-Plan (Core)

Sl. No.	Year	Allotment (Rs. in Lakh)	Expenditure (Rs. in Lakh)
1	2	3	4
1	1991-92	109.330	106.99
2	1992-93	108.050	108.450
3	1993-94	137.040	143.390
4	1994-95	136.610	145.840
5	1995-96	176.300	156.660
6	1996-97	221.80	199.79
7	1997-98	232.90	190.93
8	1998-99	181.67	197.68
9	1999-00	108.08	218.75
10	2000-01	214.65	213.61
11	2001-02	188.51	215.99
12	2002-03	312.86	265.83
13	2003-04	343.10	325.67
14	2004-05	268.89	266.13
15	2005-06	333.75	307.46
16	2006-07	342.87	342.47
17	2007-08	430.72	416.80
18	2008-09	501.47	487.62
19	2009-10	556.84	624.01
20	2010-11	838.11	800.48
21	2011-12	923.98	920.48
22	2012-13	1012.64	1009.56
23	2013-14	1297.53	1286.90
24	2014-15	1448.34	1433.36
25	2015-16	138819	1337.16
26	2016-17	3942.56	3680.52
27	2017-18	1663.32	1602.92
28	2018-19	1394.00	1391.20
29	2019-20	1632.57	1625.76
30	2020-21	1604.21	1604.51

Source: Kanha Tiger Reserve (2021)

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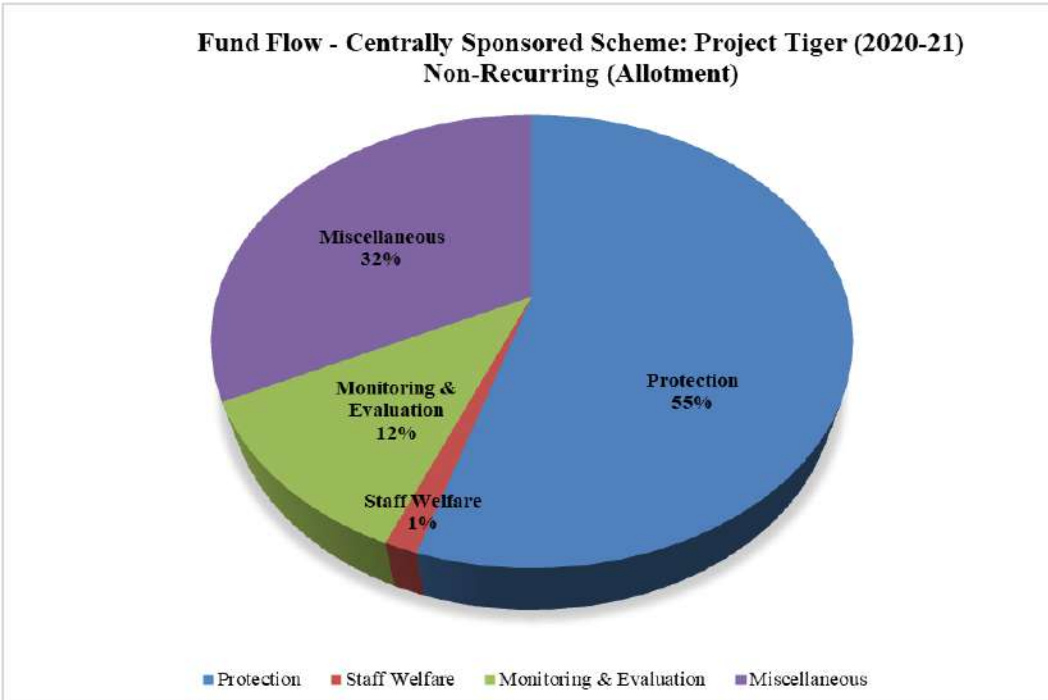
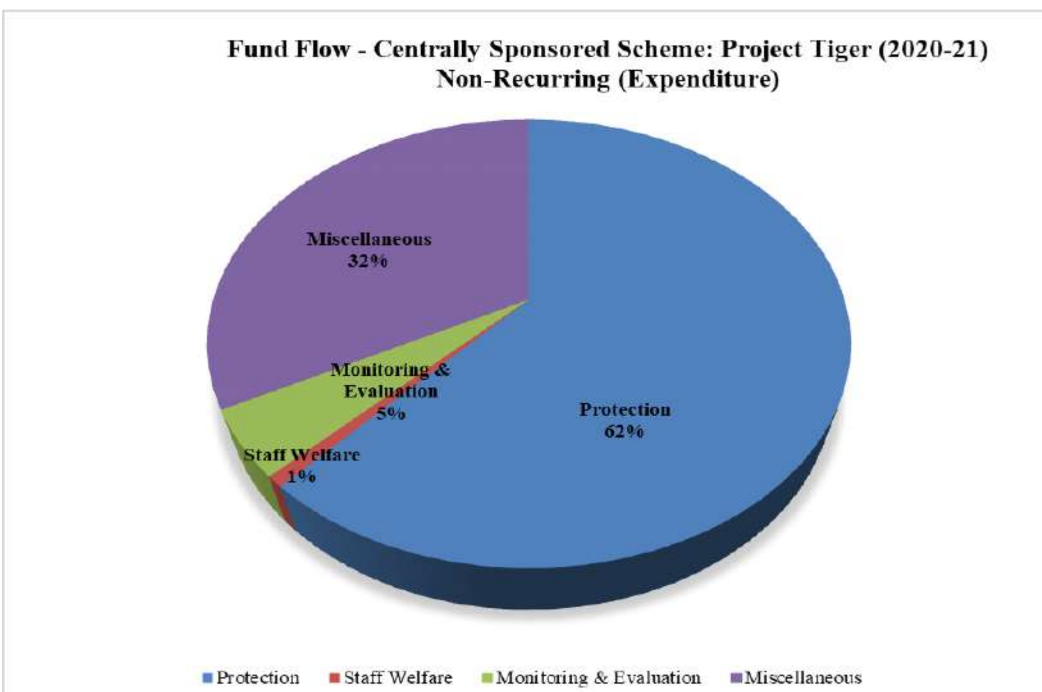
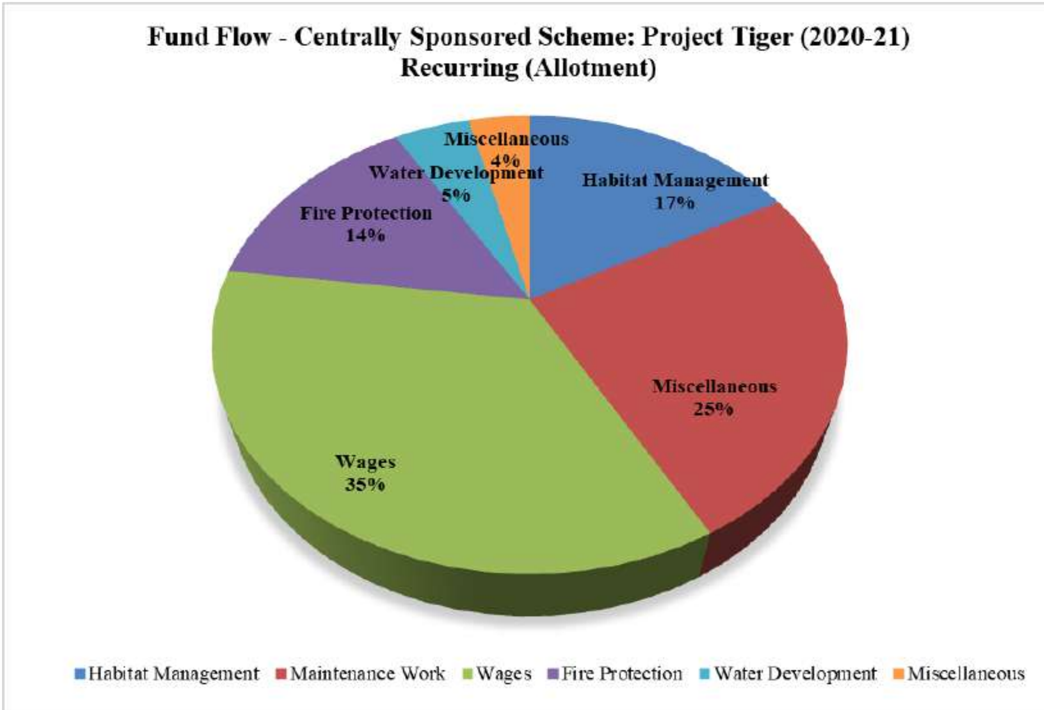
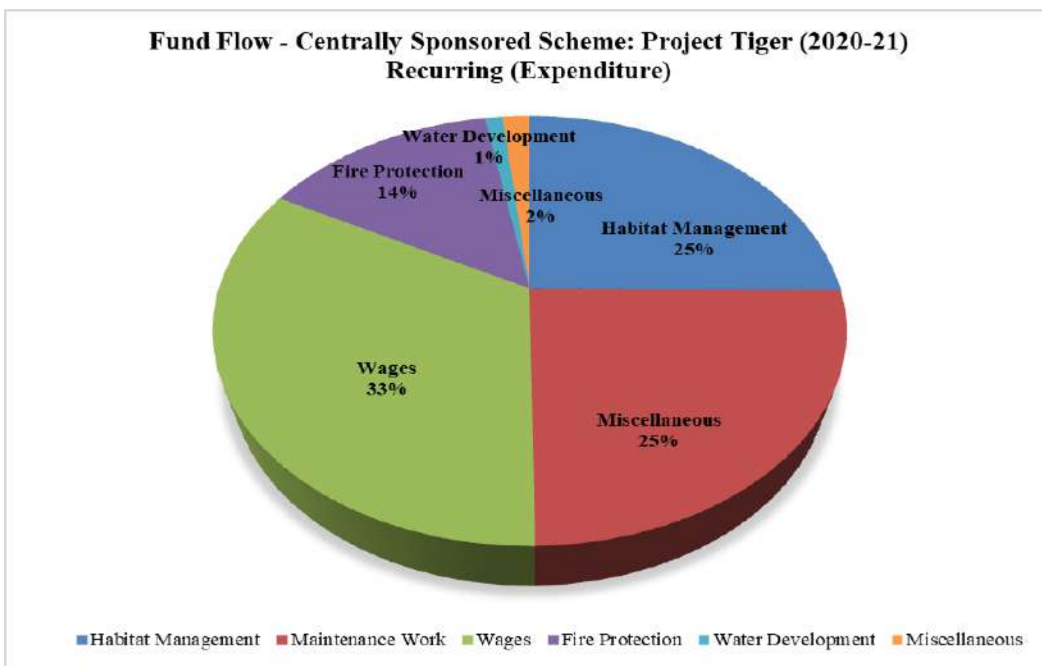
The typical patterns of expenditure are depicted below:






Fund Flow - Centrally Sponsored Scheme: Project Tiger (2020-21)
Recurring (Allotment)
Miscellaneous 4%
Water Development 5%
Fire Protection 14%
Habitat Management 17%
Miscellaneous 25%
Wages 35%
Habitat Management
Maintenance Work
Wages
Fire Protection
Water Development
Miscellaneous


Fund Flow - Centrally Sponsored Scheme: Project Tiger (2020-21)
Recurring (Expenditure)
Water Development 1%
Fire Protection 14%
Miscellaneous 2%
Habitat Management 25%
Wages 33%
Miscellaneous 25%
Habitat Management
Maintenance Work
Wages
Fire Protection
Water Development
Miscellaneous

The trend in funding under Project Tiger/ NTCA since inception is shown below:

Table-97: Fund Position Since Inception (Project Tiger), (Core Zone & Phen WLS)

Sl. No.	Year	Allotment (Rs. in Lakh)	Expenditure (Rs. in Lakh)
1	2	3	4
1	1972-73	-	-
2	1973-74	0.20	-
3	1974-75	4.00	3.51
4	1975-76	8.30	8.49
5	1976-77	13.53	11.49
6	1977-78	11.00	10.49
7	1978-79	16.00	14.15
8	1979-80	15.00	15.50
9	1980-81	14.00	15.66
10	1981-82	16.00	16.28
11	1982-83	17.00	15.07
12	1983-84	30.00	30.17
13	1984-85	30.00	25.98
14	1985-86	25.00	18.39
15	1986-87	25.00	24.99
16	1987-88	33.00	30.46
17	1988-89	24.00	28.97
18	1989-90	57.38	45.20
19	1990-91	64.81	45.62
20	1991-92	89.29	80.74
21	1992-93	96.51	107.83
22	1993-94	104.44	102.37
23	1994-95	107.67	105.02
24	1995-96	124.80	117.60
25	1996-97	126.75	112.70
26	1997-98	150.10	135.26
27	1998-99	143.60	139.97
28	1999-00	167.925	148.925
29	2000-01	272.95	221.65
30	2001-02	250.75	238.17
31	2002-03	203.35	164.85
32	2003-04	191.59	177.61
33	2004-05	209.45	196.25
34	2005-06	234.35	228.50

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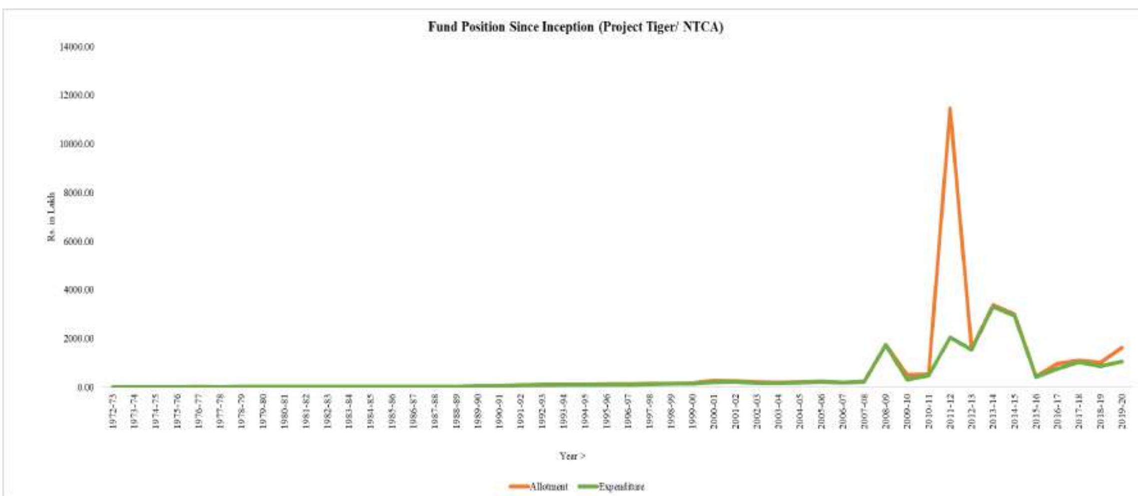
35	2006-07	200.50	192.80
36	2007-08	236.49	232.33
37	2008-09	1743.97	1730.665
38	2009-10	510.84	321.65
39	2010-11	538.03	488.53
40	2011-12	11452.27	2039.80
41	2012-13	1579.59	1536.16
42	2013-14	3386.65	3317.68
43	2014-15	3004.75	2930.19
44	2015-16	452.53	415.60
45	2016-17	979.29	770.03
46	2017-18	1108.81	1037.88
47	2018-19	1016.08	876.77
48	2019-20	1619.81	1059.39
49	2020-21	1843.96	1260.60

Source: Kanha Tiger Reserve (2021)



28.7 Funds from Kanha Vikas Nidhi:

The concept of the Kanha Vikas Nidhi has already been described in an earlier chapter. Part of the Vikas Nidhi is used every year for the development of tourism infrastructure, development of relocated forest villages and existing forest villages, and as support funds to various ecodevelopment committees of the tiger reserve. Besides, money from the Kanha Vikas Nidhi is also utilized in anticipation of regular allocations made by the Govt. of India, and the same is returned after allocations are received. The year-wise expenditure from the Vikas Nidhi is as under:

Table-98: Year-wise Expenditure from the Kanha Vikas Nidhi

Sl. No.	Tourism Year (16 Oct to 30 June)	Revenue from Vikas Nidhi (In Rs.)	Allotment (In Rs.)	Expenditure (In Rs.)			
				Tourism Infrastructure	Development Work	Support Funds to EDCs	Total
1	2	3	4	5	6	7	8
1	1995-96	836138.00	0.00	0.00	0.00	0.00	0.00
2	1996-97	1750035.00	0.00	0.00	0.00	0.00	0.00
3	1997-98	2086275.00	1246395.00	585005.00	0.00	0.00	585005.00
4	1998-99	1874494.00	884234.00	884161.00	0.00	0.00	884161.00
5	1999-00	4229597.00	5634852.00	2515534.00	1584874.00	0.00	4100408.00
6	2000-01	4585652.00	4391119.00	1986005.00	1031432.00	200000.00	3217437.00
7	2001-02	4483013.00	4642000.00	1069492.00	572508.00	3000000.00	4642000.00
8	2002-03	4394181.00	7080000.00	3183903.00	2820258.00	500000.00	6504161.00
9	2003-04	5866977.00	4779000.00	1314148.00	2038908.00	1220000.00	4573056.00
10	2004-05	13044322.00	3295000.00	512156.00	1254000.00	995000.00	2761156.00
11	2005-06	15964837.00	10515800.00	4893011.00	3655531.00	1665000.00	10213542.00
12	2006-07	23986592.00	27379686.00	12318789.00	12859159.00	1665000.00	26842948.00
13	2007-08	29165749.00	19481392.00	4560191.00	12740094.00	2080000.00	19380285.00
14	2008-09	29359134.00	26100985.00	9325373.00	11586847.00	4300000.00	25212220.00
15	2009-10	30505860.00	38819431.00	5739978.00	17019130.00	4335000.00	27094108.00
16	2010-11	50006266.00	35520424.00	9819404.00	14558850.00	6648700.00	31026954.00
17	2011-12	59850808.00	45183434.00	8743151.00	12915024.00	6648700.00	28306875.00
18	2012-13	44117280.00	50849210.00	14911307.00	16514274.00	10815000.00	42240581.00
19	2013-14	62109430.00	26612675.00	11486465.00	11684957.00	0.00	23171422.00
20	2014-15	65266880.00	122585342.00	14270622.00	65968081.00	11592000.00	91830703.00
21	2015-16	74591744.00	205013154.00	10585305.00	150706397.00	15477600.00	176769302.00
22	2016-17	62213737.00	127287737.00	23346566.00	42962574.00	20072882.00	86382022.00
23	2017-18	73553828.00	104567713.00	18678031.00	60872186.00	24500000.00	104050271.00
24	2018-19	79659568.00	183176301.00	10980929.00	133220264.00	24500000.00	168701193.00
25	2019-20	46600601.00	160661729.00	11213771.00	7927759.00	23510300.00	42651830.00
26	2020-21	63692800.00	96661011.00	23580529.00	51861276.00	11755150.00	87196955.00

Source: Kanha Tiger Reserve (2021)

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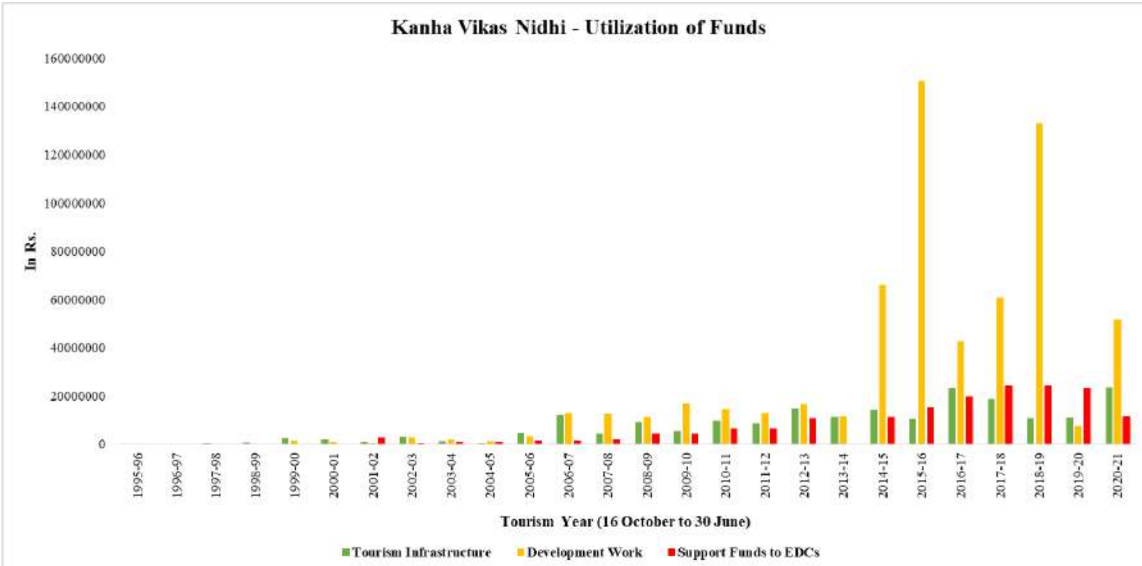

As per Forest Department, MP Govt. letter No. F-14-156/93/10-2 dated 23/04/2018, and under point No. 8 of the Code of Vikas Nidhi, the Kanha management is required to give 10% of the total revenue of received from tourism every year to the Madhya Pradesh Ecotourism Development Board, Bhopal (MPETDB). Besides, the Kanha management also submits to the Madhya Pradesh Ecotourism Development Board, Bhopal a proposal for the development of tourism infrastructure every year. Accordingly, the Board sanctions and releases the funds for this purpose. The Kanha management has so far transferred the following funds to the Board:

Table-99: Fund Transferred to the MPETDB

Sl. No.	Month of Transfer	10% Amount Transferred to MPETDB (In Rs.)
1	August, 2005 to March, 2006	1128115.00
2	April, 2006 to June, 2007	2867028.00
3	July, 07 to March, 2008	2102135.00
4	April, 2008 to June, 2008	814440.00
5	July, 2008 to March, 2009	1937397.00
6	April, 2009 to June, 2009	998516.00
7	July, 2009 to March, 2010	1880731.00
8	April, 2010 to December, 2010	2719197.00
9	January, 2011 to December, 2011	5401550.00
10	January, 2012 to August, 2012	4041169.00
11	September, 2012 to December, 2012	1080788.00

12	January, 2013 to August, 2013	3329723.00
13	September, 2013 to January, 2014	2432514.00
14	February, 2014 to June, 2014	3778429.00
15	July, 2014 to January, 2015	2813162.00
16	February, 2015 to August, 2015	3713526.00
17	September, 2015 to April, 2016	5557482.00
18	May, 2016 to September, 2016	1896299.00
19	October, 2016 to March, 2017	3800559.00
20	April, 2017 to August, 2017	2428899.00
21	September, 2017 to April, 2018	6355131.00
22	May, 2018 to September, 2018	2314554.00
23	October, 2018 to March, 2019	5060332.00
24	April, 2019 to September, 2019	1591321.00
25	October, 2019 to June, 2020	4505535.00
26	July, 2020 to July, 2021	6021991.00
	Total:	**80570523.00**

Source: Kanha Tiger Reserve (2021)

As per proposals submitted to the Madhya Pradesh Ecotourism Development Board, Bhopal for development of tourism infrastructures in the tiger reserve, the Kanha management has so far received the following yearly funds from the Board:

Table-100: Funds Received from the MPETDB

Sl. No.	Year	Particulars	Allotment (In Rs.)	Expenditure (In Rs.)	Balance Amount (In Rs.)
1	**2**	**3**	**4**	**5**	**6**
1	2010-11	-	-	-	-
2	2011-12	-	-	-	-
3	2012-13	Guide Training	876010.00	876010.00	0.00
		Total:	**876010.00**	**876010.00**	
4	2013-14	Workshop on Hotel/ Resort and Tour Operators	46437.00	46437.00	0.00
5	2013-14	Guide Training	715000.00	619984.00	95016.00
		Total:	**761437.00**	**666421.00**	
6	2014-15	Guide Training	414480.00	306719.00	107761.00
		Total:	**414480.00**	**306719.00**	
7	2015-16	Brochure (100 Nos.)	5390.00	5390.00	0.00
8	2015-16	Environment Training Centre at Sajalagan	1011000.00	991169.00	19831.00
9	2015-16	Uniform for Guides	321000.00	285322.00	35678.00
10	2015-16	Guide Training	444000.00	351919.00	92081.00
11	2015-16	Anubhuti Camp	60000.00	96375.00	-36375.00
		Total:	**1841390.00**	**1730175.00**	
12	2016-17	Furniture for Environment Training Centre at Sajalagan	594000.00	549759.00	44241.00
13	2016-17	Anubhuti Camp	166000.00	50279.00	115721.00
14	2016-17	Nature Education Camp	1925000.00	1884519.00	40481.00
15	2016-17	Construction of Pagoda at Khapa	360000.00	358575.00	1425.00

Kanha Tiger Reserve, Mandla (MP) 481 661, Phone: 07642-250760 (O), Fax: 07642-251266, Email: fdknp.mdl@mp.gov.in

		Total:	**3045000.00**	**2843132.00**	
16	2017-18	Construction of Tourism Road (23 km.) at Sijhora	2800000.00	2770298.00	29702.00
17	2017-18	Construction of Tourism Road (15 km.) at Sijhora	1715000.00	1547947.00	167053.00
18	2017-18	Guide Training	507000.00	486621.00	20379.00
19	2017-18	Anubhuti Camp	149600.00	85590.00	64010.00
		Total:	**5171600.00**	**4890456.00**	
20	2018-19	Nature Education Camp	727000.00	727000.00	0.00
21	2018-19	Guide Training in Satpura	180000.00	175000.00	5000.00
22	2018-19	Anubhuti Camp	446520.00	446046.00	474.00
23	2018-19	Uniform Tailoring for Guide	423000.00	423000.00	0.00
24	2018-19	Guide Training at Pench	340000.00	332248.00	7752.00
		Total:	**2116520.00**	**2103294.00**	
25	2019-20	Maintenance of Jungle Camp at Khatia	6684000.00	3498227.00	3185773.00
26	2019-20	Tourist Facility Centre at Mukki Entry Gate	3418000.00	3415143.00	2857.00
27	2019-20	Guide Training	300000.00	300000.00	0.00
28	2019-20	Guide Training	209000.00	209000.00	0.00
		Total:	**10611000.00**	**7422370.00**	
29	2020-21	Guide Training	300000.00	298628.00	1372.00
30	2020-21	Purchase of Furniture for Mukki Entry Gate	140000.00	34755.00	105245.00
31	2020-21	Purchase of Furniture for Khatia Entry Gate	110000.00	0.00	110000.00
32	2020-21	Guide Training Satpura TR	428000.00	404416.00	23584.00
		Total:	**978000.00**	**737799.00**	

Source: Kanha Tiger Reserve (2021)

28.8 Fund Raising Strategies:

Well-maintained and well-managed wildlife protected areas such as the core zone need adequate funds on a regular basis. While there are assured regular financial allocations from the State and Central governments, the Kanha management does require additional allocations in several inadequately funded budgetary heads. The development of the frontline staff of the core zone is one such head that requires more financial support. Naturally, under these circumstances, the Kanha management should welcome funds received from non-governmental individuals/ non-governmental organizations.

NGOs (non-governmental organizations) play a very important role in nature conservation. In the current scenario, when scientific/ technical information, people’s participation, enabling, expertise advocacy, and vigilance are vitally important for success in conservation, the role of NGOs becomes all the more crucial. Each NGO has its own mandate, expertise and functioning, and the Kanha management has been fortunate in receiving wholehearted support from such organizations working in this field. WWF-India, Wildlife Conservation Trust, Wildlife Trust of India, Royal Bank of Scotland, Adit Jain Foundation, Foundation for Ecological Security, PRATHAM, Satpura Foundation and a host of others have always been supportive in their own ways. Some of these are of extremely long-standing reputation, with prodigious expertise in supporting conservation in protected areas. These organizations have always been forthcoming in providing a vast range of support package required for staff care, protection, infrastructure, and field studies etc. in and around the tiger reserve.

The Kanha management should appraise such agencies/ organizations on the conservation efforts in the protected area over all these years and the problems of frontline staff, it should also be made clear to them that donations/ support will in no way be allowed to dictate/ change the existing conservation policies of the government. The Kanha management should also ensure that these donations/ support are not received directly and should come through the Madhya Pradesh Tiger Foundation Society, Bhopal. The information on funds/ support received from various agencies in the last several years is as under:

Table-101: Funds/ Support Received from Various Agencies

Sl. No.	Date of Donation	Name of Donor/ Institution	Cash Received (In Rs.)	Name of Items	Qty.	Cost (In Rs.)	Objective of Donation	Exp. (In Rs.)
1	2	3	4	5	6	7	8	9
Year: 2010-11								
1	01/06/2010	WCT, Mumbai	0.00	Motor Cycle	15	633698.95	Patrolling Camp	0.00
2	01/06/2010	Mr. Hector D'Souza, Mumbai	0.00	Solar Lamp	4	0.00	Patrolling Camp	0.00
3	01/07/2010	WTI, New Delhi	0.00	Winter Jacket, Haversack, Water Bottle, Cap and Torch	-	0.00	Patrolling Staff	0.00
4	01/07/2010	Celebration Resort, Mocha	0.00	Ration (Rice-40 qtl., Pigeon pea-400 kg. and Salt-200 kg.)	4600 kg.	87400.00	Patrolling Staff	0.00
5	10/08/2010	Celebration Resort, Mocha	0.00	Ration (Rice-40 qtl., Pigeon pea-400 kg. and Salt-200 kg.)	4600 kg.	87400.00	Patrolling Staff	0.00
6	16/09/2010	Celebration Resort, Mocha	0.00	Ration (Rice-40 qtl., Pigeon pea-400 kg. and Salt-200 kg.)	4600 kg.	87400.00	Patrolling Staff	0.00
7	12/12/2010	WCT, Mumbai	0.00	LPG Gas Connection	10	0	Patrolling Camp	0.00
8	12/12/2010	WCT, Mumbai	0.00	Cycle	350	960750.00	Patrolling Camp	0.00

9	12/12/2010	WCT, Mumbai	0.00	Winter Jacket	750	352500.00	Staff	0.00
		Total:	**0.00**			**2208748.95**		**0.00**
Year: 2011-12								
1	01/04/2011	Dr. PV Subramanian, Mumbai	0.00	Solar Lamp	20	0.00	Patrolling Camp	0.00
2	09/05/2011	WWF-India	0.00	Solar Home Light	20	0.00	Patrolling Camp	0.00
3	07/06/2011	WCT, Mumbai	0.00	Motor Cycle	6	0.00	Patrolling Camp	0.00
4	07/06/2011	WCT, Mumbai	0.00	Rescue Kit (Trap-1 and Bag-1)	2	0.00	Rescue Squad	0.00
5	08/07/2011	WCT, Mumbai	0.00	Bolero Camper	2	0.00	Patrolling	0.00
6	15/07/2011	Celebration Resort, Mocha	0.00	Ration (Rice)	4048 kg.	0.00	Patrolling Staff	0.00
7	02/08/2011	WWF-India	0.00	Gumboot	800	0.00	Patrolling Staff	0.00
8	12/08/2011	Celebration Resort, Mocha	0.00	Ration (Rice)	4048 kg.	0.00	Patrolling Staff	0.00
9	15/09/2011	Celebration Resort, Mocha	0.00	Ration (Rice)	4048 kg.	0.00	Patrolling Staff	0.00
		Total:	**0.00**			**0.00**		**0.00**
Year: 2012-13								
1	02/04/2012	WWF-India	0.00	Solar Energy System with Panel	20	0.00	Patrolling Camp	0.00
2	02/04/2012	WCT, Mumbai	0.00	Wireless Handset	30	157500.00	Wireless Network	0.00
3	17/05/2012	WCT, Mumbai	0.00	Bolero Camper	1	0.00	Patrolling	0.00
4	05/08/2012	SBI, Mandla	0.00	Solar Home Light	100	0.00	Patrolling Camp	0.00
5	09/09/2012	WWF-India	0.00	School Vehicle	1	0.00	Staff Students	0.00
6	09/09/2012	WWF-India	0.00	Water Filter	50	0.00	Patrolling Camp	0.00
7	09/09/2012	WWF-India	0.00	Shocks	550	0.00	Patrolling Staff	0.00
8	12/09/2012	WCT, Mumbai	0.00	Rapid Response Unit Kit	1	0.00	Wildlife Rescue	0.00
9	21/09/2012	Celebration Resort, Mocha	0.00	Ration Packet (Rice-20 kg., Pigeon pea-2 kg. and Salt-1 kg.)	180	0.00	Patrolling Camp	0.00
10	12/10/2012	Celebration Resort, Mocha	0.00	Ration Packet (Rice-20 kg., Pigeon pea-2 kg. and Salt-1 kg.)	50	0.00	Patrolling Camp	0.00
11	05/03/2013	WCT, Mumbai	0.00	Table-180 and Chair-720	900	489603.00	Patrolling Camp	0.00
12	05/03/2013	WTI, New Delhi	0.00	Winter Jacket	235	118886.00	Trainees FG	0.00
13	10/03/2013	WWF-India	0.00	Winter Jacket	1015	0.00	Staff	0.00
		Total:	**0.00**			**765989.00**		**0.00**
Year: 2013-14								
1	06/07/2013	WCT, Mumbai	0.00	Cycle	10	31900.00	Patrolling Staff	0.00
2	06/07/2013	WCT, Mumbai	0.00	Solar Integrated System	175	1575000.00	Patrolling Staff	0.00
3	06/07/2013	WCT, Mumbai	0.00	Digital Camera	180	693000.00	Patrolling Staff	0.00
4	06/07/2013	WCT, Mumbai	0.00	Mosquito Net	360	94680.00	Patrolling Staff	0.00
5	06/07/2013	WCT, Mumbai	0.00	First-aid-Box	180	73800.00	Patrolling Staff	0.00
6	06/07/2013	WCT, Mumbai	0.00	Water Bottle	360	499680.00	Patrolling Staff	0.00
7	06/07/2013	WCT, Mumbai	0.00	Torch	360	597600.00	Patrolling Staff	0.00
8	06/07/2013	WCT, Mumbai	0.00	Bag	360	166680.00	Patrolling Staff	0.00
9	06/07/2013	WCT, Mumbai	0.00	Shoe	360	228960.00	Patrolling Staff	0.00
10	06/07/2013	WCT, Mumbai	0.00	Rain Coat	360	249480.00	Patrolling Staff	0.00
11	06/07/2013	WCT, Mumbai	0.00	Mat	360	112680.00	Patrolling Staff	0.00
12	06/07/2013	WCT, Mumbai	0.00	Cot	180	0.00	Patrolling Staff	0.00
13	06/07/2013	WCT, Mumbai	0.00	Syntax Water Tank	100	0.00	Patrolling Staff	0.00
14	06/07/2013	WCT, Mumbai	0.00	Table	180	0.00	Patrolling Staff	0.00
15	06/07/2013	WCT, Mumbai	0.00	Chair	720	0.00	Patrolling Staff	0.00
16	06/07/2013	WCT, Mumbai	0.00	Jacket	360	0.00	Patrolling Staff	0.00
17	06/07/2013	WCT, Mumbai	0.00	Monkey Cap, Hand Gloves and Socks	360	0.00	Patrolling Staff	0.00
18	06/07/2013	WCT, Mumbai	0.00	Blanket	360	0.00	Patrolling Staff	0.00
19	21/07/2013	WWF-India	0.00	Camera Trap	50	700000.00	Patrolling Staff	0.00
20	07/08/2013	Celebration Resort, Mocha	0.00	Ration Packet (Rice-20 kg., Pigeon pea-2 kg. and Salt-1 kg.)	180	0.00	Patrolling Camp	0.00
21	03/08/2013	Celebration Resort, Mocha	0.00	Ration Packet (Rice-20 kg., Pigeon pea-2 kg. and Salt-1 kg.)	180	0.00	Patrolling Camp	0.00
22	02/10/2013	WWF-India	0.00	Binocular	20	0.00	Patrolling Camp	0.00

23	02/10/2013	WWF-India	0.00	Still Camera Panasonic	3	0.00	Patrolling Camp	0.00
24	02/10/2013	WWF-India	0.00	Torch	10	0.00	Patrolling Camp	0.00
25	02/10/2013	WWF-India	0.00	Jacket	10	0.00	Patrolling Camp	0.00
26	02/10/2013	WWF-India	0.00	Tent	5	0.00	Patrolling Camp	0.00
27	02/10/2013	WWF-India	0.00	Sleeping Bag	10	0.00	Patrolling Camp	0.00
28	02/10/2013	WWF-India	0.00	Rain Coat	10	0.00	Patrolling Camp	0.00
29	02/10/2013	WWF-India	0.00	Helmet	10	0.00	Patrolling Camp	0.00
30	02/10/2013	WWF-India	0.00	Shoes	10	0.00	Patrolling Camp	0.00
31	02/10/2013	WWF-India	0.00	Dinner Set (10 people)	1	0.00	Patrolling Camp	0.00
32	02/10/2013	WWF-India	0.00	Dress, Belt, Socks and Cap	10	0.00	Patrolling Camp	0.00
33	15/01/2014	Mr. Hemendra D'Souza	0.00	BPL Solar Lantern	20	0.00	Patrolling Camp	0.00
		Total:	**0.00**			**5023460.00**		**0.00**
Year: 2014-15								
1	30/05/2014	Shri RK Kshatri, Incharge, Environment Club, Mandla	1000.00				TFS	0.00
2	18/07/2014	WWF-India		Bolero (Model - XL)	1	639457.00	Patrolling	
3	16/07/2014	WWF-India		Tractor with Trolley	1	745000.00	Patrolling	
4	21/08/2014	WWF-India		Vehicle - Mahindra Thar	1	537395.00	Patrolling	
5	25/08/2014	WWF-India		Solar Pumping System	1	330791	Drinking water	
6	28/08/2014	WWF-India		Night Vision Device	2	652500	Patrolling	
7	23/11/2014	WWF-India		Vehicle - Tata Cruiser	1	635000.00	School Student	
8	27/11/2014	WCT, Mumbai		Bolero Camper	1	541507.00	Patrolling	
9	23/11/2014	WWF-India		Solar Head Light	25		Patrolling	
10	23/11/2014	WWF-India		Cage	1	251900.00	Rescue	
11	23/12/2014	WCT, Mumbai	54151.00	Bolero Camper (Entry Tax)			Patrolling	0.00
12	02/11/2015	WCT, Mumbai	1124235.00	Medical Insurance			Staff	1124235.00
13	16/02/2015	Shri Ravi Pratap Singh	10000.00				TFS	0.00
		Total:	**1189386.00**			**3350259.00**		**1124235.00**
Year: 2015-16								
1	20/08/2015	WWF-India	0.00	Bolero Camper	1	599074.00	Patrolling	
2	28/08/2015	Cab Canar	5000.00				TFS	0.00
3	04/09/2015	Gagan Narang, Gun for Glory		Bicycles	5	15750.00	Patrolling	
4	15/03/2016	WWF-India	0.00	Tractor	1	550000.00	Patrolling	
5	15/03/2016	WWF-India	0.00	Trolley	1	135000.00	Patrolling	
		Total:	**5000.00**			**1299824.00**		**0.00**
Year: 2016-17								
1	01/01/2017	Gypsy Association, Kanha	387380.00				TFS	
2	01/02/2017	Singhinawa Foundation	125000.00				Nature & Eco-Anubhuti Camp	124970.00
3	03/02/2017	WWF-India	0.00	Force Vehicle	2	1350000.00	Nature & Eco-Anubhuti Camp	
4	16/03/2017	Dr. Sachin Waze, Pune	0.00	Laptop	1	0.00	Nature & Eco-Anubhuti Camp	
5	16/03/2017	Dr. Sachin Waze, Pune	0.00	Desktop	1	0.00	Nature & Eco-Anubhuti Camp	
6	16/03/2017	Dr. Sachin Waze, Pune	0.00	Printer	1	0.00	Nature & Eco-Anubhuti Camp	
7	16/03/2017	Dr. Sachin Waze, Pune	0.00	DVD Player	1	0.00	Nature & Eco-Anubhuti Camp	
8	16/03/2017	Dr. Sachin Waze, Pune	0.00	LED TV	1	0.00	Nature & Eco-Anubhuti Camp	
9	11/04/2016	Wildlife Conservation Trust	0.00	Blanket	130	51350.00	Patrolling	
10	07/06/2016	WWF-India	0.00	Box	25	0.00	Patrolling	
11	07/06/2016	WWF-India	0.00	Steel Tank	20	0.00	Patrolling	
12	07/06/2016	WWF-India	0.00	Water Trough	30	0.00	Patrolling	
13	07/06/2016	WWF-India	0.00	Food Container	5	0.00	Patrolling	
14	07/06/2016	WWF-India	0.00	Cooking Equipment (Kadai)	10	0.00	Patrolling	
15	07/06/2016	WWF-India	0.00	Cooking Equipment (Jhara)	2	0.00	Patrolling	
16	07/06/2016	WWF-India	0.00	Spoon (Small and Big)	68	0.00	Patrolling	
17	07/06/2016	WWF-India	0.00	Bucket	10	0.00	Patrolling	
18	07/06/2016	WWF-India	0.00	Katori	100	0.00	Patrolling	
19	07/06/2016	WWF-India	0.00	Steel Cup	50	0.00	Patrolling	
20	07/06/2016	WWF-India	0.00	Steel Mug	60	0.00	Patrolling	

21	07/06/2016	WWF-India	0.00	Plate (Small and Big)	100	0.00	Patrolling	
22	07/06/2016	WWF-India	0.00	Dress Cloths	150	0.00	Patrolling	
23	12/06/2016	Wildlife Conservation Trust	0.00	Box (size: 3x6)	65	466830.00	Patrolling	
24	22/07/2016	Wildlife Conservation Trust	280000.00	Incentive for Award			Incentive for Award	285000.00
25	15/07/2016	The Corbett Foundation	0.00	Solar Light System	155	320075.00	Patrolling	
26	15/07/2016	The Corbett Foundation	0.00	Solar Lantern	155	88807.00	Patrolling	
27	21/07/2016	Wildlife Conservation Trust	0.00	Pure-It Water Filter	100	285000.00	Patrolling	
28	15/10/2016	WWF-India	0.00	Gumboot	884	288184.00	Patrolling	
29	29/10/2016	Wildlife Conservation Trust	0.00	Hunter Shoes	130	59763.00	Patrolling	
30	29/10/2016	Wildlife Conservation Trust	0.00	Gumboot	130	57914.00	Patrolling	
31	29/10/2016	Wildlife Conservation Trust	0.00	Water Bottle	130	12075.00	Patrolling	
32	29/10/2016	Wildlife Conservation Trust	0.00	Hand Gloves	130	36351.00	Patrolling	
33	29/10/2016	Wildlife Conservation Trust	0.00	Winter Socks	130	16635.00	Patrolling	
34	29/10/2016	Wildlife Conservation Trust	0.00	Raincoat	130	131848.00	Patrolling	
35	29/10/2016	Wildlife Conservation Trust	0.00	Carry mat	130	28341.00	Patrolling	
36	29/10/2016	Wildlife Conservation Trust	0.00	Cap	130	19716.00	Patrolling	
37	15/11/2016	WWF-India	0.00	Binocular (big)	1	0.00	Patrolling	
38	15/11/2016	WWF-India	0.00	Binocular (small)	4	0.00	Patrolling	
39	23/11/2016	Film Production Unit, Mumbai	75000.00	0	0	0.00		0.00
40	26/12/2016	Singhinawa Foundation	0.00	Blanket	400	0.00	Patrolling	
		Total:	**867380.00**			**3212889.00**		**409970.00**
Year: 2017-18								
1	30/06/2017	Gypsy Association	220880.00	Skill Development			Skill Development	
2	18/07/2017	WCT, Mumbai	150000.00	Incentive for Staff			Staff Welfare	150000.00
3	19/07/2017	Singinawa Conservation Foundation	675000.00	Play School & Study Center			Play School & Study Center	
4	25/07/2017	WWF-India	0.00	Binocular	6		Patrolling	
5	29/07/2017	WWF-India	0.00	Mosquito Net	300		Staff Welfare	
6	30/07/2017	WCT, Mumbai	0.00	Raincoat	548		Staff Welfare	
7	24/07/2017	WCT, Mumbai	0.00	Chair	328		Patrolling Camp	
8	24/07/2017	WCT, Mumbai	0.00	Table	65		Patrolling Camp	
9	30/08/2017	The Corbett Foundation	0.00	Steel Box	27		Elephant Camp	
10	30/08/2017	The Corbett Foundation	0.00	Cot	27		Elephant Camp	
11	24/10/2017	WCT, Mumbai	0.00	Shoes	394	208820.00	Staff	-
12	24/10/2017	WCT, Mumbai	0.00	Backpack	394	230336.00	Staff	-
13	24/10/2017	WCT, Mumbai	0.00	Winter Jacket	558	694685.00	Staff	-
14	24/10/2017	WCT, Mumbai	0.00	Cycle	279		Staff	-
15	31/10/2017	WWF-India	0.00	Scorpio Vehicle	1	948422.00	Patrolling	
16	13/11/2017	Singinawa Conservation Foundation	45000.00	-	-		Play School & Study Center	45000.00
17	13/11/2017	Mr. Ramakant Pandya, Mumbai	300000.00	-	-		Staff Welfare	242589.00
18	13/11/2017	Other Source	20000.00	-	-		Staff Welfare	
19	14/11/2017	Meditrina Medical Science, Nagpur	0.00	Ambulance	1		Staff Welfare	-
20	01/03/2018	Mukki Dispensary	31870.00	-	-	-	Mukki Dispensary	1800.00
21	27/02/2018	WWF-India		Bolero Camper Vehicle	1	-	Patrolling	-
22	27/02/2018	WCT, Mumbai		Bolero Camper Vehicle	1	-	Patrolling	-
23	31/03/2018	Revenue from Souvenir (Lapel Pin)	142500.00	-	-	-	Staff Welfare	
		Total:	**1585250.00**			**1133841.00**		**439389.00**

Year: 2018-19								
1	11/05/2018	Kanha Jungle Lodge, Manjitola	-	Sport Materials	15	11128.00	Play School & Study Center	-
2	04/07/2018	Mr. Dhaniram & 23 Others	-	School Books (240), Copy (160), Drawing Copy (25), Chart (8) and Scrap Book (40)	473	47505.00	Play School & Study Center	-
3	04/07/2018	Mr. Budh Singh Pandre & 8 Others	-	School Dress	30	18020.00	Play School & Study Center	-
4	06/07/2018	Kanha Jungle Lodge, Manjitola	-	School Dress	40	20000.00	Play School & Study Center	-
5	06/07/2018	Kanha Gypsy Association	-	School Dress	50	30000.00	Play School & Study Center	-
6	06/07/2018	Singinawa Conservation Foundation	-	Water Cooler	1	15600.00	Play School & Study Center	-
7	06/07/2018	Singinawa Conservation Foundation	-	Desk Bench	35	52750.00	Play School & Study Center	-
8	06/07/2018	Singinawa Conservation Foundation	-	Lunch Box	60	12000.00	Play School & Study Center	-
9	06/07/2018	Singinawa Conservation Foundation	-	Water Bottle	60	32400.00	Play School & Study Center	-
10	06/07/2018	Singinawa Conservation Foundation	-	Compass Box	60	7200.00	Play School & Study Center	-
11	06/07/2018	Singinawa Conservation Foundation	-	School Bag	100	23600.00	Play School & Study Center	-
12	11/07/2018	Last Wilderness Foundation	666000.00	-	-	-	Play School & Study Center	-
13	20/09/2018	WWF-India	-	Gypsy-King	1	-	Patrolling	-
14	28/10/2018	WCT, Mumbai	-	Bolero Camper	1	-	Patrolling	-
15	28/10/2018	WCT, Mumbai	-	Bolero Camper	1	-	Patrolling	-
16	15/11/2018	Corbett Foundation	-	Water Filter	50	-	Patrolling Camp	-
17	29/11/2018	Mr. Bijal Shah	75000.00	-	-	-	Play School & Study Center	-
18	29/11/2018	Mr. Kantilal Manilal Charitable Trust	100000.00	-	-	-	Play School & Study Center	-
19	16/02/2019	WWF-India		Bolero-ZLX Vehicle	1	838428.00	Patrolling	-
20	16/02/2019	WWF-India		Bolero-ZLX Vehicle	1	838428.00	Patrolling	-
21	20/02/2019	WWF-India		Solar Pumping System	2		Water Supply	-
22	26/02/2019	WWF-India		Bolero Ambulance	1	726550.00	Staff Welfare	-
23	26/02/2019	WWF-India		Bolero-ZLX Vehicle	1	-	Patrolling	-
24	15/03/2019	Mr. Iskandar Laljee	250000.00	-	-	-	Play School & Study Center	-
25	17/03/2019	Singinawa Conservation Foundation	-	Musical Materials, Projector with HDMI Cable and I Pod	2	111123.00	Play School & Study Center	-
26	25/03/2019	Hon'ble Governor, MP	25000.00	-	-	-	Play School & Study Center	-
27	28/03/2019	Mr. Vipul Gupta	500000.00	-	-	-	Play School & Study Center	500000.00
		Total:	**1766000.00**			**2784732.00**		**1191000.00**
Year: 2019-20								
1	05/04/2019	The Baagh Resort	-	Water Cooler	1	6500.00	Play School & Study Center	-
2	17/05/2019	Singinawa Foundation	-	Solar System (1 KV)	2	200000.00	Patrolling Camp	-
3	09/05/2019	Singinawa Foundation	-	School Bus	1	1268500.00	Play School & Study Center	-
4	08/07/2019	Mr. Ramakant Pandya, Mumbai	-	Ration Packet for 3 Months (Rice, Pigeon pea and Salt)	620	0.00	Patrolling Camp	-
5	21/10/2020	Singinawa Foundation	-	Laptop	1	34900.00	Play School & Study Center	-
6	21/10/2020	Singinawa Foundation	-	Projector Wall Hang Screen	1	4999.00	Play School & Study Center	-
7	21/10/2020	Singinawa Foundation	-	UHD TV	1	70990.00	Play School & Study Center	-
8	21/10/2020	Singinawa Foundation	-	Sound Box	1	7999.00	Play School & Study Center	-
9	05/01/2020	Kantilal Manilal	500000.00	-	-	0.00	Play School &	-

		Charitable Trust					Study Center	
10	01/01/2020	Adinath Enterprises	13000.00	-	-	0.00	Play School & Study Center	-
11	01/01/2020	Singinawa Foundation	0.00	Fire Extinguishers	8	8000.00	Play School & Study Center	-
12	10/02/2020	Singinawa Foundation	-	Book Self	1	16000.00	Play School & Study Center	-
13	10/02/2020	Singinawa Foundation	-	Almirah	1	7500.00	Play School & Study Center	-
14	18/03/2020	Mr. Sharad Vats	100000.00	-	-	0.00	Play School & Study Center	-
15	18/03/2020	Mr. Sharad Vats	200000.00	-	-	0.00	Play School & Study Center	-
16	18/03/2020	Mr. Islamdar Laljee	250000.00	-	-	0.00	Play School & Study Center	-
		Total:	**1063000.00**			**1625388.00**		**0.00**
Year: 2020-21								
1	23/04/2020	MPTFS	100000.00	-	-	0.00	Food distribution for employees	-
2	27/04/2020	MPTFS	50000.00	-	-	0.00	Food distribution for employees	-
3	29/04/2020	MPTFS	105000.00	-	-	0.00	Food distribution for employees	-
4	23/04/2020	MPTFS	700000.00	-	-	0.00	Kraal for wild elephant	-
5	27/05/2020	MPTFS	1000000.00	-	-	0.00	Relief enclosure	-
6	27/05/2020	MPTFS	1000000.00	-	-	0.00	Purchase of Solar System	-
7	05/05/2020	MPTFS	20000.00	-	-	0.00	Food distribution for employees	-
8	30/06/2020	Mr. Vrit Pal Singh	25000.00	-	-	0.00	Play School & Study Centre	-
9	24/09/2020	MPTFS	25000.00	-	-	0.00	Food distribution for employees	-
10	17/08/2020	MPTFS	5000.00	-	-	0.00	Audit Fee	-
11	07/10/2020	MPTFS	165000.00	-	-	0.00	Tiger Rescue	-
12	07/10/2020	MPTFS	204000.00	-	-	0.00	Other expenditure	-
13	23/11/2020	MPTFS	640000.00	-	-	0.00	Rescue Workshop	-
14	14/01/2021	MPTFS	24000.00	-	-	0.00	Food distribution for employees	-
15	18/01/2021	M/s Pushpavati Kantilal Charitable Trust, Ahmedabad	500000.00	-	-	0.00	Play School & Study Centre	-
16	18/01/2021	Capt. Atul Samvatsar, Mumbai	49000.00	Laptop	1	35000.00	Play School & Study Centre	-
17	19/03/2021	M/s Earth Brigade Foundation	-	3 Solar Pump System and 4 Pump Repairing	3	350000.00	Patrolling camps	-
		Total:	**4612000.00**	**-**	**4**	**385000.00**	**-**	**-**

Source: Kanha Tiger Reserve (2021)

28.9 Proposed Plan Works:

The Kanha management should raise its physical as well as financial requirement every financial year on the basis of the objective needs of range-wise development works. These budgetary requirements should be raised in the APOs and special projects deemed necessary for the development of core zone with special reference to habitat management, barasingha conservation, ecotourism management and village development etc. The budgetary requirements, however, are not limited to only these items/ practices, but would also cover the entire gamut of conservation programmes and management practices for the core zone. As in the past, budgetary requirements are left to the discretion of the Field Director and senior officers visiting the tiger reserve from time to time. Tentative budget requirements only for grassland management and barasingha conservation are, however, proposed as under. The detailed information on the proposed range-wise grassland amelioration works is appended **(Appendix-73).**

Table-102: Tentative Budget Requirement for Grassland Management

Proposed Work	Financial Year									
	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31
	Proposed Amount (Rs. in Lakhs)									
2	3	4	5	6	7	8	9	10	11	12
Lantana Eradication	58.18	59.52	46.02	49.28	31.30	39.10	34.56	28.93	24.77	31.62
Weed Eradication	62.63	49.59	44.90	34.12	53.02	45.47	50.26	37.20	36.47	33.38
Brushwood Eradication	72.19	71.61	77.51	57.61	59.79	40.49	51.76	32.44	37.49	30.76
Amelioration/ Restocking of Meadows (grass enclosure & harrowing)	98.00	9.00	9.00	42.00	12.00	12.00	51.00	18.00	18.00	48.00
Sorghum Eradication	0.00	30.82	26.68	18.13	10.88	14.25	5.18	2.59	3.37	3.89
Removal of Non-Palatable Grasses and Seed Sowing	1.95	8.55	3.75	5.25	4.50	2.25	3.75	1.50	3.00	0.00
Lantana Mopping 1st Year	0.00	69.99	71.61	55.36	59.29	37.65	47.05	41.58	34.80	29.80
Lantana Mopping 2nd Year	0.00	0.00	69.99	71.61	55.36	59.29	37.65	47.05	41.58	34.80

Source: Kanha Tiger Reserve (2021)

Table-103: Tentative Budget Requirement for Barasingha Habitat Management

Proposed Work	Financial Year									
	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31
	Proposed Amount (Rs. in Lakhs)									
2	3	4	5	6	7	8	9	10	11	12
Lantana Eradication	11.52	13.76	18.56	17.60	18.24	18.88	19.52	19.52	19.52	19.52
Weed Eradication	1.55	15.54	15.54	15.54	15.54	17.22	17.64	17.64	17.64	17.64

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Brushwood Eradication	23.00	24.15	25.30	25.30	26.45	31.05	31.05	35.65	36.80	36.80
Lantana Mopping 1st Year	0.00	13.86	16.56	22.33	21.18	21.95	22.72	23.49	23.49	23.49
Lantana Mopping 2nd Year	0.00	0.00	13.86	16.56	22.33	21.18	21.95	22.72	23.49	23.49

Source: Kanha Tiger Reserve (2021)

28.10 Activity Budget:

The Kanha management has to undertake a wide range of conservation practices/ activities in the protected area throughout the year. Needless to add, these activities/ interventions have to be got approved on the basis of the APO submitted to the State Govt. and the National Tiger Conservation Authority, New Delhi. Each conservation practice/ intervention has to be taken up in a certain month (s) of the financial year. An indicative time plan of all major activities/ interventions in the core zone under non-recurring (all new interventions) and recurring (pay & allowances, maintenance/ repair etc.) budget heads is as under:

Table-104: Prescribed Format of Annual Plan of Operations

Sl. No.	Particulars	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
	NON-RECURRING												
	Water Resource Development:												
1	Construction of Tanks								✓	✓	✓	✓	
2	Construction of Saucer											✓	✓
3	Deepening of Tank/ Well/ Jhiria/Anicut											✓	✓
4	Construction of Stop Dams								✓	✓	✓	✓	
5	Construction of Anicut-cum-Bridge											✓	✓
6	Spl. Repair of Anicuts											✓	✓
7	Construction of Stop Dam-cum-Bridge								✓	✓	✓	✓	
	Protection Infrastructure:												
8	Construction of Patrolling Camps/ FG Naka								✓	✓	✓	✓	
9	Construction of Residential Qtrs.								✓	✓	✓	✓	
10	Paint & Mosquito wire-mesh for Doors, Windows, Ventilators & Grill of FG Nakas/ RA Qtrs./ RO Qtrs./ ACF Qtrs./Tiger Cell Buildings							✓	✓				
11	Other Construction Works								✓	✓	✓	✓	
12	Special Repair Work of Old Buildings								✓	✓	✓	✓	
13	Construction of Checking Barriers-cum-Labour Hut								✓	✓	✓	✓	
14	Upgradation/ Repair of Roads							✓	✓	✓			

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15	Construction of Culverts							✓	✓	✓			
16	Construction of Rapta							✓	✓	✓			
17	Purchase/ Maintenance/Creation of Pump House								✓	✓			
18	Purchase of Scorpio								✓	✓	✓		
19	Procurement of Digital Cameras								✓	✓	✓		
20	Procurement of Personal Digital Assistant (PDA) Device with Accessories								✓	✓	✓		
21	Procurement of Binoculars					✓	✓						
22	Procurement of Night Vision Device					✓	✓						
23	Data logger					✓	✓						
24	Electric charge sticks					✓	✓						
25	Speed guns					✓	✓						
26	Purchase of Wireless handsets					✓	✓						
	Protection Wages:												
27	Ex-servicemen Engaged for Patrolling	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
28	Tiger Protection Force	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Rewards & Awards:												
29	Reward to Informers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
30	Reward to Staff & Employees	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
31	Legal Support for Defending Court Cases	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
32	Field Gear for Patrolling Staff				✓	✓	✓	✓	✓	✓			
	Rehabilitation of Traditional Hunting Tribes:				✓	✓	✓	✓	✓	✓	✓	✓	✓
	Research Activities:								✓	✓	✓	✓	
33	Construction of School Buildings & Hostels												
34	Soft-loans for Alternative Livelihoods	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Staff Welfare:												
35	Construction of Wells											✓	✓
36	Spl. Repair of Wells											✓	✓
37	Installation of Hand Pump											✓	✓
38	Project Allowance											✓	✓
	Cattle/ Wildlife Proof Structures:												
39	Chain-link Fence							✓	✓	✓	✓	✓	✓
	Human Resource Development:												
40	Training		✓	✓	✓				✓	✓	✓	✓	
41	Study Tours		✓	✓	✓				✓	✓	✓	✓	
42	Workshops		✓	✓	✓				✓	✓	✓	✓	
43	Training Equipment		✓	✓	✓				✓	✓	✓	✓	
	Relocation & Compensation:												
44	Rehabilitation Package						✓	✓	✓	✓	✓	✓	
45	**Modernization of information Technology:**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Ecodevelopment:												
46	Land Levelling									✓	✓	✓	✓
47	Construction of Wells											✓	✓
48	Provision of LPG Gas Connection											✓	✓
	Conservation Education & Awareness, Ecotourism Facilities:												
49	Wildlife Week Celebrations							✓	✓				
50	Workshops & Seminars							✓	✓				
51	Purchase of Documentary Films					✓	✓	✓	✓				
52	Purchase of Film CDs/DVDs					✓	✓	✓	✓				

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53	Nature Conservation Awareness					✓	✓	✓	✓				
54	Library Books	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Management Planning:												
55	Purchase of Satellite Imageries					✓	✓						
56	Digitization of Maps					✓	✓						
57	Wages for Field Work & Data Gathering				✓	✓	✓	✓	✓	✓	✓	✓	✓
58	Pay & Allowances of Officers/ Employees	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
59	Stationery, Form Printing, Software, Toner, Maintenance, etc.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
60	Printing of Tiger Conservation Plan for Core & Buffer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
61	Office Expense (Telephone, Furniture, Equipment, Books, Electric, etc.)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
62	Impact Assessment, Study of Grasslands, Flora, Fauna, Soil Survey, Hydrology etc.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
63	Procurement of GPS, Range Finder, Mobile Mapper etc.				✓	✓	✓	✓	✓	✓	✓	✓	✓
64	**Monitoring & Evaluation:**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	RECURRING:												
	Habitat Development:												
1	Eradication of Lantana					✓	✓						
2	Eradication of Weed					✓	✓						
3	Eradication of Brushwood from Meadows					✓	✓						
4	Control of Meadows Burning	✓	✓	✓								✓	✓
5	Reclamation of Meadows (Creation of Grass Exclosure, Corridors etc.)					✓	✓						
6	Eradication of Kush Grass & Plantation of Palatable Grass				✓	✓							
	Water Resource Maintenance:												
7	Soil Moisture Conservation				✓	✓				✓	✓	✓	
8	Maintenance of Waterholes							✓	✓	✓	✓	✓	✓
	Protection Wages:												
9	Patrolling Camp Watchers General Patrolling	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
10	Monsoon Patrolling				✓	✓	✓	✓					
11	Wages of Wireless Attendants	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Maintenance of Protection Infrastructure:												
12	Special Repair Work of FG Nakas/ Wireless Stations.									✓	✓	✓	✓
13	Maintenance of Wireless Sets	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
14	POL for Vehicles	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
15	Maintenance of Vehicles	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Maintenance of Roads:												
16	a. Core Zone						✓	✓	✓				
17	b. Staff Colony						✓	✓	✓				
	Fire Protection:												
18	Fireline Cleaning & Burning									✓	✓		
19	Fire Watchers Engaged	✓	✓									✓	✓
20	Fire Watchers Camps	✓	✓									✓	✓
21	Fire Fighting Equipment (Water bottle, gamcha etc.)	✓	✓									✓	✓

22	**Rescue Squad Equipment:**						✓	✓	✓				
23	**Population Estimation & Monitoring:**				✓	✓				✓	✓		
24	**Office Expenses:**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
25	**Maintenance of Management Infrastructure:**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
26	**Maintenance of Elephant Camps:**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Cattle Immunization:												
27	Purchase of Vaccines			✓	✓						✓	✓	
28	**Compensation for Damage to Human Life & Cattle Kills:**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Maintenance of Conservation Education & Awareness & Interpretation, Ecotourism Facilities:												
29	Maintenance of Interpretation Centres						✓	✓					
30	Maintenance of Wayside Exhibits & Display Boards						✓	✓					

Source: Kanha Tiger Reserve (2021)

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CHAPTER – 29

MONITORING & EVALUATION

29.1 Introduction:

Monitoring and evaluation is now recognized as a very essential component of wildlife conservation practices. It is a very important tool for managing conservation programmes, and the Kanha management should undertake it for decision making and accountability to measure and assess appropriateness, effectiveness and efficiency of conservation initiatives/ actions. Monitoring and evaluation can identify the exact direction of a management initiative, the course it takes to reach there and the appropriateness of this direction using resources in the most cost effective manner. In short, effective monitoring and evaluation ensures that these initiatives are delivering the desired outcomes and the Kanha management is achieving the intended results.

Systematic monitoring and evaluation of important conservation practices constitutes an early warning system, enabling the management to undertake preventative or remedial action. This is actually an in-depth assessment of programme performance. Monitoring and evaluation should not be regarded a theoretical concept or a dispensable luxury, but an operational reality and essential tool for adaptively managing conservation actions as conditions change and the Kanha management learn from its efforts.

The Kanha management should plan monitoring and evaluation programme with potential responses in mind if the monitoring detects levels of acceptable/ unacceptable change in the conditions of the natural resource base. It must focus on assessing the outcome of management initiatives specifically designed to resolve some threat to conservation issues. It should also lead to a response when expected results are not achieved and changes in management actions are required.

29.2 Monitoring & Evaluation Committee:

The National Tiger Conservation Authority, New Delhi provides allocation (100%) for monitoring and evaluation activities and the Kanha management should undertake it in right earnest. The management should take necessary steps to constitute a Monitoring and

Evaluation Committee, comprising officers from the office of the Principle Chief Conservator of Forests (Wildlife), Bhopal and representatives from premier institutes such as the Wildlife Institute of India, Dehradun, State Forest Research Institute, Jabalpur, Tropical Forest Research Institute, Jabalpur, and Indian Institute of Forest Management, Bhopal.

As there is a vast range of methodologies/ designs for monitoring and evaluating wildlife protected areas at various scales and recommended time intervals, it is proposed that the Committee should develop its own framework in the context of the core zone to avoid any possible bias.

It should also be noted that the Wildlife Institute of India already undertakes Management Effectiveness Evaluation of all the tiger reserves every four years in the country. This is a serious and detailed exercise for evaluation based on a wide range of criteria. The Kanha management should undertake this monitoring and evaluation exercise every three years.

29.3 Broad Framework & Indications:

A theoretical framework and some broad indications for the monitoring and evaluation of the core zone are proposed for the consideration of the above Committee. The theoretical framework should also incorporate the following points:

- Health of wildlife ecosystem/ habitats.
- Population trends of endangered species of animals and plants.
- Management interventions vis-à-vis their intended effect on wildlife ecosystem.
- Tourism activities and conservation practices.
- Park-people interface.
- Staffing.

Monitoring and evaluation and consequently management effectiveness of any protected is generally determined by the assessment of a range of criteria. These criteria are adequately represented by select indicators against stated objectives/ goals of management. In this way, effectiveness evaluation is defined as the assessment of how well the protected area is being managed-primarily the extent to which management is protecting values and achieving goals and objectives.

IUCN-WCPA has developed (Hockings et al., 2000) a management effectiveness evaluation framework which provides a consistent basis for designing evaluation systems for protected areas. On the basis of this evaluation framework, modified criteria and indications with special reference to the core zone are proposed as under:

Table-105: Broad Framework and Indicators

Theme	**Design**		**Appropriateness/ Adequacy**		**Delivery**	
Element	**Context**	**Planning**	**Inputs**	**Process**	**Outputs**	**Outcomes**
Evaluation Focus	Importance, threats and policy/ cultural environments	Design and planning	Adequacy of resources needed to manage	How management is conducted	Implementation of management initiatives/ actions	Extent of objectives achieved
Criteria Assessed	Values	Protected area legislation and policy	Resources available for management	Suitability of management processes	Results of management initiatives/ actions	Effects of management in relation to objectives
	Threats	Protected area or wildlife ecosystem				
Indicators	Biological importance, socio-economic importance, vulnerability	Goals/ objective legal security, site design and planning	Staffing infrastructure finance (Central & State)	Management planning, management decision making, research communication & coordination, monitoring & evaluation	Management plans, rules/ regulations, guidelines	IUCN category II Buffer Zone declaration

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Level of Evaluation	Status & threats	Appropriateness	Natural resources	Efficiency & appropriateness	Efficiency	Effectiveness & appropriateness

Source: Kanha Tiger Reserve (2021)

The indicators proposed for monitoring and evaluation are based on MacKinnon et al., (1990) and Cifuentes et.al., (2000), and modified in the context of the core zone. Several broad fields selected are further divided into relevant variables. Here, a field represents a large group of variables. Each variable represents major indicators. The variables are further divided into sub-variables and parameters as under:

Table-106: Indicators Proposed for Monitoring and Evaluation

Field	**Variable**	**Sub-Variable**	**Parameter**	**Relation with IUCN-WCPA Framework**
Biological attributes	Connectivity			
	Status of endangered species	Tiger, hard ground barasingha		Context
Threat	Peripheral biotic pressure			Context
	Animosity towards the park			
	Fire hazards			
	Disease transmission			
Planning	Management Plan	Up to date Management Plan exists, Plan implementation		Planning
	Zonation			
Administrative	Funds/ Budget	Budget allocations		Input
		Regularity of budget		
		Capacity to manage own resources		
		Special funds		
		Accounting system	Management capacity,	

			budget management, spending capacity, auditing mechanism	
	Infrastructure	Facilities for basic management	Staff housing, transportation, communication	Input
		Facilities for specific management		Input
Management programmes	Habitat management	Weed eradication, brushwood eradication, restocking of grasslands, water development, soil conservation etc.		Process
	Conservation education	Interaction with students, awareness programme for target groups, celebration of the wildlife week		
	Research & monitoring	In-house monitoring programme, research projects, collaborative projects, technical skill development of staff		
	Coordination & collaboration			
Legal uses (with reference to forest villages)	Grazing			Output
	Poles/ bamboos for bonafide use			
	Public right of way			
Illegal Uses	Extraction of natural resources			Output
	Poaching			
	Grazing			
	Fishing			
	Intrusion			

Source: Kanha Tiger Reserve (2021)

It is also proposed that five different criteria (0-4) of wildlife management scenario in the core zone should be developed, with the optimal condition as satisfactory, having the highest rating for each variable, sub-variable and parameter, and the lowest rating for unsatisfactory condition. The management scenario for the core zone should be based on the information contained in the Tiger Conservation Plan, rules and regulations, guidelines and other existing planning instruments. While the Committee can structure its own criteria, some broad criteria along with their rating explanations are proposed as under.

Table-107: Criteria of Wildlife Management Scenario in the Core Zone

Sl. No.	Criteria	Value
1	**2**	**3**
	VALUES DOCUMENTATION	
1	All the values identified, systematically assessed and monitored	4
2	Most values identified, systematically assessed and monitored	3
3	Values generally identified, systematically assessed and monitored	2
4	Values generally identified, but not systematically assessed and monitored	1
5	Values not systematically identified, assessed and monitored	0
	CONNECTIVTY	
1	Over 90% of the core zone perimeter is contiguous to other forest areas will genetic and biological resources and ecological processes	4
2	Over 76% of the core zone perimeter is contiguous to other forest areas	3
3	Over 50% of the core zone perimeter is contiguous to other forest areas	2
4	The core zone exists almost in isolation.	1
5	The core zone exists in total isolation, with no ecological connectivity	0
	BIOLOGICAL STATUS	
1	Biological attributes are conserved with specific action plans to preserve endangered species and their habitats	4
2	Biological attributes are conserved with important species under a general plan	3
3	Several biological attributes are under partial degradation, but the most significant attributes are not impacted	2
4	Several biological attributes are under severe degradation, with no plan for conserving such attributes	1
5	Important biological attributes are under severe degradation, with no plan for their conservation	0

	THREATS	
1	Threats systematically identified, and assessed	4
2	Most threats systematically identified, and assessed	3
3	Threats generally identified, and assessed	2
4	Threats generally identified, but not assessed	1
5	Threats not identified and assessed	0
	CHANGE IN LAND COVER	
1	Very resistant to biological invasions/ disturbances, with very low impact	4
2	Resistant to biological invasions/ other disturbances, with low impact	3
3	Moderately resistant to biological invasions/ disturbances, with moderate impact	2
4	Low resistance to biological invasions/ disturbances, with high impact	1
5	No resistance to biological invasion/ disturbances, with very high impact	0
	WEED INVASION	
1	No problem of weed/ unwanted species	4
2	The invasion of weed/ unwanted species has very low effect	3
3	The invasion of weed/ unwanted species has serious effect, but are manageable, avoidable and early reversible	2
4	The invasion of weed/ unwanted species has probably harmful effects, but could be reversed in the long-term	1
5	The invasion of weeds/ unwanted species has very serious and irreversible effects	0
	POACHING	
1	Absolutely no problem of poaching	4
2	Poaching has almost no effect in the core zone	3
3	Poaching has serious effect, but are manageable, avoidable and early reversible	2
4	Poaching has harmful effects, but could be reversed in the long-term	1
5	Poaching has serious and irreversible effects	0
	TIGER CONSERVATION PLAN (TCP)	
1	The core zone is under a valid TCP	4
2	TCP under preparation, with an out of date plan over 5 years old	3
3	TCP not revised for over 4 years, with no other planning instruments	2
4	Very outdated TCP of over 10 years old, with no forthcoming revision	1
5	No TCP at all, and no plans for preparation	0
	PLAN IMPLEMENTATION	
1	Clearly understandable management prescriptions/ recommendations for development works, budgets and other operational plans	4
2	Generally understandable management prescriptions/ recommendations for development works, budgets and other operational plans	3
3	Confusion in using the TCP as a basis for development works, budgets and other operation plans	2

4	Difficulty in using the TCP as a basis for development works, budgets and other operation plans	1
5	Conservation initiatives/ actions carried out in a disorganized manner	0
	REGULARITY OF ALLOCATIONS	
1	Budget allocations reach within the prescribed deadline	4
2	Budget allocations reach within the prescribed deadline, with occasional variations	3
3	Budget allocations always reach with predictable variations	2
4	Budget allocations are generally irregular	1
5	Budget allocations are irregular	0
	CAPACITY OF GENERATING OWN FUND	
1	The core zone has a legal mechanism to raise its own funds for investment in its own development	4
2	The core zone has a legal mechanism to raise its own funds for investment in its own development, without adequately structured administrative and financial systems	3
3	The core zone has a legal mechanism to raise its own funds for investment in its own development but it is prevented by the administrative and financial structure	2
4	The core zone has a legal mechanism to raise its own funds for investment in its own development but the administrative and financial structures prevent it from being utilized directly	1
5	The core zone does not have to any legal mechanism to raise its own funds for investment in its own development	0
	NON-GOVERNMENTAL SUPPORT FUNDS	
1	The core zone regularly receives support funds from non-governmental organizations	4
2	The core zone almost regularly receives support funds from non-governmental organizations	3
3	The core zone receives support funds from non-governmental organizations with some variations	2
4	The core zone sometimes receives support funds from non-governmental organizations	1
5	The core zone does not receive support funds from non-governmental organizations	0
	BUDGET MANAGEMENT	
1	Adequate budgets are proposed and spending programme is well-defined	4
2	Budget proposal acceptable, the spending programs not well-defined	3
3	Budgets proposal acceptable, but spending is limited due to budgetary constraints	2
4	Budgets not structured properly, spending uncontrolled	1
5	No budget nor a spending plan	0

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	EXPENDITURE MECHANISM	
1	Timely and systematically programmed spending, required returns prepared regularly	4
2	Spending not always timely, required returns not regularly prepared	3
3	Expenditures often delayed and programming is weak, required returns prepared infrequently	2
4	Expenditure in a haphazard manner, required returns are inadequate	1
5	Expenditures always untimely, no required returns prepared	0
	STAFF	
1	Staff strength is adequate, with excellent personal management. Staff training, orientation and skills are satisfactory for the management needs of the core zone	4
2	Staff strength is not adequate, excellent personal management. Staff training, orientation and skills are satisfactory for the management needs of the core zone	3
3	Staff strength is sub-optimum for vital management activities. Personal management is more or less adequate. Though adequately trained, it can be improved	2
4	Staff strength is inadequate. Professionalism leaves much to be desired	1
5	Staff strength is very low, and it lacks professionalism seriously	0
	BASIC MANAGEMENT FACILITY	
1	Existing facilities sufficient in quantity and quality, and are strategically placed to support managerial activities	4
2	Not enough facilities, but good in quality and make it possible to carry out most of managerial activities	3
3	Not enough facilities, nor of the best quality, but are placed strategically to develop important activities	2
4	Not enough facilities and are of poor quality, conditions do not allow for the many of the managerial needs to be met	1
5	No facilities and/ or so bad that they cannot be made use of	0
	TOURISM MANAGEMENT	
1	Perfect tourism management policy with no impact on the ecology of the core zone	4
2	Good quality tourism management policy with no impact on the ecology of the core zone	3
3	Good tourism management policy with slight impact on the ecology of the core zone	2
4	Ineffective tourism management policy with visible impact on the ecology of the core zone	1
5	Unsatisfactory management policy with clear impact on the ecology of the core zone	0

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	HABITAT MANAGEMENT	
1	Planned and effective habitat management linked to the objectives and needs of the core zone	4
2	Enough planned habitat management programmes, but still with serious gaps	3
3	Limited planned habitat management programmes, and still with still gaps	2
4	Very few unplanned programmes with considerable gaps	1
5	No habitat management programme	0
	CONSERVATON EDUCATION	
1	Planned and effective conservation education and awareness programme linked to the objectives and needs of the core zone	4
2	Planned education and awareness programme, but still with gaps	3
3	Planned education and awareness programme, but still with serious gaps	2
4	Very few unplanned conservation awareness programmes	1
5	No conservation education and awareness programme	0
	RESEARCH & MONITORING	
1	Comprehensive programme of research and monitoring relevant to management objectives and needs. Well-staffed and regular activities	4
2	Comprehensive research and monitoring programme, but irregular and is readily directed towards the objectives and needs of the management	3
3	Unplanned research and monitoring activities, not directed towards the needs of the management. No regular allocations for research by the Kanha management.	2
4	Some systematic studies by outsiders and not by the Kanha management	1
5	No research and monitoring activities by the Kanha management or by outsiders	0
	COMMUNICATION AND COORDINATION	
1	Well planned communication and coordination system, with no complaint from the stakeholders	4
2	Well planned communication and coordination system, but with complaints from the stakeholders	3
3	No planned communication and coordination with all types of stakeholders, but it occurs as and when required, there are gaps	2
4	Very low communication and coordination among the stakeholders	1
5	No communication and coordination among the stakeholders	0
	EXTRACTION OF NATURAL RESOURCES	
1	No extraction of natural resource	4
2	Extraction, but with no perceptible impact	3
3	Extraction, with negative impact on non-threatened species	2
4	Extraction, with negative impact on endangered species and or natural communities	1
5	Extraction, causing damage to the core zone	0

	PROTECTION STRATEGY (PS) AND SECURITY PLANNING (SP)	
1	A very comprehensive PS and SP	4
2	Good PS and SP, not very effective	3
3	Modest PS and SP, not very effective	2
4	Ad-hoc PS and SP, not effective	1
5	No or hardly any PS and SP	0
	ILLICIT GRAZING	
1	No grazing	4
2	Grazing, but with no perceptible impact	3
3	Grazing, with negative impact on non-threatened species	2
4	Extraction, with negative impact on endangered species and or natural communities	1
5	Extraction, causing damage to the core zone	0
	POACHING	
1	No poaching	4
2	poaching, but with no perceptible impact	3
3	poaching ,with negative impact on non-threatened species	2
4	poaching, with negative impact on endangered species and or natural communities	1
5	poaching, causing damage to the endangered species	0
	COMPLAINTS	
1	All complaints systematically recorded and responded to within a reasonable timeframe	4
2	Most complaints systematically recorded and responded to within a reasonable timeframe	3
3	Complaints generally recorded and not responded to within a reasonable timeframe	2
4	Complaints generally recorded but not responded to	1
5	Ad-hoc approach to recording and responding to complaints	0

Source: Kanha Tiger Reserve (2021)

The Committee can also develop the methodology of collecting, analyzing, crosschecking information/ data and verifying the same with the data collected from some other sources. The results/ findings of the monitoring and evaluation programme should be reported very clearly so that the Kanha management can act upon the recommendations and make the required improvements.

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