Guidelines for preparation of Tiger Conservation Plan

National Tiger Conservation Authority
Ministry of Environment & Forests
Government of India

Technical Document : NTCA/01/07

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1. Perspective

The Project Tiger guidelines made it mandatory that every Tiger Reserve should be managed in accordance with a site specific management plan, which is the road map for managing a tiger reserve. Project Tiger thus became a role model for scientific management of protected areas in India. It laid down the concept of core-buffer zonation, prescribed interventions for protection, habitat improvement, field data collection relating to change in the composition of flora and fauna on account of protection, animal estimation and other aspects.

The Wildlife (Protection) Act, 1972 was amended in 2006, and a separate Chapter (IVB) has been added on the 'National Tiger Conservation Authority', which has replaced Project Tiger. This Chapter, *interalia*, has enabling provisions (Section 38V) for preparing a ***'Tiger Conservation Plan'*** for the proper management of a tiger reserve, which will also include staff development and deployment plan.

2. Objectives

The objectives of the Tiger Conservation Plan are to ensure:

1. protection of tiger reserve and providing site specific habitat inputs for a viable population of tigers, co-predators and prey animals without distorting the natural prey-predator ecological cycle in the habitat;

2. ecologically compatible land uses in the tiger reserves and areas linking one protected area or tiger reserve to another for addressing the livelihood concerns of local people, so as to provide dispersal habitats and corridors for spillover population of wild animals from the designated core areas of

tiger reserves or from tiger breeding habitats within other protected areas;

3. forestry operations of regular forest divisions and those adjoining tiger reserves are not incompatible with the needs of tiger conservation.

The 2006 amendment to the Wildlife (Protection) Act, 1972 also specifies that subject to the provisions of the Act, the State Government shall, while preparing a Tiger Conservation Plan, ensure the agricultural, livelihood, developmental and other interests of the people living in tiger bearing forests or a tiger reserve. For the first time, the 'core' and 'buffer' areas of a tiger reserve have also been defined, the former being the critical, inviolate area, and the latter the peripheral area to foster coexistence with local people for safeguarding the integrity of the core.

3. Approach to Tiger Conservation Planning

Owing to habitat fragmentation on account of biotic pressures and ecologically unsustainable land uses, coupled with poaching pressures, the following approach is imperative in the present context for tiger conservation planning:

3.1 Consolidating and strengthening of 'source' populations of tiger in tiger reserves and protected areas

The management interventions would involve:

1. Protection, anti-poaching activities and networking

2. Strengthening of infrastructure within Tiger Reserves

3. Habitat improvement including water development

4. Rehabilitation package for traditional hunting tribes living around tiger reserves

5. Staff development and capacity building

6. Delineating inviolate spaces for wildlife and relocation of villagers from crucial habitats in Tiger Reserves within a timeframe (five years) and settlement of rights

7. Safeguarding tiger habitats from ecologically unsustainable development

3.2 Managing 'source-sink' dynamics by restoring habitat connectivity to facilitate dispersing tigers to repopulate the core areas

The management interventions would involve:

1. Co-existence agenda in buffer / fringe areas (landscape approach/sectoral integration) with ecologically sustainable development programme for providing livelihood options to local people, with a view to reduce their resource dependency on the core. The strategy would involve reciprocal commitments with the local community on a *quid-pro-quo* basis to protect forests and wildlife, based on village level, participatory planning and implementation through ecodevelopment committees(EDC).

2. Addressing man-animal conflict issues (ensuring uniform, timely compensation for human injuries and deaths due to wild animals, livestock depredation by carnivores, crop depredation by wild ungulates).

3. Mainstreaming wildlife concerns in the buffer landscape by targeting the various production sectors in the area, which directly or incidentally affect wildlife conservation, through 'Tiger Conservation Foundation', as provided in the Wildlife (Protection) Amendment Act, 2006.

4. Addressing tiger bearing forests and fostering corridor conservation through restorative strategy in respective working plans of forest divisions, involving local communities, to arrest fragmentation of habitats.

5. Ensuring safeguards / retrofitting measures in the area in the interest of wildlife conservation.

4. Components of Tiger Conservation Plan

The Tiger Conservation Plan of a given landscape will have two major components, to address two different areas, viz. core and buffer. The constitution, area extent, objectives of management and the prescribed management interventions (zone and theme plans) covering all aspects of wildlife conservation in the core, with prescriptions for an inclusive agenda in the outer buffer zone for providing livelihood options to local people to reduce their resource dependency on forests would form part of the Tiger Conservation Plan. The buffer prescriptions need to ensure mainstreaming wildlife concerns in various production sectors operating in the area. Apart from this, the plan should also include a strategy for staff development and deployment. The plan would also include an 'indicative strategy' for restorative management of adjoining areas having a corridor value, which would be implemented by respective field formations based on directives from the State Chief Wildlife Warden .

Thus, tiger source populations in core areas falling in a larger landscape would be interspersed and juxtaposed in a matrix of various landuses, with mainstreaming of wildlife concerns to safeguard the source-sink dynamics of tiger populations. Wildlife conservation activities will be focused in the '*core*' areas and the '*co-existence*' agenda will be actively pursued in the '*buffer*' and '*adjoining*' areas providing connectivity /corridor linkages.

5. Strategies for Management

5.1 Protection Strategy

While no generalised approach can be prescribed for the entire country, certain broad points are highlighted below for planning, which may be used in evolving or improving the protection strategy in tiger reserves:-

(1) Review of the existing patrolling camps/chowkis in Protected Areas, so that each chowki/patrolling camp has, on an average, an area of 25-30 sq. km. under its jurisdiction to ensure the desired amount of legwork by beat guards and his camp followers posted in such patrolling camps/chowkis.

(2) Prescribing a daily schedule of patrolling keeping in mind the vulnerability of the area from protection point of view.

(3) Maintaining a monitoring/daily observation register in each patrolling camp/chowki in the local language preferably, in which the field personnel can record their daily observations based on patrolling.

(4) Adopting a regular supervision schedule for field officers, along with minimum patrolling to be done by them jointly with patrolling camp/chowki staff.

(5) Maintaining a system of "surprise checks" of chowkies/patrolling camps by senior officers.

(6) Keeping a record of the local village level market days in the peripheral areas, and deploying staff in civil dress to keep track of any untoward incident/transaction relating to wildlife.

(7) Organising vehicular patrolling by constituting squads comprising of field staff, labourers and police/SAF personnel, tools (if necessary), with wireless handset and paraphernalia for apprehending offenders, apart from prescribing a patrolling calendar for the squad.

(8) Maintaining a list of vehicles passing through manned barriers, and surprise checks by senior officers at such points every month.

(9) Evolving a monitoring system for collation of information regarding livestock depredation/human injury/loss of human life/large scale crop depredation by wild animals through wireless network and prompt payment of compensation as per Citizens' Charter.

(10) Wherever half eaten carcasses of livestock on account of carnivore depredation are reported, such carcasses should be incinerated in the presence of a gazetted officer to eliminate the possibility of poisoning for revenge killing retaliation by local people.

(11) In areas where more than three incidents of livestock depredation are reported within a fortnight, continuous monitoring based on field evidences should be done by deploying trackers.

(12) Ensuring monthly meetings with the neighboring district officials for exchanging wildlife crime dossiers to facilitate joint action.

(13) Exchange of crime dossiers with local police to facilitate their updation, apart from organizing monthly review meetings with the District Superintendent of Police.

(14) Periodic meetings with the District Judge to expedite the disposal of pending cases relating to wildlife offences.

(15) Organising surprise raids jointly with the local police in railway stations, local trains, bus-stops, buses and cafeteria.

(16) Ensuring special site-specific protection measures, during monsoon such as 'Operation Monsoon' – considering the terrain and accessibility of Protected Areas.

(17) Organising inter-state meetings at least once in three months, to exchange wildlife crime data between border Parks/Tiger Reserves/Sanctuaries.

(18) The area should be constantly monitored to ascertain the presence of gangs and wandering pastoral people, apart from keeping an inventory of their temporary settlements.

(19) Wherever EDCs have been constituted, a village level crime register should be maintained at the EDC level to keep track of villagers involved in wildlife offences.

(20) At the range level, dossiers of habitual/ incorrigible offenders should be maintained, to help in tracing new crimes to old offenders.

(21) Identifying local persons and imparting them the basics of wildlife crime detection so as to avail their services as and when required as informers.

(22) Preparing a monthly crime map of each Protected Area on a 1:50,000 scale indicating the locations of each crime with date. It should also highlight the recorded cases of live stock depredation by carnivores during the period.

(23) Patrolling camp/chowki staff should be instructed to collect field evidences like pugmarks, plaster cast of foot-prints on a regular basis, so that individual identities of carnivores like tiger can be fixed. This would serve as a continuous monitoring also.

(24) Laying out impression pads near water points in villages to ascertain the presence of carnivores in the area.

(25) Constituting a Defence Squads comprising of local, pro-active villagers at the EDC level, which can assist the PA staff in apprehending miscreants involved in wildlife poaching.

Effective 'Anti Poaching' measures and 'Patrolling Strategy' should be accorded topmost priority in a Tiger Reserve management. The need for a reliable, round the clock wireless system, strategically placed forest patrolling camps and an ever vigilant, motivated frontline staff requires no elaboration.

5.2 Strategy for the buffer: mainstreaming wildlife concerns in various production landscapes

A number of production sectors operate in the buffer area of a tiger reserve, which directly (D) or incidentally (I) affect tiger conservation (**Plate 1**). Therefore, the basic managerial strategy for the buffer area should focus on mainstreaming wildlife concerns amongst such sectors. Some of the common production sectors in the buffer areas are:

(a) Forestry (D)

(b) Agriculture (D)

(c) Integrated Development (ecodevelopment, development through District Administration) (D)

(d) Tourism (D)

(e) Fisheries (D)

(f) Tea/Coffee Estates (I)

(g) Road / Rail transport (D)

(h) Industry (D)

(i) Mining (I)

(j) Thermal power plants (I)

(k) Irrigation projects (D)

(l) Temple tourism (I)

(m) Communication projects (D)

The above list is only indicative and not exhaustive.

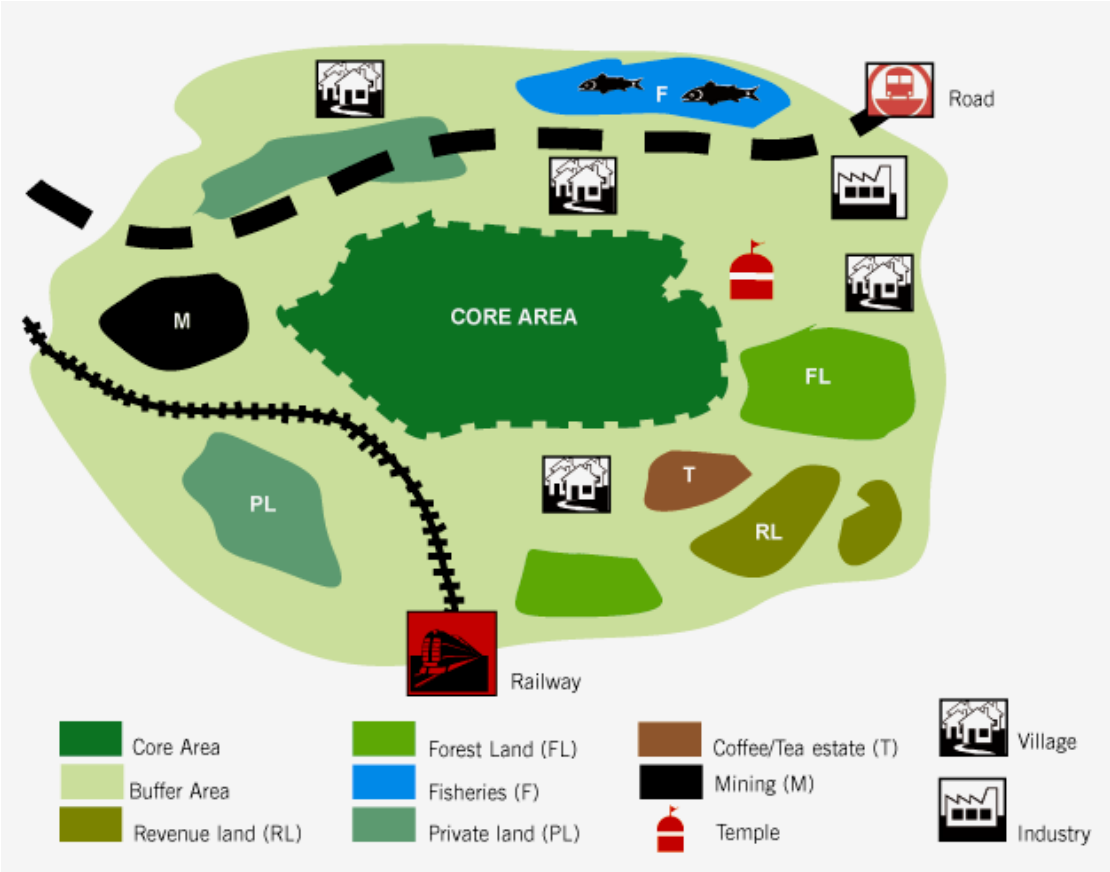


Plate 1: Production Sectors in a Tiger Landscape

5.3 What is 'Mainstreaming'?

Mainstreaming of wildlife concerns should be understood as a process to integrate wildlife conservation in various production sectors of the buffer zone where the primary emphasis is not conservation. This would safeguard wildlife interests by ensuring habitat supplements in outer areas beyond the core for tiger spatial land tenure dynamics. Further, it would also strengthen conservation by reducing the possible interface conflicts between various production sectors and conservation, which otherwise leads to wild animals earning a 'pest value' and eventually getting eliminated from the area. Thus, mainstreaming of wildlife concerns in the outer buffer landscape is essential to prevent such area from turning into *'ecological sinks'*.

5.4. Process of mainstreaming

Mainstreaming tiger (wildlife) conservation concerns in various production sectors is imperative for the buffer zone to be viable and fulfill its objectives. This would involve modification of developmental activities /practices in the key production sectors to make them more 'conservation friendly'. The process is sector as well as landscape specific. However, some generic suggestions based on environmental guidelines issued by the Ministry of Environment and Forests for developmental projects in different sectors, are given below for guidance:

5.4.1 Forestry

- monitoring wildlife/tiger presence in standardized formats on a daily basis
- foot patrolling by staff to ensure protection
- exchange of tiger/wildlife presence data with nearby protected area or tiger reserve
- monitoring of carnivore kills
- monitoring of water points
- timely payment of compensation for livestock depredation by wild carnivores
- regulating livestock grazing in areas prone to wild ungulates
- payment of compensation for crop damage by wild animals
- fire protection Village Forest Committees
- review of wildlife status in the meetings of Forest Development Agency
- regulating collection of Non Timber Forest Produce

- monitoring village cattle for disease
- maintenance of village level wildlife crime dossier
- protection of riparian margins
- retention of old/dead trees
- staggering of forest stands belonging to different age groups
- maintaining grassy blanks
- retention of endemic species
- incentives to local communities from the fund accruing through recycling of gate receipts, as a reciprocal commitment for their involvement in addressing wildlife concerns , forming part of a MoU with the Tiger Conservation Foundation in the village level micro plan

5.4.2 Agriculture

- adoption of 'écoagriculture' as a land use to produce food as well as to conserve wildlife
- maintaining non -domestic habitat
- discouraging sudden change in cropping patterns(*viz* lure crops) to avoid accentuating man-wild animal conflicts
- maintaining a habitat mosaic, *viz*. fallow land, cultivation field, fruit orchard, plantation, under planting of spices, small timber etc. to mimic natural forest
- promoting soil conservation
- providing economic incentives for safeguarding wildlife concerns

- providing incentive for carbon, water and other environmental services to local people
- compensating losses due to wildlife
- recognizing the value of traditional farming in conservation
- fostering use of green manure and discourage use of chemical manures and pesticides
- facilitating marketing of local products through the Tiger Conservation Foundation
- recognizing property rights of farmers for genetic resources
- fostering rural tourism
- use of market instruments through the Tiger Conservation Foundation (production certificate for organic products)

5.4.3 Integrated Development

(i) Ecodevelopment

- participatory village level planning and preparation of village level micro plans for eco development
- providing inputs for resource substitution, income generation, community welfare, ecotourism for reducing the resource dependency of local people on surrounding forests
- ensuring reciprocal commitments with the local people through respective ecodevelopment committees, forming part of a MoU in the micro plan for safeguarding wildlife interests

(ii) Development through District Administration

This involves a multiplicity of sectors operating in the landscape pursuing development, where wildlife concerns have to be integrated through formal contracts/ agreements between the Tiger Conservation Foundation, district authorities and ecodevelopment committees. The responsibilities of various parties should be spelt out in the contract/ agreements for safeguarding wildlife concerns along with reciprocal commitments. Normally, such contracts/ agreements should discourage any detrimental practice and assign responsibility to the community for carrying out some interventions. In return, the community should receive an assurance from the tiger reserve authorities for access to certain natural resources in the area or benefits.

5.4.4 Tourism

- facilitating wildlife ecotourism involving local host communities
- facilitating wildlife tourism on private lands in the vicinity as per the normative guidelines
- obtaining contributions from private commercial tour operators and lodge owners for local community development
- obtaining contributions from tour operators for maintaining tourist facilities , staff welfare
- recycling of tourist gate receipts for community welfare through the Tiger Conservation Foundation

5.4.5 Fisheries

- granting permits to ecodevelopment committees(EDCs)
- regulation through the Tiger Conservation Foundation
- MoU with EDCs for safeguarding nesting sites, breeding areas
- reciprocal commitments for patrolling, fire protection etc
- facilitating marketing through the Tiger Conservation Foundation

5.4.6 Tea /coffee plantations

- facilitating marketing through Tiger Conservation Foundation
- supplementing its economy (in case the situation warrants)
- providing livelihood options, relief to displaced workers through EDCs
- fostering rural tourism

5.4.7 Road / rail transport

- safeguarding floral / faunal values *en route*
- speed level
- regulation of traffic flow
- maintenance of noise level as per noise abatement criteria
- adoption of cut and fill technology in construction
- establishment of local vegetation on filled up area and road side land

- adoption of erosion control measures
- protection of drainage system
- dumping of excavated material on ecological principles
- safeguards to prevent road / train hits to wild animals
- safeguards to prevent fires
- compensation for habitat fragmentation and barrier effect

5.4.8 Industry

- maintaining a zone of 5 km from the periphery of core zone as a "*no developmental zone*" to foster wildlife corridor
- construction activities should not lead to depletion of forests
- preventing pollution on account of gaseous and other effluents
- organizing service systems relating to drinking water, drainage, garbage disposal so as not to disturb the wildlife habitat

5.4.9 Mining projects

- treatment of effluents as per standard procedures
- use of treated water for raising plantations of local species for stabilizing mine waste dumps
- establishing solid waste management area away from natural water courses
- disposing off wastes with high concentrations of reactive elements in sanitary land fields

- use of over-burden and mine waste in reclamation of the terrain
- providing for drainage of water discharged with the tailings to decantation wells and establishing plantations as wind belts to minimize the dry tailings being airborne
- control of acid mine drainage
- providing an attractive relocation / rehabilitation package for relocation (if any) with provisions for handholding beyond the process

5.4.10 Thermal power plants

- locating the power plant at least 25 km away from the core periphery
- an exclusion zone of 2 km should be provided around the project area located on the leeward side with respect to wind direction
- avoiding forest or prime agricultural land for setting up the power project or disposal of ash

5.4.11 Irrigation project

- safeguards for preventing landslides on the periphery of reservoir
- safeguards for potential seismic impact on account of reservoir loading
- monitoring recharge of ground water
- identification of areas prone to siltation and erosion
- retention of trees in the impounded area to facilitate roosting of birds

- fostering ecotourism through the Tiger Conservation Foundation in the impounded area
- assisting the management in patrolling the water body
- providing an attractive relocation / rehabilitation package for relocation (if any) with provisions for handholding beyond the process

5.4.12 Temple tourism

- preparation of a master plan and adherence to its normative standards for crowd regulation and visitor facilitation
- ensuring proper garbage disposal
- providing accommodation facilities for pilgrims in nearby satellite township
- architectural code of civil works as contained in the master plan should blend with the environment
- avoiding / safeguarding passages / corridors used by wild animals
- avoiding contamination / pollution of local streams and water bodies
- providing local shopping facilities to tourists through the Tiger Conservation Foundation, involving the Ecodevelopment Committees

5.4.13 Communication projects

- avoiding wetlands, animal corridors and habitats rich in wildlife
- avoiding agricultural land, streams, forest areas
- avoiding slopes

- institutionalizing a system of patrolling for safeguarding the use of transmission lines and cleared strips for poaching
- the maximum width (w) of Right of Way for the transmission lines on forest land for varying kv lines is 7 m (11 kv), 15 m (33 kv), 180 m (66 kv), 22 m (111 kv), 27 m (132 kv), 35 m (220 kv) and 52 m (400 kv)
- maintaining the prescribed clearances for different kv lines within the Right of Way, which may be widened in areas having tall trees or elephants

5.5 Implementation Strategy

5.5.1 The buffer zone of a tiger reserve will not have the status of a national park or sanctuary. However, as a "multiple use area", it may encompass conservation or community reserves, apart from revenue lands, private holdings, villages, towns and other production sectors as indicated above.

5.5.2 The buffer zone should be notified as required under the Wild Life (Protection) Amendment Act, 2006, and should be placed under the unified control of the Field Director of the tiger reserve.

5.5.3 Subject to the provisions of the Wild Life (Protection) Act, 2006, the existing land uses in the buffer zone can continue with due mainstreaming of wildlife concerns as indicated above.

5.5.4 The role of Deputy Director (Buffer Zone) of a tiger reserve would be to carry out **implementation** of inputs (Forestry/Joint Forest Management/Ecodevelopment) in forest areas, while ensuring **coordination** with other sectors. Wildlife protection would be an overlapping mandate for the entire area.

5.5.5 To facilitate coordination and mainstreaming of wildlife concerns at the field as well as state level, the following Committees are suggested:

(a) (State level Monitoring Committee)

(i) Chief Secretary of the State - *Chairman*
(ii) Secretaries of related departments - *Members*
(iii) Chief Wildlife Warden (assisted by the Field Director of tiger reserve) - *Member Secretary*

(b) (District level Coordination Committee for ensuring convergence of other sectors)

(i) District Collector - *Chairman*

(ii) CEO - *Member*

(iii) Representative officials from: PWD, Social Welfare, Tribal Department, Health Department, Agriculture Department, Education Department, Power and Irrigation Departments - *Members*

(iv) Representatives of various Government/ private production sectors - *Members*

(v) Deputy Director of the Tiger Reserve/PA - *Member Secretary*

5.5.6 The working plan provisions for forest areas in the buffer zone would be implemented after duly mainstreaming wildlife concerns.

5.5.7 The existing rights/concessions of local people would be regulated as per the legal provisions invogue.

5.5.8 As provided in Section 38-V of the Wild Life (Protection) Act, 1972 (as amended in 2006), the provisions of sub-section (2) of section 18, sub-sections (2), (3) and (4) of section 27, sections 30, 32 and clauses (b) and (c) of section 33 shall apply to the buffer zone of a tiger reserve, to accord protection to wildlife in the area.

5.5.9 Ecodevelopment as well as Joint Forest Management activities in the area would be implemented using a participative strategy as codified by the State, through village forest committees and ecodevelopment committees.

5.5.10 Buffer zone management should address threats to wildlife conservation emanating from regional developmental activities such as forest concessions, industrial pollution, highway development, extensive high value farming or ecologically unsustainable and intensive land uses like mining through appropriate mainstreaming in such sectors.

5.5.11 Integrated development (ecodevelopment and developmental activities of District Administration) should be innovatively used for addressing conflicts arising on account of pressures on forest resources from local people.

5.5.12 For areas with ongoing conflicts on account of law and order, insurgency and the like, integrated development should be complemented by deploying native workforce and homeguards/ex-army personnel to contain the situation, as the site specific situation warrants.

6. Importance of a buffer zone *vis-à-vis* the tiger land tenure dynamics

6.1 Tiger is a territorial animal, which advertises its presence in an area and maintains a territory. It is a well known fact that partial overlaps of resident male territories in an area do occur. However, the degree of overlap increases lethal internecine combats. Several female territories do occur in an overlapping manner within the territory of a male tiger. The tiger land tenure dynamics ensures presence of prime adults in a habitat which act as source populations, periodically replacing old males by young adults from nearby forest areas (**Plate 2**).

6.2 The ongoing study and analysis of 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 areas) require an inviolate space of 800 -1000 sq km (see **Annexure I**). 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. Therefore, buffer areas with forest connectivity are imperative for tiger dynamics, since such areas foster sub adults, young adults, transients and old members of the population. The young adults periodically replace the resident ageing males and females from the source population area.

6.3 The buffer area, absorbs the "shock" of poaching pressure on populations of tiger and other wild animals. In case of severe habitat depletion in buffer areas, the source population would get targeted and eventually decimate.

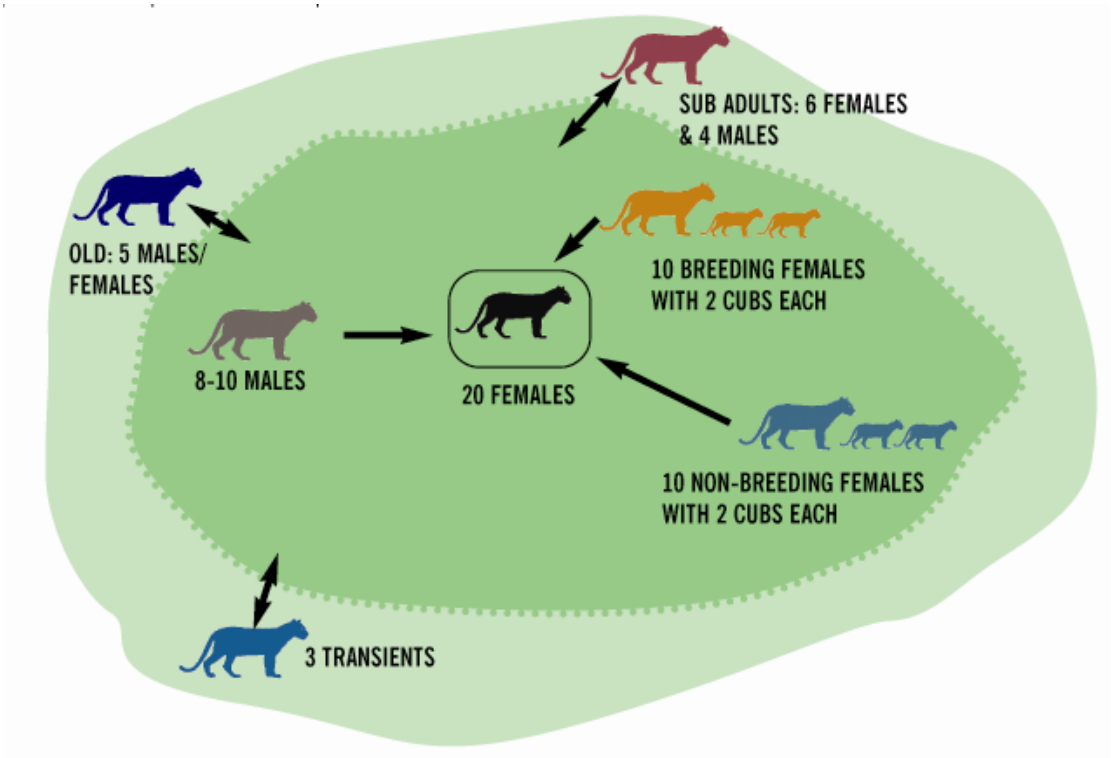


Plate 2: Tiger Land Tenure Dynamics. Minimum population of tigers in breeding age needed for maintaining a viable population (80-100 tigers), which require an inviolate space of 800-1000 square kilometers.

7. Tiger Conservation Foundation

7.1 The Wild Life (Protection) Amendment Act, 2006 (Section 38X provides for establishment of a Tiger Conservation Foundation in each tiger reserve, to facilitate and support management, apart from taking initiatives for involving people in conservation. The Foundation is a new institutional framework which can complement the tiger reserve management and liaison with various ecodevelopment committees and their confederations apart from production sectors in the landscape. The Foundation should be registered under the relevant rules of the State as a Trust, and as prescribed in the guidelines, will have a State level Governing Body, apart from a field level executive committee under the Chairmanship of the Field Director with representatives of the

ecodevelopment committees as nominated by the Governing Body. The Foundation would act as a "non profit center" and as a "development agency" by increasing local participation. It can secure the tiger reserve from financial constraints by providing funding support through various sources: recycling of gate receipts, service charges, donations and the like. The Foundation, may undertake various activities related to mainstreaming of conservation: ecodevelopment, staff welfare, visitor regulation, field research, facilitating ecodevelopment committees for market access, conducting capacity building programs, ecotourism and Joint Forest Management.

8. Value of Corridors

8.1 Isolated populations of wild animals face the risk of extinction owing to insularization. Habitat fragmentation adversely affects wildlife due to decreased opportunity available for wild animal movement from different habitats. This in turn prevents gene flow in the landscape. The equilibrium theory of island biogeography predicts greater species richness in large wildlife areas or in smaller areas connected by habitat corridors owing to increased movements of wild animals. Such connecting habitats, apart from facilitating animal movements also act as refuge for spill over populations from the core areas.. They may also act as smaller "source" by facilitating breeding and movement of native wildlife populations to colonize adjoining habitats. Natural linear features like rivers or mountain ranges may act as boundaries for wildlife populations. However, disturbance of corridors on account of human interventions (highways, canals, industries, roads, railway tracks, transmission lines) is deleterious to wildlife.

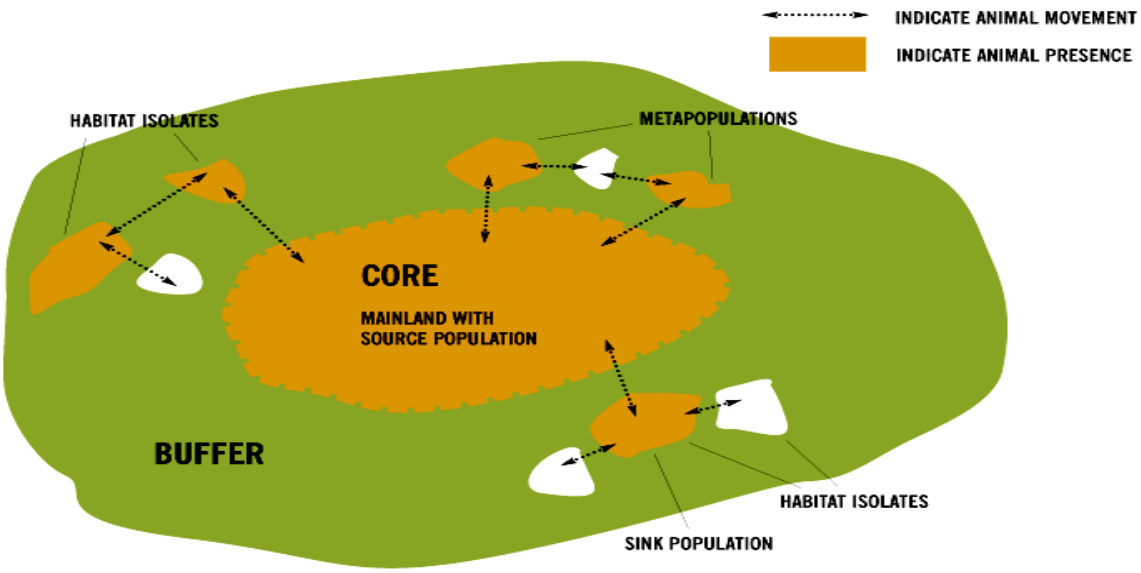


Plate 3: Tiger Land Tenure Dynamics

8.2 "Source" populations are those which produce a surplus of animals which are potential colonizers. On the other hand, "Sinks" are those populations in which deaths exceed births, and their persistence depends on regular influx of immigrants.

8.3 Patches of suitable habitats in the landscape may support wildlife populations (local populations), which may be separated from one another on account of various disturbance factors. Collectively, such patches of local populations are known as "regional populations". This general situation of sub divided populations interacting with one another in a landscape to supplement new genes through movement, is known as a "meta population". In the context of tiger land tenure dynamics, the core-buffer areas conform to the "island-mainland" or "core-satellite" form of meta population model. The core area of a tiger reserve provides a source of colonizers for the surrounding local populations of different sizes and varying degrees of isolation. The core area may not readily experience extinction owing to the

protection inputs for maintaining its inviolate nature. However, the surrounding isolated patches in the buffer area may suffer from local extinction if wildlife concerns are not mainstreamed in the area. Therefore, a meta population management approach is required for the buffer zone as well as corridors to facilitate:

(a) Supplementing declining local tiger populations

(b) Facilitating re-colonization in habitat patches through restorative management

(c) Providing opportunity to tiger for colonizing new areas through patches of habitats (stepping stones) between isolated populations (**Plate 4**).

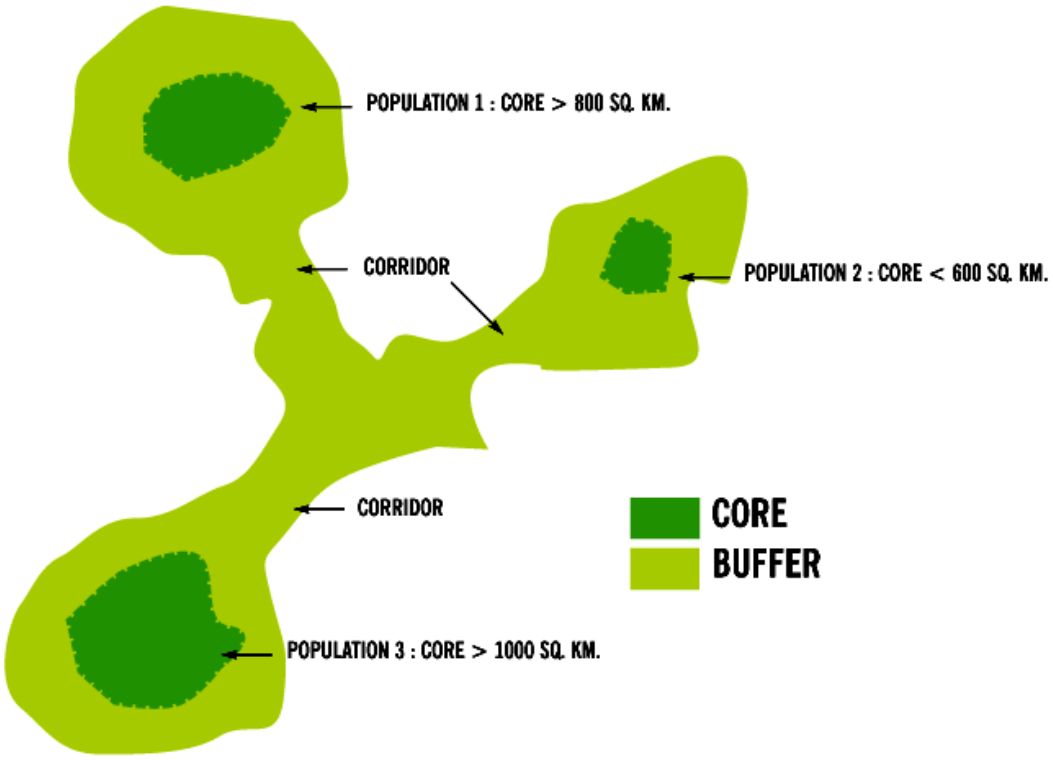


Plate 4 : Meta population dynamics. Corridors become crucial for maintaining viability of Population 2 as by itself it does not have the habitat to sustain greater than 20 breeding tigers

9. Monitoring Tiger Co predator, Prey and their Habitat

9.1. Monitoring status of tigers, co predator prey base and evaluating habitat quality constitutes on of the most important components of the conservation plan. The existing methodology of tiger estimation has been reviewed and refined methodology has been developed. This refined methodology has been endorsed by the National Tiger Conservation Authority (NTCA) in its first meeting held on 28.11.2006. The details of the methodology are given as **Annexure V(a)**. It comprises of a three stage process involving primary data collection at forest guards beat level, its collation and analysis. As output of the process, spatial distribution, relative abundance and densities of tigers and its biotope is generated. It also generates other information relating to habitat quality. All these information are then used to develop relationships for understanding tiger population dynamics in tiger occupied landscapes. This process is required to be carried out every fourth year at All India Level under the supervision of National Tiger Conservation Authority.

9.2. Project Tiger areas are home to source populations which are extremely important for long term conservation of tigers at landscape level. It is therefore necessary to intensively monitor tigers and its associated components of prey and habitat attributes on continuous basis. **Annexure V (b)** prescribes format for daily monitoring. This would strengthen not only supervision at field level but also would generate information on regular basis for evaluating tiger occupancy. The manager should use daily monitoring data in a suitable manner to generate tiger occupancy maps. The analyzed information thus generated should be sent to NTCA every month.

9.3. Apart from above, Project Tiger Management should also carry out estimation of Tiger as per process prescribed for All India Tiger Monitoring on annual basis. The data collection format are given in **Annexure V (c)**. They are also expected to monitor the source population intensively by using camera traps/ radio telemetry and other modern tools. This intensive monitoring could be done by each Tiger Reserve in association with a local, regional or national level institution of repute.

10. Relocation of Human Settlements from Core

It is essential to have a minimum inviolate area (forming the core of the Tiger Reserve) capable of supporting 20 breeding tigresses. On an average, a tigress requires 40-60 km^2 of territory for successful breeding. Pressure of human habitation is detrimental in sustaining high density breeding tiger populations. Settlements, therefore, need to be re-habilitated from the core area of a tiger reserve. The translocations/ rehabilitation package should be such that people should readily be willing to relocate. The relocation site should be so chosen so as not to compromise the conservation value of the Tiger Reserve i.e. it should be as far away from the core as possible and not located in connecting habitat corridors. Networking with local institutions and NGO's should be established so that post relocation assistance is provided to the relocated population for some time atleast. Effort should be made to wean the resettled population away from their dependence on forest resources. This would be possible by providing assistance (both technically and financially) in developing alternative livelihood options.

11. Template for preparing a Tiger Conservation Plan

Name of the Tiger Reserve:

11.1 Introduction of the Area

11.1.1 Description of the Tiger Conservation Unit/ Landscape and significance of the area for tiger conservation.

11.1.2 Map of Tiger Conservation Unit/Landscape.

11.1.3 Legal provisions contained in the Wildlife (Protection) Act regarding Tiger Conservation Plan and brief description of their relevance in the Tiger Conservation Unit/ Landscape.

11.1.4 Delineation of Area into Core, Buffer and Adjoining Landscape.

11.2 Tiger Conservation Plan: Core Area

Part A: The Existing Situation

Chapter 1: Introduction of the Area

1.1 Name, Location, Constitution & Extent

1.1.1 Name

1.1.2 Location

1.1.3 Constitution

1.1.4 Extent (Area statement and Legal Status)

1.1.5 Notification

1.2 Approach & Access

1.3 Statement of Significance

Part B: The Proposed Management

Chapter 13: Organization, Administration and Budget

13.1 Tiger Steering Committee

13.2 Tiger Conservation Foundation

13.3 Coordination with Line Agencies/ Departments

13.4 Staff Deployment

13.5 Fund Raising Strategies

13.6 Schedule of Operations

13.7 Activity Budget

Chapter 14: Monitoring and Evaluation

14.1 Criteria

14.2 Process

i. List of Maps

ii. List of Appendices (Will include all relevant and compiled data/information relating to the Tiger Conservation Unit such as All Notifications/Circulars constituting Tiger reserve, Guidelines, Committees; Flora and Fauna indicating threatened and Invasive alien species status; Administration and Protection Infrastructure such as Buildings, Anti poaching camps, Vehicles and Boats, Working Elephants, Wireless Communication network; Habitat attributes such as important water bodies, rivers and streams etc.; Staff; Arms and ammunition; Tourism and interpretation facilities; Visitors and revenue statistics; Roads, patrolling Path; Past Expenditure; List of research projects/studies undertaken and publications; Any other relevant information for the Area.

11.3 Tiger Conservation Plan: Buffer Area

As per section 38V (4ii) of the Wildlife (Protection) Amendment Act – 2006, each Tiger Reserve is required to create a Buffer or Peripheral area consisting of areas peripheral to critical tiger habitat or core area, where a lesser degree of habitat protection is required to ensure the integrity of the critical tiger habitat with adequate dispersal for tiger. This area will promote the co-existence between wildlife and human activity with due recognition of the livelihood, developmental, social and cultural rights of local people. This area will have to be determined on the basis of scientific and objective criteria in consultation with the concerned Gram Sabha and an expert committee constituted for the purpose. The Buffer area of a Tiger Reserve will have following major functions :

1. To provide habitat supplement to the spill over population of tiger and its prey from the core area, conserved with the active cooperation of stakeholder communities.
2. To providing site specific, need based, participatory eco-development inputs to local stakeholders for rationalizing their resource dependency on the Tiger Reserve and strengthen their livelihoods, so as to elicit their support for conservation of the area.
3. Mainstreaming wildlife concerns in various production sectors in the area.

The management of the Buffer Area will have to be carried out on following broad principles:

1. Implementation of forestry activities after mainstreaming wildlife concerns.
2. Implementation of ecodevelopmental activities for reducing resource dependency of local people on surrounding forests.

3. Coordination with governmental / non governmental production sectors in the landscape for mainstreaming conservation.

4. Habitat management and improvement activities will be carried out in the existing habitat of tiger and its prey species through active involvement of local communities. The existing silvicultural operations will be accordingly modified to promote conservation of the area and the management will be based on specific forest lands forming part of village level micro plans. Community will be involved in the overall management of the buffer area.

5. Site specific ecodevelopment initiatives based on participatory village level micro plans will be carried out for the local communities for strengthening their livelihoods through a balanced approach of rationalization of resource use, biomass regeneration and alternatives, so that the ecological status of the area could be improved and maintained (See **Annexure-II** for menu of options from best practices under India Ecodevelopment Project and **Annexure-**III for possible ecodevelopment activities in different type of areas in the buffer).

6. Reciprocal commitments by the local people through specific measurable actions as per MoUs for improving protection and conservation of the area will be implemented. This may include rationalization of resource use from the forest, participation in fire protection and anti-poaching efforts.

7. Ecotourism activities in the Buffer Area will be used as an important component of ecodevelopment for strengthening the livelihood of the local people and the protection of the area.

8. Capacity building of the field staff as well as ecodevelopment committee member will be undertaken on a regular basis through the Tiger Conservation Foundation. Similarly intensive nature conservation awareness programme should be part of the buffer area management plan with a focus on different stakeholders particularly local communities.

The suggested/ indicative format for the buffer area plan is given below:

Part A: The Existing Situation

Chapter 1: Introduction of the Area

1.1 Name, Location, Constitution & Extent

1.1.1 Name
1.1.2 Location
1.1.3 Constitution
1.1.4 Extent

1.2 Approach & Access

1.3 Statement of Significance

1.4 Geology, Rock and Soil

1.5 Hydrology and Water Sources

1.6 Vegetation Types

1.7 Wild Fauna and Habitats

1.8 Major Conspicuous Changes in the Habitat Since Inception

Chapter 2: Status of Tiger and Co-Predators

2.1 Distribution

2.2 Abundance Status

2.3 Prey-Predator Relationships

2.4 Assessment of Threats

Chapter 3: History of Past Management and Present Practices

3.1 Conservation & Forest Management History

3.2 Protection of Tiger, its Prey and Habitat

3.3 Other Land use – Villages, Agriculture, Developmental Programmes, Tourism etc.

3.4 Research, Monitoring and Wildlife Health

3.5 Nature Education and Interpretation

3.6 Administration and Organization

Chapter 4: Production Sectors in the Landscape

4.1 Forestry (affects directly) (D*)
4.2 Agriculture (D)
4.3 Integrated Development (ecodevelopment, development through Dist. Administration) (D)
4.4 Tourism (D)
4.5 Fisheries (D)
4.6 Tea/Coffee Estates (affects incidentally) (I**)
4.7 Road / Rail transport (D)
4.8 Industry (D)
4.9 Mining (D)
4.10 Thermal power plants (I)
4.11 Irrigation projects (D)
4.12 Temple tourism (D)
4.13 Communication projects (D)

* D = Affects wildlife directly

** I = Affects wildlife incidentally

Chapter 5: Land use Patterns and Conservation-Management Issues

5.1 Land use Classification

5.2 Socio-economic Profile of Villages

5.3 Resource Dependence of Villages

5.4 Human-Wildlife Conflicts

5.5 Assessments of Inputs of Line Agencies/ Other Departments

Part B: The Proposed Management

Chapter 6: Visions, Goals, Objectives and Problems

6.1 Vision

6.2 Management Goals

6.3 Management Objectives

6.4 Problems in Achieving Objectives

6.5 Strengths-Weaknesses-Opportunities-Limitations (SWOT) Analyses

Chapter 7: Management Strategies

7.1 Delineation of Buffer Areas and Other Zones within the Buffer Area (e.g. Ecodevelopment Zone, Forestry Zone, Production Sector Zone, etc.)

7.2 Zone and Theme Approaches to Management Strategies

7.2.1 Zone Plans

7.2.2 Theme Plans

* D = Affects wildlife directly

** I = Affects wildlife incidentally

11.4 Indicative Plan for Adjoining Areas Providing Connectivity / Corridors (to be implemented by the Chief Wildlife Warden)

Conservation of Tiger will not only require the management of core and the buffer areas but it will also be the necessary to maintain connectivity to other core areas for ensuring gene flow as an ecological requirement for long term survival of the species. Therefore, it will be necessary to identify these areas of connectivity /corridors between two source populations. Infact management of these critical areas will be as important as the core areas. In most of the cases such areas will be under traditional forestry practices and other landuses. These areas will also the under tremendous pressures due to habitations and human activities. Therefore in such areas the existing management practices will have to be modified so as to upgrade and maintain the ecological status of the connectivity/ corridors. Obviously the agenda of co-existence will have to be implemented for such areas with a focus on the wildlife habitat parameters and the livelihoods/developmental needs of the local communities. Role of the local communities, line agencies and other stakeholders will be extremely important for the management of such areas.

The plan for these areas has to be very simple and focused. Many of the activities of extension, research/ monitoring and HRD will have to be linked with the Buffer Area Plan.

Following indicative format is proposed for the Management Plan of adjoining areas (corridors):

Part A: The Existing Situation

Chapter 1: Introduction of the Area

1.1 Brief Description of the Area and significance for tiger conservation.

1.1.1 Natural Habitat Corridors

1.1.2 Remnant Habitat Corridors

1.1.3 Regenerated Habitat Corridors

1.1.4 Planted Habitat Corridors (from plantations, shelter belts, etc.)

1.1.5 Disturbances in Habitat Corridors (railway lines, cleared transmission line, etc.)

1.1.6 Stepping stones (suitable habitat patches)

1.2 Map Showing landscape beyond Core and Buffer Areas.

1.3 Major Land use Classification in the Area.

1.3.1 Reserve Forest/ Proposed Reserve Forests/ Unclassified State Forests (Divisions/ Range/ Blocks/ Beats)

1.3.2 Villages/ Towns/ Cities (Districts, Sub-Divisions, Blocks, Panchayats)

1.3.3 Other uses (Agriculture, Tea Gardens, Plantations etc.)

1.3.4 Government Lands

1.3.5 Quality of Habitat

1.4 Statement of Significance (not covered under 1.1 above).

1.5 Geological attributes and Hydrology.

1.6 Vegetation Types

1.7 Wild Fauna and Habitats.

1.8 Major changes in the landscapes (Settlements/ other infrastructure).

1.9 Administration and Organization.

Chapter 2: Status of Tiger and Co-Predators

2.1 Distribution and Abundance Status with type of use by the tiger and co-predators.

2.3 Prey-Predator Relationships.

2.4 Assessment of Threats.

Chapter 3: Land use Patterns and Conservation-Management Issues

3.1 Socio-economic Profile of Villages and Resource Dependency and Human-Wildlife Mutual Impacts.

3.2 Assessments of Inputs of Line Agencies/ Other Departments.

Part B: The Proposed Management

Chapter 4: Visions, Goals, Objectives and Problems

4.1 Vision

4.2 Management Goals

4.3 Management Objectives

4.4 Problems in Achieving Objectives

4.5 Strengths-Weaknesses-Opportunities-Limitations (SWOT) Analyses

Chapter 5: Management Strategies

5.1 Delineation of Corridors and other habitat used by tigers and co-predators.

5.2 Prioritization of linkages

5.3 Development of integrated Landuse Approach for the Area commensurate with tiger conservation and co-existence agenda (Formulation and Coordination).

5.4 Wildlife management in territorial forest areas (Identification and inclusion of prescriptions in the Working Plans of respective divisions as per Working Plan Code).

5.5 Zone Plan Management Strategies (Protection, Habitat Management and Habitat Restoration, Supplementing Declining Local Populations and Facilitating their Recolonisation)

Chapter 6: Ecodevelopment and Livelihoods

6.1 Constitution of Adjoining Corridor Area Management Committee (with representation of different Forest Divisions, Line agencies and other Stakeholders) and Linkages with Tiger Conservation Authority

6.2 Formation of Ecodevelopment Committees (EDCs) and supporting institutional framework (Confederation of EDCs, Self Help Groups and Nature Clubs)

6.3 Livelihood Support Initiatives through Village Micro-plans supported by Tiger Conservation Foundation and Other Line Agencies

6.4 Monitoring and Evaluation

Chapter 7: Tiger Population and Habitat Assessment

7.1 Day to Day Monitoring Protocol

7.2 Tiger Population Estimation Framework (Phase I and II).

7.3 Analyses and Reporting Framework and Periodicity.

Chapter 8: Organization, Administration and Budget

8.1 Coordination Committee for effective implementation and management and Linkages with Tiger Steering Committee and Tiger Conservation Foundation.

8.2 EDC Coordination.

8.3 Staff deployment, Protection Strategy and Linkages with Tiger Cell and Buffer Zone Striking Force.

8.4 Schedule of Operations.

8.5 Activity Budget.

i. References

ii. List of Maps

iii. List of Appendices

12. Planning process (action points)

- Procure / obtain maps (beat level)
- Digitize maps
- Procure hardware
- Procure GIS software (arc view / arc info)
- Organize capacity building workshops for staff and other stakeholders
- Prepare local flora for identification
- Prepare guides / photo templates for identification of wild animals
- Collate secondary data relating to past management
- Collate secondary data relating to socio-economic profile
- Collate official data relating to villages and cattle
- Organize training workshops for data collection, use of range finder, compass, GPS and data collection formats
- Translate the data collection forms in local language (if necessary)
- Acquaint data entry operators with the excel spreadsheets for data collation
- Collect field data in standardized new formats used for all India tiger estimation
- Supervise data collection through independent panel of experts
- Transfer / attach beat level data to GIS maps at beat level
- Compute relative abundance of animals and vegetation values in the GIS domain
- Use this knowledge for prescribing appropriate zonation and management interventions

ANNEXURE-I

Simulation Results for Viable Tiger Population

To achieve the goals of the National Tiger Conservation Authority which are :

i. To prevent the extinction of wild tigers,
ii. To maintain and perpetuate viable free ranging tiger populations,
iii. To maintain representative viable free ranging populations so as to conserve unique genetic, behavioral and ecological adaptations of the tiger,
iv. To restore tiger populations in the remnants of their historical range.

The Wildlife Protection Act and Tribal and Forest Dwellers Act has the provision to declare ecologically critical areas as inviolate.

To establish guidelines for deciding on the size of critical areas needed for achieving the above objectives of tiger conservation, published data on tiger ecology, demography, and those available to the NTCA were used.

Data from the all India tiger status monitoring exercise jointly taken up by NTCA along with State Forest Departments and the Wild Life Institute of India wherein all potential tiger bearing forests were extensively surveyed with a systematic sampling design between November 2006 and March 2006, were used. A total effort of about 700,000 man days were invested with 396,000 km of transect walks for prey and habitat assessment, and 660,000 km of carnivore sign surveys were conducted. The effort resulted in the mapping of tiger occupancy and relative abundance, prey abundance indices, anthropogenic pressure indices and habitat quality across 17 states known to harbor tiger populations. A team of 50 researchers simultaneously estimated absolute abundance of tigers and prey by double sampling in a stratified sample of different tiger sign abundance. Relationship between indices and absolute abundance were evaluated and calibrated for predicting tiger densities. This research has demonstrated that tiger occupancy of forests were dependent on availability of wild prey and low human impact on the habitat. Tiger densities declined with increase in human use of the forests. Good source populations of tigers were found in areas devoid of human settlements and least human impact. Thus, to ensure perpetuation of the above goals it is essential to have an inviolate area for a minimum viable source population of tigers. A minimum of two such populations should be ensured in each bioregion so as to preserve the unique behavioral, ecological and genetic adaptations of the tiger.

Based on the demographic parameters and life history traits of tigers population (Box 1) simulation models suggest that if a core area having territories of 20 breeding tigresses were made inviolate, the resultant tiger population with an adequate buffer (multiple use area with eco-sensitive land use) has a very low probability of extinction (< 5% in 100 years, See Box 2). Tigress's territories are determined by prey availability which in turn are dependent on the productivity of the area. The size of this inviolate area depends on the average territory size of tigresses. These range between 40 to 60 km^2 within most of the tiger areas in the sub-continent. Thus, for a population of 20 tigresses we need an inviolate area of 800-1200 km^2. An ecological sensitize zone (buffer, Co-existence area, multiple use area) around this inviolate space is needed for sustenance of dispersal age tigers, surplus breeding age tigers and old displaced tigers of 1000-3000 km^2. This buffer and the tiger population within it is essential to make the core of 20 breeding females viable for long term, since it sustains the dynamics of source and sink. Such a tiger reserve will sustain a population of 75-100 tigers (Box 3).

In tiger areas where there is no possibility of securing sufficient habitat for the minimum core needed for 20 territorial breeding females the maintenance of inviolate corridors connecting these populations to other source populations of tigers is crucial. An inviolate core as large as

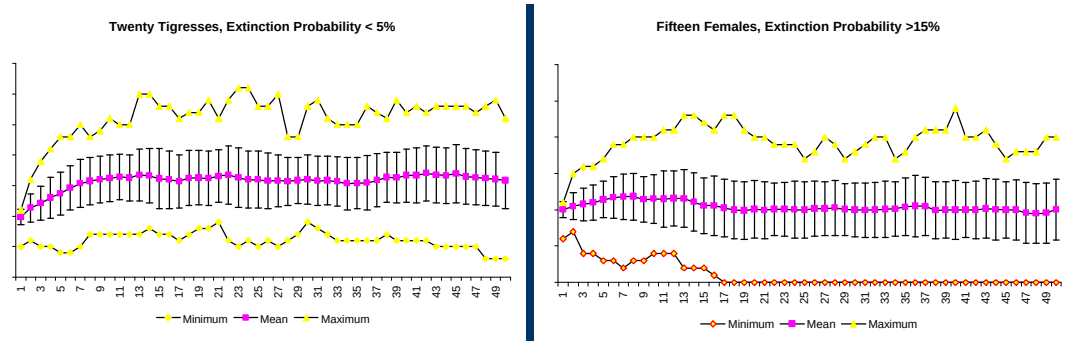
possible needs to be made in such reserves and tiger population viability ensured by an inviolate immigration corridor connecting this reserve to a major tiger source population.

In some small tiger reserves it may not be possible to either have sufficient space for 20 breeding females nor have habitat for an immigration corridor, in such cases an inviolate area as large as possible needs to be declared and the tiger population actively managed for demographic and genetic viability. This option needs to be exercised as a last resort after the first two options have been explored and found to be infeasible.

Box 1 Demographic Parameters of Tigers used for Simulation Models

- Adult sex ratio 2.4 tigresses: 1 male tiger
- Birth Interval 20 – 28 months
- Sex ratio at birth 50:50
- Survival of Cubs up to 1 Year : 50%, 40-80% Range
- Survival of 1 Year Old : 70% (CV 15%)
- Survival of 1-2 Year Old : 85% (CV 15%)
- Survival of >2 Year Old : 95% (CV 10%)
- Fecundity :litter size average 2.4, range 1 to 5

Box 2. Results of the Simulation of female population



Box 3. Expected Tiger Population in an Typical Tiger Reserve

For 20 breeding Tigresses
Core Area Required (Inviolate) 800-1000 km^2

Total Population in the Core (inviolate)
Male Tigers 8-10
Cubs < 1 Year 10 -15
Cubs 1-2 Year 10 -15

Buffer (Co-Existence Area with eco-sensitive land use)
Area Required 1000-3000 km^2
2-3 Year old tigers (recent dispersers) 10 -15
3-4 Year old tigers older dispersers 10 -15
Old tigers & Surplus breeding age tigers 10-15

Total Tiger Population in the Tiger reserve 75 – 100 Tigers

ANNEXURE -II

Menu of Options Emerging from Best Practices under the India Ecodevelopment Project (Based on a Study by the "Peace Institute", New Delhi)

(These are indicative only: each site has to innovatively evolve its site specific approach)

A) POLICY AND LEGAL MATTERS

1) It is evident that sites like Periyar TR, Kanha TR, KMTR, Gir NP, Buxa TR and Pench TR which have benefited from clear policy directives and enabling legal regime/s have produced commendable results. Clearly in future timely planning and action on devising national / state level ecodevelopment policies that facilitate institution building would be sine quo non for achieving lasting results. Further any policy sans enabling legal regime/s shall remain at best a half hearted step.

2) States need to see the results of IEDP as more than just a short term project's outputs but devise policy tools that **address threats that go beyond the control of the PA management.**

3) **Reciprocal commitments** by the beneficiaries for park protection as provided by the IEDP has gone a long way in improving park's protection and built good synergy between the people and the park. This should be incorporated as an essential element of any future ecodevelopment strategy.

B) INSTITUTIONAL MATTERS

a) Effective management planning as experienced by Periyar TR, KMTR, Kanha TR and Gir NP needs to be emphasized.

b) Specialized EDCs at Periyar has been a singular exceptional initiative under the IEDP. Periyar TR model should accordingly be adapted elsewhere too.

c) Transfer of responsibility to manage EDC affairs at Kanha TR and Pench TR in form of an EDC member being nominated as the Joint Secretary of EDC is a positive development whose success needs to be monitored and replicated elsewhere if experiment at Kanha and Pench show encouraging results in form of EDC empowerment.

d) Unified Buffer division at Kanha TR is a success story which should be replicated in other such Pas.

e) Capacity Building of frontline staff and the local people at Gir NP through focused training and long term EE has changed attitudes and empowered staff as well as the local people. The Gir experience needs to be widely disseminated and adapted at other sites.

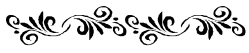
C) CROSS CUTTING INNOVATIONS

a) Income Generating Activities (IGAs) for social change at KMTR is an excellent example of visionary leadership and team effort.

b) Women's saving and credit groups (SHGs) at GHNP are again a remarkable effort resulting from motivated leadership.

c) Eco tourism and use of 'Mowgli' as the Park's mascot at Pench TR is an innovative use of historical / literary fame for attracting tourists.

d) Pilgrim management at Periyar that has transformed a recurring problem into an opportunity is a glaring example of successful conflict management.



ANNEXURE-III

Menu of Options in Ecodevelopment Practices (Based on a Study by the IIFM, Bhopal)

(These are indicative only: each site has to innovatively evolve its site specific approach)

S. No	**Problems (General for all PAs) Nature of problems**	**Strategies to tackle problems (General)**	**Strategies (Special)**	**PAs where practiced**
1	Large human and cattle population (Dependent on forest)	• Alternative employment in collaboration with other departments. • Awareness generation • Alternative livelihood provided • Started stall feeding	• Measures for trans-boundary cooperation	Buxa
2	Grazing	• Epidemic control by prophylactic immunization • Alternative employment in collaboration with other departments.	• People sold away cattle	KMTR
3	Poverty & Livelihood problems	• Trust building efforts • Installation of bio-gas, distribution of pressure cookers LPG	• Micro-credit scheme for women empowerment • Training and tourism centers • Pavitra van around temple • Adoption of school by Forest Department	Buxa GHNP Nagarhole
4	Illicit felling & Encroachments	• Environmental education and awareness generation • Effective management planning	• Boundary pillars created to demarcate park boundary	Pench / Ranthambhore, Gir, Periyar
5	Fire	• Fire control • Regular patrolling • Increase of staff strength • Alternative employment in collaboration with other departments. • Maintenance of roads, fire lines, trenches, patrolling tracks etc.	• 6250 kms of ‘D' lines & fire lines cleared	Nagarhole

S. No	Problems (General for all PAs) Nature of problems	Strategies to tackle problems (General)	Strategies (Special)	PAs where practiced
6	Poaching	• Equipping staff with rifles, wireless & vehicle etc.	• Creating EDC of ex-poachers to stop poaching • A team of anti-poaching watchers created • Formulation of forest protection force • Yearly census of wild animals • Aranya Sena	Periyar Ranthambhore Nagarhole Periyar
7	Human animal conflict crop raiding		• Feed back from tourists	Ranthambhore Periyar
8	Low participation of women	• Gender empowerment through training programmes	• Capacity building of the local people	Gir
9.	People's Participation		• Transfer of responsibility. • Joint Secretary of EDC • Three types of specialized • EDCs: Neighbourhood, user-group & professional groups. • EDCs. Pilgrim management and conservation. • Mowgli' as a park Mascot - and its impact on tourism • Providing a legal basis to Ecodevelopment. • Clear Govt. orders for effective institutionalization • Reciprocal commitments from people	Pench Periyar Periyar Pench KMTR Periyar GHNP

ANNEXURE-IV

Illustrative, Inventory of Possible Activities under Ecodevelopment in Conservation and Extension Buffer Zones of Protected Areas

(Source: WII)

(These are indicative only: each site has to innovatively evolve its site specific approach)

Note: Depending upon site attributes (climate, terrain, soils, present patterns of farming, fishing, livestock raising, practices of other resource use, status of conservation/degradation, potential for restoration, variety of non-wood forest products, local skills, existing and possible infrastructure etc.) a holistic site-specific package of measures in an appropriate combination most suited to the given site should emerge as a result of a fully participatory planning process, involving local people, NGOs (Is) and government agencies (concerned with land and resource use, and rural development) as conducted by the PA management with the coordinating assistance of district administration.

A. In Forests, grasslands & scrub-savanna lands

(i) Orientation of forestry operations for the concurrent promotion of biodiversity conservation and meeting resource needs of and generating employment for local people.

(ii) Joint management of forests, grasslands and scrub-savanna lands with formalized prior agreements for substantial sharing of (even exclusive claim on) usufruct, in return for direct contribution to protection and conservation.

(iii) Organized collection of important non-wood .forest products with measures to ensure long term sustenance of productivity.

(iv) Cultivation and/or organized collection of medicinal plants, essential oil bearing herbs, mushrooms, pepper, cardamom, other species, tussar silk cocoons etc, which is compatible with other forestry objectives, especially conservation and other local interests.

(v) Preferential and concessional availability of wood and non-wood resources to local people directly participating in conservation of forest and other resources.

(vi) Pasture improvement through weed suppression/eradication and enrichment planting with complete or rotational closures.

(vii) Economic employment generation through weed suppression *e.g. Lantana* harvests for pulp, chipboard or basket making on small or cottage industry scale.

(viii) Providing green fodder at beginning of monsoon by hiring irrigated fields, at least during the 'gestation period' to enable people to take to rotational grazing/ lopping and stall feeding.

(ix) Rotational lopping and promotion of goatary subject to stall feeding based on sustainable lopping regimes.

(x) Harvest of green grass and plant fodder during monsoon in designated areas (if necessary, rotational) in the 'conservation' and 'extension' buffer zones.

(xi) Harvest of grass at the end of monsoon and providing hay in return for cooperation in observance of regulated grazing/lopping.

(xii) Special consideration to exclusive pastoralists in above measures, backed where necessary by relocation from forests and a viable package of rehabilitation in other near by lands (or forests where non-forest land is unavailable) with green fodder farms (grass and/or fodder trees/plants).

(xiii) Simple water harvesting and catchment treatment works.

(xiv) Preferential employment to locals in all the above works.

B. In private farms

(i) Improved dry farming techniques (improved seed, manure/ fertilizer regimes).

(ii) Efficacious water harvesting (surface and ground water).

(iii) Soil conservation measures.

(iv) Preference to cash crops *e.g.* pulses, oil seeds, spices, cotton, medicinal plants.

(v) Agro forestry.

(vi) Sericulture & horticulture with assured employment through these on one's own land and from other community works, in order to tide over the 'gestation period'.

(vii) *Jhumming areas.:* l}Partial switch over to agro-forestry and/or cash crops (including medicinal plants and plantation crops) with assured employment through these work on one's own land and on other community works, in order to tide over the 'gestation period'.

(viii) Apiculture.

C. Minor Irrigation

(i) Simple diversion or diversion cum storage type micro-minor irrigation schemes including development of village tanks with preferential employment to local people.

(ii) Lift irrigation schemes using micro-hydel (or grid where available) power or pump sets, based on rivers, reservoirs and wells.

(iii) Bore well irrigation, where feasible.

D. Animal Husbandry, dairying and wool crafts

(i) Phased reduction in population of scrub livestock and improvement of breed through controlled fertilization of female stock in proper health and age with males of better local breeds, aided by sterilization of scrub bulls.

(ii) Goatary and sheep raising subject to stipulations suggested under ' A ' above.

(iii) Cooperative dairying with marketing support.

(iv) Support to small scale enterprises based on meat and wool.

E. Fisheries

(i) Exclusive rights to organized cooperatives/user groups of local people in all situations, subject to observance of regulations for sustainability and optimal economic productivity -especially, closed areas/seasons and mesh size of fishing nets, and cooperation in ensuring ban on use of explosives and other forms of poaching.

(ii) Marketing support backed by cold storage and appropriate transport arrangements.

(iii) Special to deltaic mangroves: Sustainable prawn culture without prejudice to natural regeneration in the estuaries.

(iv) Special to coasts: Sustainable harvests using sail and/or powered boats with appropriate back up to keep away large scale commercial operators exploiting directly. The latter should acquire the catch on reasonable payments from user groups.

F. Ecotourism:

(i) Obligatory use of local guides (after training) on nature trails, trekking and mountaineering routes.

(ii) Preferential and assisted allocation of way side lodges on long trekking mountaineering routes to locals, with a back up of micro-hydel power and fodder development to mitigate pressures on forests and pastures in high altitude areas.

(iii) Development of trekking routes in tracts which have potential for ecotourism.

(iv) Preferential employment to locals in protected areas and tourism facilities, after education and training as necessary.

(v) Promotion of local handicrafts as tourist souveniers with appropriate sale outlets.

G. Infrastructure

(i) Microhydel/ grid/ solar power for energy for cottage industries and local value addition by processing.

(ii) Ropeways or trails, especially for goods movement in difficult and remote high altitude areas so as to ensure better economic returns from products exported and economic prices for goods (including food) imported.

(iii) Wind mills/water mills for food processing and crafts *e.g.* turnery.

(iv) Piped (gravity) supply, hand pump or open wells for drinking water.

H. Cottage Industry & Handicrafts

(i) Promotion based on local skills with appropriate technological and infrastructure support.

(ii) Curing/processing of collected/cultivated products *e.g.* medicinal herbs and essential oil for value addition.

(iii) Investigation of potential plants/products by pursuing ethno botanical and ethno zoological studies and rich development for consumption/marketing.

Development Projects

(i) Obligated to have a local orientation so that they become part of local area development and in no case upset local people's resource equations, especially in relation to CPRs. Appropriate compensation/alternatives to be built into project costs.

(ii) Obligated to compensate by providing inputs into site-specific packages of ecodevelopment measures *e.g.* lift irrigation along reservoir and along the river upstream and downstream.

(iii) Obligated to allow (where admissible *vis-à-vis* the PA) local people to farm in draw down areas by providing lift irrigation facilities.

(iv) Preferential employment to locals, if necessary after arranging education and/ or training.

ANNEXURE-V (a)

Methodology for estimating and monitoring tiger status and habitat

- **Y V JHALA,** *Faculty, Wildlife Institute of India*
- **QAMAR QURESHI,** *Faculty, Wildlife Institute of India*
- **RAJESH GOPAL,** *Director, Project Tiger*

The only form of tiger population monitoring undertaken in the country is a total count (census) of the country-wide tiger population every four years and within tiger reserves every one-two years. The census is 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 methodology has come under severe criticism (Karanth et al, 2003). The major limitations of the above technique are that

1. it relies on subjective (expert knowledge) identification of tigers based on their pugmarks;
2. the pugmarks of a tiger are likely to vary with substrate, tracings/casts and the tiger's gait;
3. it is not possible to obtain pugmarks of tigers from all tiger occupied landscapes, and
4. the method attempts a total count of all tigers (*Karanth* et al, *2003*).

An alternative proposed by tiger biologists is to use individually identified tigers by camera traps in a capture-recapture statistical framework to estimate tiger densities (*Karanth 1995 and 1998, Karanth and Nichols 1998, 2000 and 2002, Karanth* et al *2004, Per Wegge* et al *2004 and Pollock* et al *1990*). The method has been useful in determining tiger densities in small areas, within tiger reserves having high to medium density tiger populations. The method has a high potential for monitoring source population and smaller sample areas within tiger occupied landscapes. However, due to the technical nature of the technique, high cost, security issues of the equipment and low performance in low density tiger populations this method has its limitations for a country-wide application for monitoring tigers (*Carbone* et al *2001, Karanth 1995 and 1998, Karanth and Nichols 1998, 2000 and 2002, Karanth* et al *2004 and Kawanishi and Sunquist 2004*).

The other two potential methods that can be used in smaller sample areas for monitoring source tiger populations are the individual identification of tigers from digital images of their pugmarks (*Sharma* et al, *in press*) and tiger DNA profiles obtained from scats and other non-invasive techniques (*Broquet and Petit 2004, Prugh* et al *2005 and Xu* et al *2005*).

Here, we propose an alternative technique based on a four-stage approach:

Stage I: Spatial mapping and monitoring of tigers, prey and habitat

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 km^2.

We consider a forest beat (an administrative unit, 15-20 sq km in size, delineated primarily on natural boundaries) as the unit for sampling. Since each beat is allocated to a beat guard for patrolling and protection, the boundaries of a beat are well recognised by forest staff. The sampling would be systematically distributed in all beats of tiger occupied forests (tiger reserves, revenue and reserve forests). Thus, in effect, the entire landscape where tigers are likely to occur is sampled (beats are not stratified or randomly sampled, but all beats are sampled as large humanpower is available for sampling). In forest areas, where beat boundaries are not delineated (< 20 per cent of tiger occupied forests in the country) – such as the northeast — 15-20 sq km sampling units will be identified on the basis of natural boundaries (ridges, drainage, etc). The detailed methodological approach for sampling carnivore signs, ungulate encounter rates, pellet/dung counts, habitat and anthropogenic pressures are presented in the 'Field Guide' (*Jhala and Qureshi 2004*).

The target data are extremely easy to collect and require no high level of technical skills or equipment. It is crucial that the forest department staff is primarily responsible for the data collection due to the sheer magnitude of the task involved. Furthermore, the involvement of the forest department staff instills ownership and accountability of this agency which is primarily responsible for the protection and management of wildlife resources. The forest

department staff will be trained in the data collection protocol and tested for consistency.

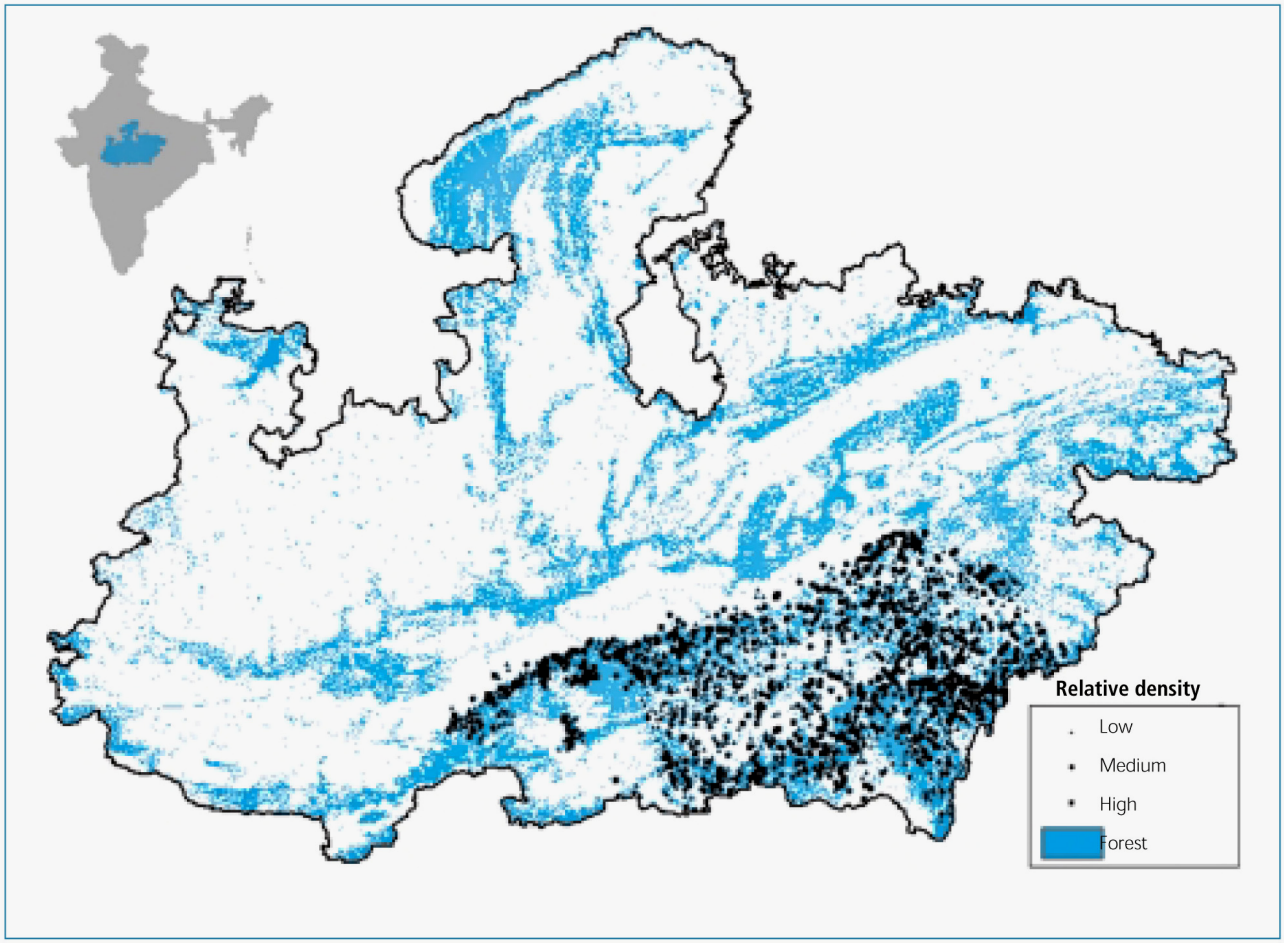
The spatial data generated will be scientifically robust, and amenable for statistical analysis and inference. Since several replicate surveys will be undertaken in each beat, we shall be able to model tiger occupancy, detection probability of tiger signs, and relative sign density at a high spatial resolution (stratified on the basis of ecological characteristics, range or a superimposed grid of varying scale) using the approach of MacKenzie *et al* (2002), Royale and Nicholes (2003) and Royle (2004). Since the data will be analysed in a GIS domain, several spatial and attribute data like human density, livestock density, road network, topographical features, forest type and cover, meteorological data, poaching pressures and landscape characteristics will be 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.

We have tried to address the issue of reporting inflated numbers by laying emphasis on animal signs instead of numbers. Furthermore, the resolution of the data generated will be reduced to four-five categories (high, medium, low and absent). Several corroborating variables like prey encounter rates, pellet group counts and habitat condition will help in ensuring quality data; discrepancies in reporting will be easy to pinpoint. There would be an audit mechanism in place to scrutinise the data collection, compilation and analysis. National and international experts would act as observers while officers in-charge will ensure adherence to the prescribed protocol and transparency of protocol implementation.

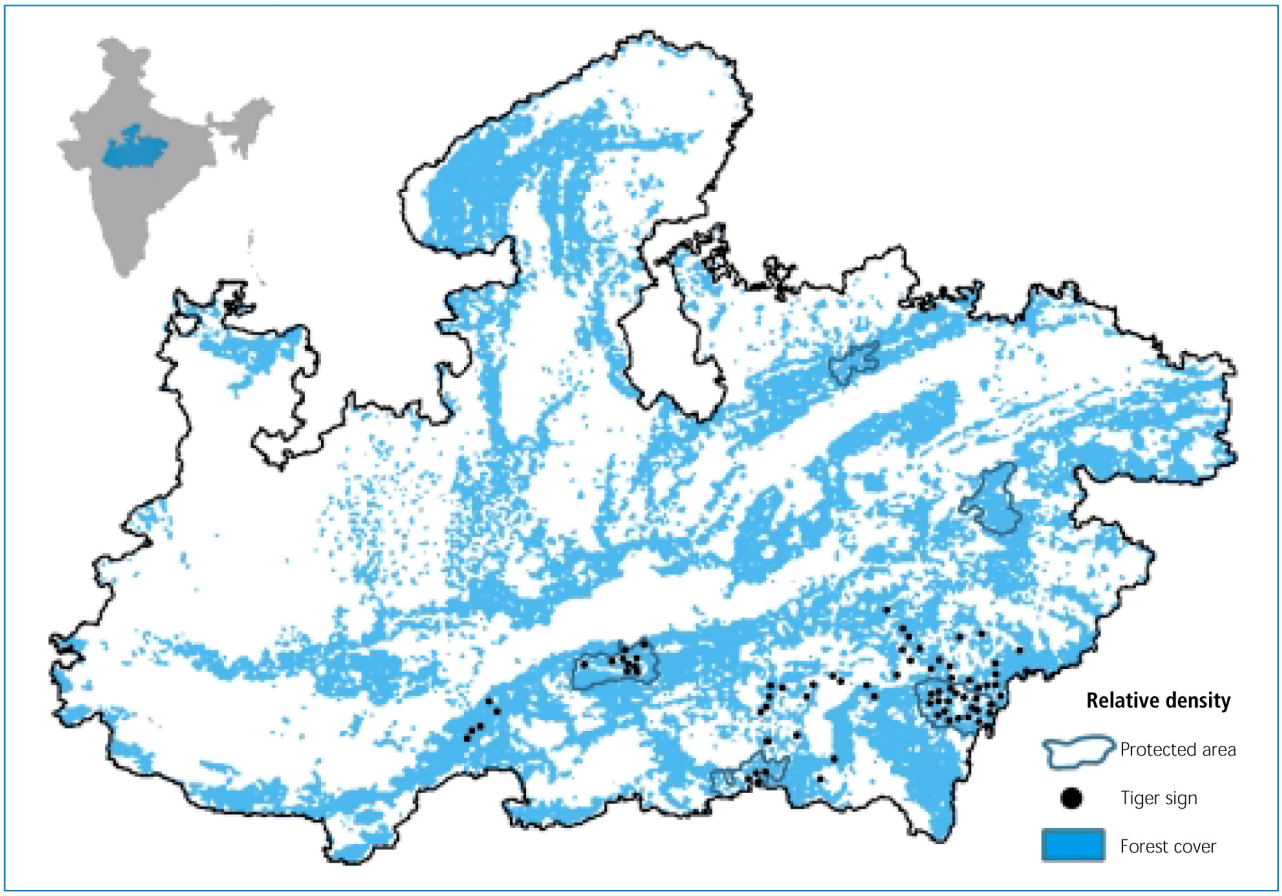
The system, once institutionalised and implemented, will not only serve to monitor tiger populations but will also monitor the status of other biodiversity resources of all tiger occupied landscapes, truly exemplifying the role of the tiger as a flagship. It will serve as an effective tool for decision makers, managers and conservationists alike and will help guide and plan land use policy at a landscape level.

We have tested the logistics of implementation of the above methodology in the Satpura-Maikal

Map 1: **DISTRIBUTION OF UNGULATE TIGER PREY IN THE SATPURA-MAIKAL LANDSCAPE**



Map 2a: **TIGER SIGN PRESENCE WITHIN THE SATPURA-MAIKAL LANDSCAPE**



landscape (about 48,000 sq km) in Madhya Pradesh covering 3,150 beats in 178 forest ranges and mapped tiger and ungulate abundance. Tiger presence was recorded in 290 beats with 78 beats having high, 57 having medium and 155 having low abundance of tiger signs. Ungulate tiger prey was recorded in 1,678 beats. Spatial distribution of these is shown in Figures 1, 2a and 2b. The analysis of this data is in progress.

Stage II: Spatial and attribute data

The spatial and aspatial data that are likely to influence tiger occupancy of a landscape will be used for modeling in a GIS domain. The vegetation map, terrain model, night light satellite data, drainage, transportation network, forest cover, climate data, Normalised Difference Vegetation Index, livestock abundance, human density, socio-economic parameters, etc will be used for modeling habitat condition and tiger occupancy. Beat-wise vegetation sampling will be done to generate broad vegetation map. IRS (KISS3 and AWiFS), LANDSAT and AVHRR satellite data will be used. Part of this component will be done in collaboration with Forest Survey of India. This modeling will help in determining current spatial distribution of tigers, potential habitats, threats to crucial linkages between occupied landscapes and conservation planning.

Stage III: Estimating the population of tigers and its prey

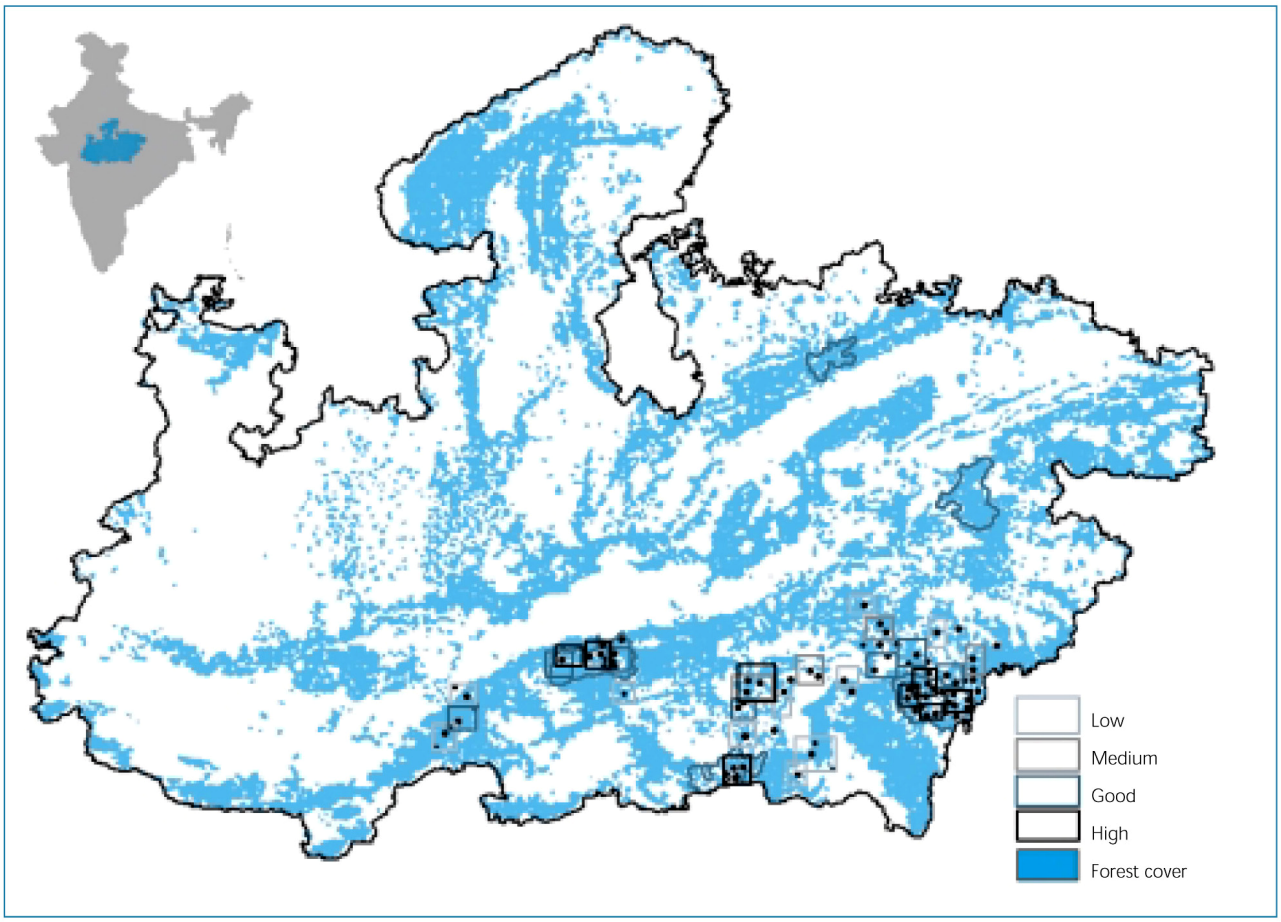
Stage 3 of the proposed methodology answers the question of how many tigers and ungulates are there. Teams of researchers will be deployed in each landscape complex for estimating tiger density and ungulate densities within stratified sampling units.

Tiger numbers

We propose to stratify a Tiger Conservation Unit (TCU) into tiger sign abundance classes of high, medium, low and no tiger sign at the beat and larger spatial resolution (range 100 sq km). In each of these strata, within a landscape (TCU), we propose to estimate actual tiger density in three-five replicates of sufficient size (50-200 sq km).

All known techniques of tiger density estimates will be used depending on the logistic possibility within each landscape: capture-recapture based on

Map 2b: **100 SQ KM HABITAT BLOCKS WITH DIFFERENT ABUNDANCE RANKING OF TIGER SIGNS WITHIN THE SATPURA-MAIKAL LANDSCAPE**

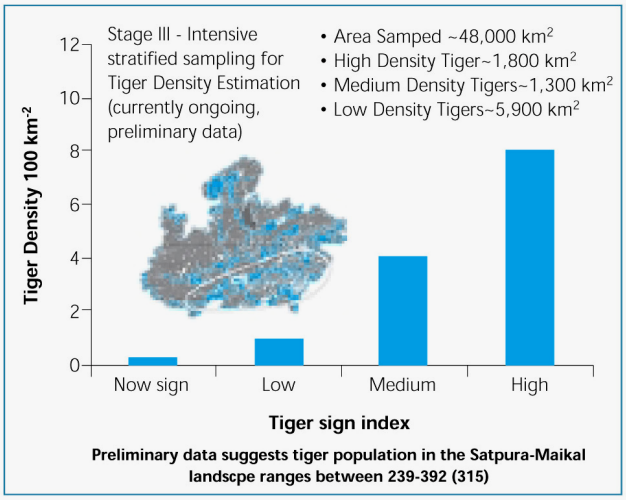


camera traps (*Karanth 1995 and 1998, Karanth and Nichols 1998, 2000 and 2002, Karanth* et al *2004, Pollock* et al *1990, Carbone* et al *2001 and Per Wegge* et al *2004*), mark-recapture based on pugmarks (*Sharma* et al *in press*) and DNA profile obtained from tiger scats (*Broquet and Petit 2004, Prugh* et al *2005 and Xu* et al *2005*). These densities will then be extrapolated for the areas under various density classes within the landscape to arrive at a tiger population estimate (*Figure 3*). We do realise that these population estimates are likely to have high variances, but since these estimates will not be used for monitoring trends (which is proposed to be done through the site occupancy and relative abundance data), they should suffice the need for converting a relevant ecological index to a more comprehensible concept of numbers.

Tiger prey

Stage I of the protocol would be reporting encounter rates on line transects (*Buckland* et al *1993*); these would suffice for monitoring trends in ungulate population and site-specific occupancies. To convert encounter rates to density, an estimate of the effective strip width of these transects would be essential. The effective strip width of a transect primarily depends on the visibility (vegetation and terrain type), ability to detect ungulates by different observers and animal behaviour response (*Buckland* et al *1993*). We modeled effective strip widths in different vegetation types of a landscape in the Satpura-Maikal landscape using model ungulate cutouts (*Figure 4*). Effective strip widths determined from the model and actual sightings of ungulates for different vegetation types estimated for the same season did not differ (*Mitra 2004*) within Kanha (a protected area). However, ungulate response is likely to play an important role in disturbed areas in determining effective strip widths. We intend to determine habitat and terrain-specific effective strip widths by actually sampling selected sampling units and by modeling. Since the transect line in a beat is habitat-specific (*Jhala and Qureshi 2004*), we would be able to use these estimates of effective strip widths for converting encounter rates of ungulates to density

EXTRAPOLATING TIGER SIGN INDEX TO TIGER DENSITIES AND POPULATION ESTIMATES



Preliminary data suggests tiger population in the Satpura-Maikal landscpe ranges between 239-392 (315)

estimates by modeling detection probabilities.

Pellet group counts on transects would serve as an index to the presence of ungulate species and pellet relative abundance (and are not used for absolute density estimation), especially in disturbed areas where actual sightings may be difficult.

Stage IV: Intensive monitoring of source populations

We propose that source populations of tigers (tigers in tiger reserves and protected areas) in each tiger landscape complex be monitored intensively. We propose the following methodology for this monitoring:

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 (*Panwar 1979, Smith* et al *1999 and Sharma 2001*). Sign surveys and individual tiger monitoring should become a regular task for every guard as was the practice some years ago and is currently practised in some tiger reserves. The monthly data should be mapped and maintained to analyse 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 Project Tiger directorate will play the overall supervisory and coordination role for all the phases and tasks under each phase of the monitoring.

ANNEXURE V (b)

Protocol for daily monitoring/ forecasting of tiger presence in a habitat

1. Lay 10 pugmark impression pads (PIPS) in a beat, preferably in areas frequented by tigers.
2. The distance between two successive PIPS should be 1 km.
3. The size of PIPS should be 3m X 2m.
4. Monitor the PIPS once a week for tiger evidences (pugmarks/ scats) or use camera traps if available.
5. Take photographs as well as plaster casts of pugmarks; if possible.
6. Sudden, drastic reduction in tiger evidences is warning (forecasting)

Date: _____ RANGE: _____ BEAT NAME: _____ PIOP No.: _____ GPS Coordinate: _____ Time: _____

Put tick marks in appropriate column			
S.No			
1.	Tiger pugmark	Present	Absent
2.	Plaster cast of pug mark	Taken	Not taken
3.	Habitat Type		
4.	Male	Tracks recorded	Not recorded
5.	Female	Tracks recorded	Not recorded
6.	Cubs	Tracks recorded	Not recorded
7.	Other Carnivore Tracks	Present	Not Present
8.	Hyaena		
9.	Leopard		
10.	Sloth bear		
11.	Wild dog		

ANNEXURE-V (c)

Data collection protocol

(Source: Monitoring Tigers, Co-predators, prey and their habitat: Field Guide, Jhala, Y. V. Qureshi,Q & R.Gopal 2005. Project Tiger Directorate and Wildlife Institute of India)

1- Sampling for Tiger, Leopard, and Other Carnivore Sign Encounter Rate

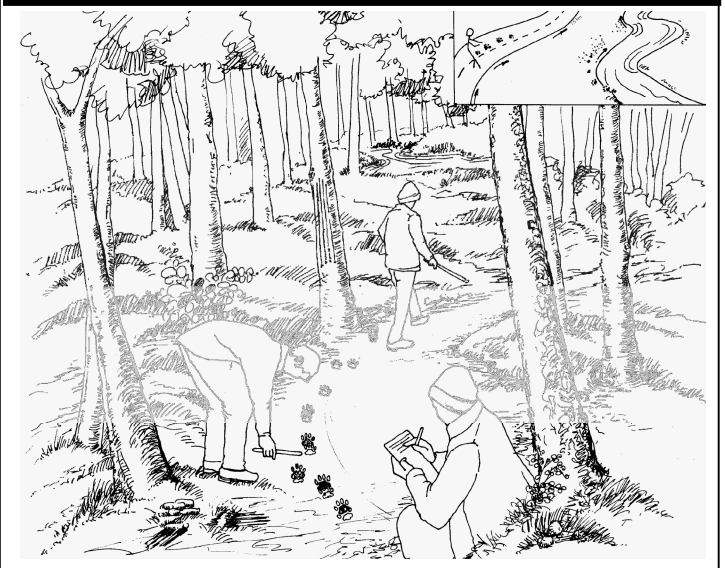
To obtain data on the presence, absence and intensity of use of a beat by tigers and other carnivores, we shall quantify the relative abundance of tiger, leopard, and carnivore signs in an area. The following procedure needs to be followed for data collection:

? A beat will be considered as a sampling unit.

? Areas within the beat that that have the maximum potential for tiger occupancy will be intensively searched.

? Since tigers & leopards have a tendency of using dirt roads, trails, foot paths, river beds and nullahas, these landscape features within the beat need to be searched intensively (Figure 1).

Figure.1. Sampling for Tiger



? One to three persons who know the terrain and habitat features of the beat should conduct the search for tiger sign.

? There should be 3-5 separate searches (in different compartments within the beat and/or at different times 1-5 days apart) each search covering about 4-6 km distance in areas having the best potential for tiger presence. It is important to record the distance covered and the time spent during each search separately (in the data sheet-1) and accurately. If time is spent resting or in other activities while conducting the search, this duration should be reported separately. If possible the GPS coordinate of the beginning point of each search path should be recorded.

? The total minimum distance covered while searching for tiger and other carnivore sign should be 15 km per beat.

? Tiger & leopard signs should be classified into the following categories 1) Pugmark trails, 2) Scats (Old : dry with hair and bones visible; Fresh: dry but intact with shiny surface; Very Fresh: soft, moist, and smelly, 3) Scrapes, 4) Scent marks (spray, rolling), 5) Rake marks on trunks, 6) Actual sighting, 7) Roaring (vocalization).

? A brief description of the topography and forest type is to be recorded for each sign.

? In case of pugmark trails, each trail set is considered as one sign (not each pugmark as one sign). In case a tiger (or other carnivore) continues to walk along a dirt road for a long distance (say 1 km), then this should be considered as one sign, and a comment recorded in the remarks section of the data regarding distance covered by a pugmark trail of a single tiger.

? Tiger and leopard signs if encountered outside of the sampling route should also be recorded with GPS coordinates (if available) and with appropriate comments.

? Special emphasis should be given to sign of tigress & leopards with cubs, and any authentic evidence of tiger cubs (sightings of cubs, lactating tigress, tracks, etc.) obtained within the past twelve months should be mentioned in the data sheet.

? While sampling for tiger and leopard signs, record should also be kept for signs of any other carnivore that are encountered.

? The number of livestock that are killed by predators within the past three months needs to be recorded in the questionnaire following the data sheet.

? It is important to report data sincerely. It is likely that there may be reliable information that tiger/leopard is present in the beat being sampled, but no tiger/leopard signs are recorded during the intensive search survey. In such cases, mention should be made in the remarks column of the data sheets. However, failure in obtaining tiger sign from a beat is equally important as recording tiger/leopard signs and for appropriate analysis of this data the actual data should be reported.

Data Sheet – 1

Data Sheet for Tiger, Leopard &
Other Carnivore Sign Encounter Rate

Observers name :..... Start Time : .....
Date: ..... End Time : .....
Begin GPS : Lat: .....N, Long : ..... E
Forest Circle :..... Forest Division: .....
Range: ..... Beat : .....
Total Kms. Walked ..... Km. Times Spent in any other activity ..... Min.

Sl. No.	*Carnivore Species	^ Sign Type	Forest Type	Terrain Type	Remarks
1					
2					
3					

* Carnivore species to be recorded: tiger, leopard, wild dog, bear, hyaena, wolf, jackal

^Sign types to be recorded are pugmark, scats, scrapes, rake, vocalization, and direct sighting.

1) Has any tigress with cubs been reported during the past 12 months ?
Yes____ No____ Approximate date/month_____
a) Seen by staff, b) Pug Marks,
c) Reported by local persons, d) Seen by officials (? the appropriate)
How many cubs _____, approximate age of cubs _____.

2) In case tigers are known to be present in the beat, but no sign was obtained during the sampling period then mention on what evidence was this conclusion made (pugmark, direct sighting, scat, other sign)_____.
Approximate date/month_____ Tiger presence was last recorded in the beat.

3) Has any leopard with cubs been reported during the past 12 months ?
Yes____ No____ Approximate date_____
a) Seen by staff, b) Pug Marks,
c) Reported by local persons, d) Seen by officials (? the appropriate)
How many cubs _____, approximate age of cubs _____.

4) In case leopards are known to be present in the beat, but no sign was obtained during the sampling period then mention on what evidence was this conclusion made (pugmark, direct sighting, scat, other sign)_____.
Approximate date/month _____ leopard presence was last recorded in the beat.

5) How many livestock predation events have been recorded in the past 3 month, _____ by tigers, _____ by leopards, _____ by dhole, _____ by other carnivores_____, _____, _____, specify which carnivores if known_____, _____, _____.

6) Comments & Remarks :
_____

2 - Sampling for Ungulate Encounter Rates

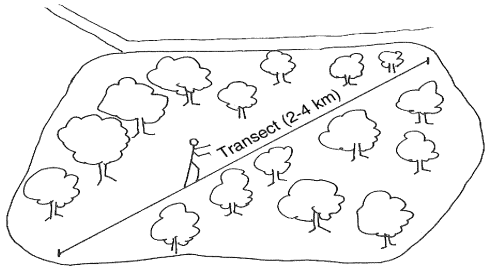
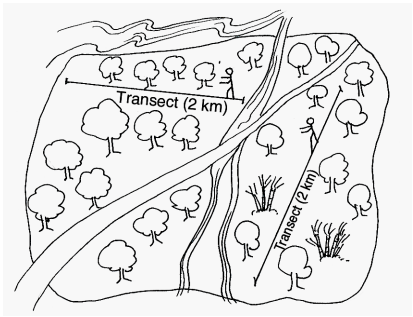
This protocol outlines a simple method for quantifying ungulate abundance in an area based on visual encounters while walking along fixed line transects. The following procedure needs to be followed for data collection:

? A beat would be considered as the unit for sampling.

? 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 will be marked for sampling.

? The transect line should traverse similar habitat (broad vegetation types) as far as possible. If the beat is composed of 2 or 3 distinct vegetation types eg. Mixed Teak Forest comprising 40% of the beat and the remaining 60% comprised of Miscellaneous forest with bamboo, then 2 separate line transects should be marked for sampling as shown in Figure. 2b.

Figure 2. Marking Transects in a Beat.

Figure 2A Line transect in a beat with similar habitat	**Figure 2B Line transect in a habitat with 2 habitat types**
	

? As shown in figure 2b, the line transect within a beat may be broken up into 2 or more segments so that each segment has a minimum length of 2 km and traverses similar habitat.

? Care should be taken that a line transect is not located near a busy road nor should it run parallel to a river or other features of the landscape which may bias sighting of ungulates.

? For each transect the point of beginning and end point coordinates (Latitude and Longitude) should be recorded by a global positioning system.

? The broad forest type and terrain type that the transect traverses needs to be recorded.

? Each transect should be walked by 1-2 persons during the early morning hours (6:30 AM to 8:30 AM). Preferably one of the persons walking should be a good field person who is able to spot wildlife.

? A record should be kept of all mammals and peafowl seen during the walk in the prescribed format (see data sheet). For each animal sighting the following needs to be recorded: 1) serial no of the sighting, 2) time of the sighting, 3) species (eg. sambar, chital, wild pig, peafowl, langur, etc.), 4) group size – number of animals of the same species in the group sighted, it is important to try to count the number of animals in the group as accurately as possible. Animals are considered to belong to two different groups if the closest animals from the two groups are separated by a distance of over 30 m.

? If possible the number of young (fawns/calves less than 1 year of age) seen in the group should also be recorded.

? A broad habitat category (vegetation and terrain type) needs to be recorded for each sighting eg. S. No.5. 12 chital (10 adults and 2 young) were seen at 6:40 am, in mixed teak forest, gently undulating terrain.

? Each line transect needs to be walked at least on three different mornings for estimating ungulate encounter rates.

Data Sheet - 2

Encounter Rate on Line Transects

Observer name : .....
Start Time : .....
Date : .....
End Time : .....
ID no. of Line Transect :.....
Total Length : .....km
Forest Circle : .....
Forest Division :.....
Range : .....
Beat : .....
Transect Forest Type :.....
Transect Terrain Type:.....
Weather condition : Cloudy/Clear sky
Beginning GPS Lat : .....N;
Long : .....E
End GPS Lat : .....N;
Long : .....E

Sl. No.	Time	Species*	Total Nos. (Adults & Young)	Young	Forest Type	Terrain Type	Remarks
1							
2							
3							
4							
5							

*Species that need to be recorded on the transect: chital, sambar, nilgai, gaur, barking deer, elephant, rhino, wild buffalo, swamp deer, hog deer, chowsingha, blackbuck, chinkara, wild pig, langur, peafowl, hare, cattle(live stock), and other mammalian species seen.

Figure 3 Ungulate Encounter

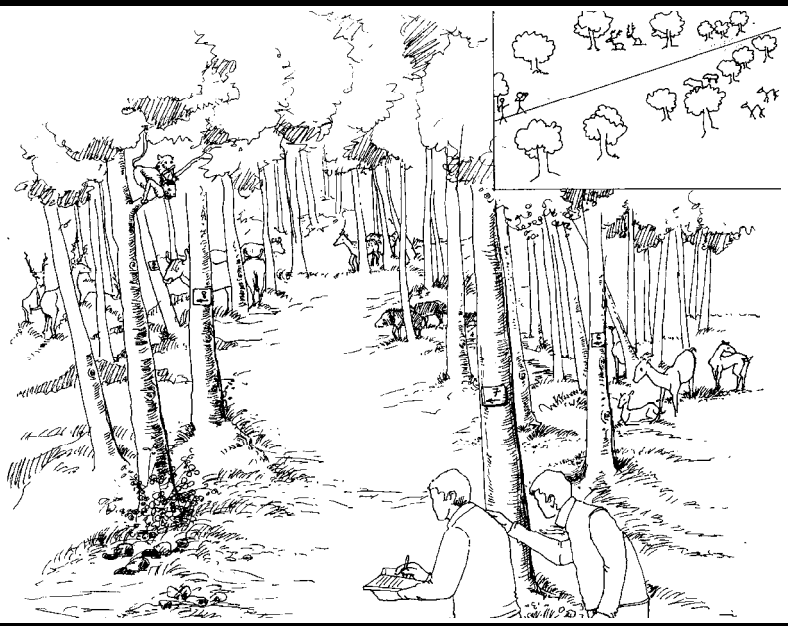


Figure 4 Vegetation

3 - Sampling for Vegetation, Human Disturbance, and Ungulate Pellets

To quantify the habitat parameters and determine relative abundance of ungulates sampling will be done along the same line transect on which ungulate encounter rates were estimated. For economy of time and effort it would be possible to first sample the line transect during early morning hours for ungulate encounter rate and then while returning along the same line, sample for vegetation and ungulate pellets. Sampling for vegetation, ungulate dung and human disturbance will be done only once on a transect.

- Again a beat will be the sampling unit, and sampling will be done along the established line transect.
- The beginning and end point coordinates of the line transect need to be recorded using a GPS unit.
- The same principal of laying line transects as explained in the section on ungulate encounter rates is applicable here (see Figure 2).
- Vegetation would need to be sampled every 400 m along the transect.
- The vegetation would need to be quantified visually at the following categories for each plot:

Figure 5. Estimating canopy cover

Figure 6. Estimating the ground cover

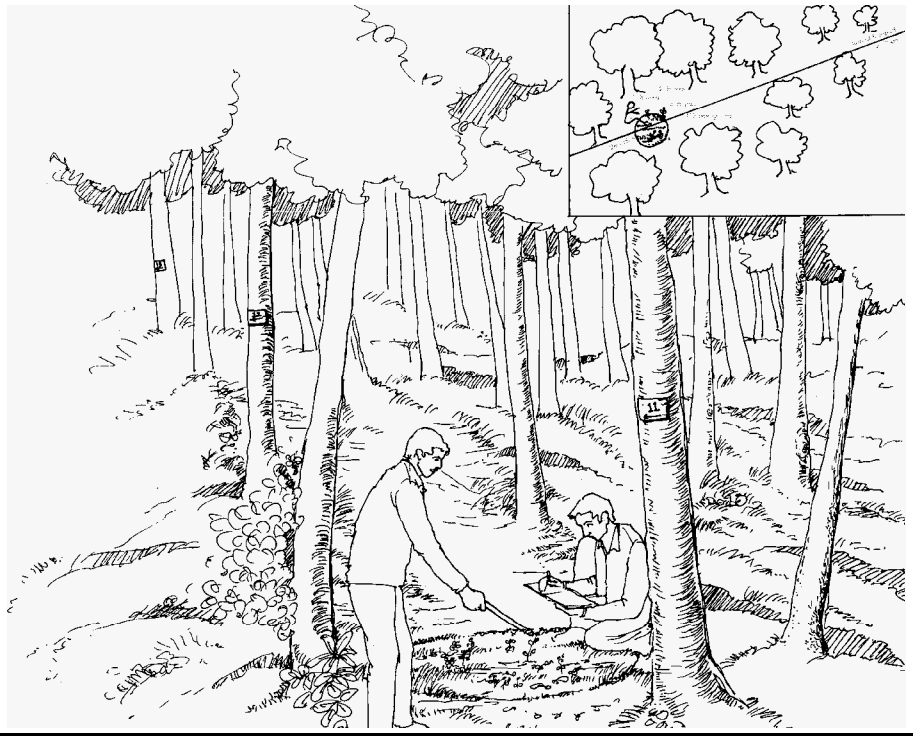
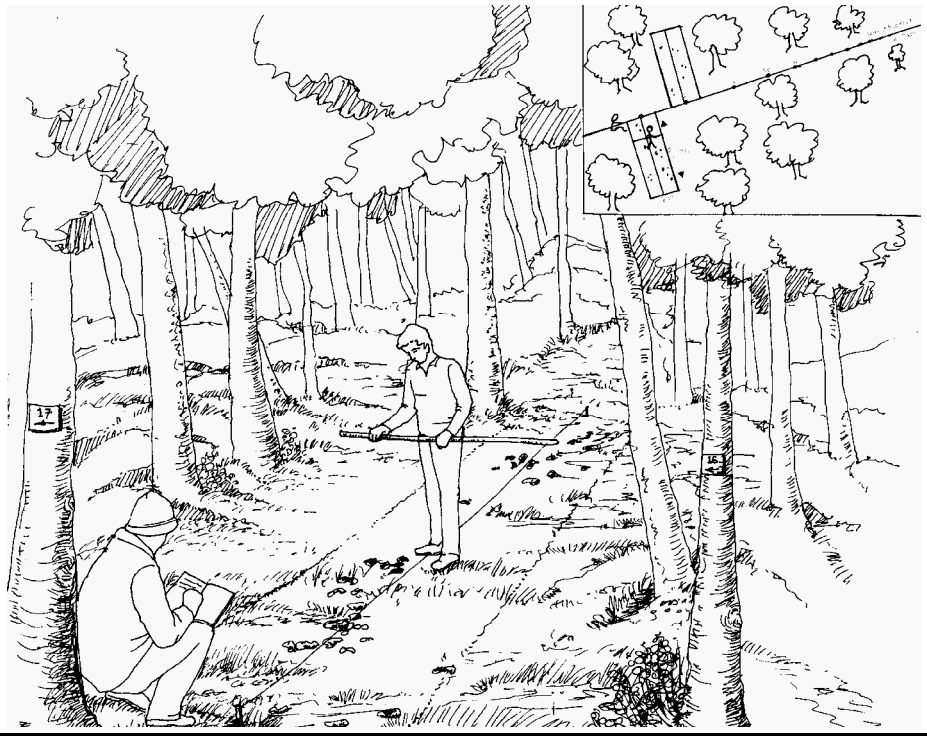


Figure 7. Quantifying ungulate fecal pellets



In 15 m. radius circular plot

1) Broad vegetation type and associated terrain type eg. mixed teak forest on hilly terrain, sal forest on flat land, etc.

2) Within a distance of approximately 15 m of the observer the five most dominant trees need to be listed in the order of dominance (abundance) (see Figure 4).

3) The observer needs to list the 5 most dominant shrub species in order of dominance (abundance) within 15m of the location. He needs to categorize shrub density (under-story vegetation) as absent, very low, low, medium, and dense. Shrubs will be assessed on five point scale (0 to 4 i.e. absent to most abundant) for density estimation.

4) If weeds are present, their abundance needs to be scored on 0 to 4 scale (0 being absent and 4 high abundance) and the three most common weeds seen in 15 m need to be listed in order of abundance.

5) Within the same 15 m distance the observer needs to record number of signs of looping, wood cutting, and presence/absence of human foot trail.

6) The observer needs to visually quantify the canopy cover at the location. The observer should subjectively classify the proportion of the sky above him that is covered by canopy foliage and categorize it into <0.1, 0.1-0.2, 0.2-0.4, 0.4-0.6, 0.6-0.8, >0.8 canopy cover (see Figure 5).

7) A mention needs to be made in the data sheet regarding the number of permanent human settlements, human population, and livestock population present in the beat (to the best of his knowledge).

8) A mention needs to be made based on the observers knowledge if any non timber forest product is collected from the beat. If yes, which NTFP and to score the magnitude of collection on a 5 point scale (0- no collection 4-high rate of collection).

In 1 m radius circular plot

The observer needs to use a 2m long stick to define an imaginary circle around him with the stick as the diameter. Within this circular plot (2m diameter) the observer needs to a) quantify the percent ground cover, i.e. the proportion of the ground covered by herbs, grasses, litter, and bare ground, b) List the 3 most dominant grass species, and herb species in order of dominance (see Figure 6).

4 - Sampling for Ungulate Pellets

Ungulate abundance will also be indexed by enumerating their fecal pellets. This exercise will be done on the same line transect that has been sampled for ungulate encounter rate. To save time, this exercise could be done after the line transect has been sampled in the early morning for ungulate encounters.

? At every 400 m along the transect (line of walk) the observer needs to sample an area of 2m by 20m, perpendicular to the transect for quantifying ungulate pellets. This is done by using the 2 m long stick held at the centre horizontally in his hand and by walking slowly, 20m right and left of the transect alternately at every 400 m (see Figure 7).

? All ungulate pellets encountered need to be recognized to ungulate species and recorded in appropriate columns of the attached data sheet (see Appendix 3).

? The number of fecal pellets need to be counted. In cases where the pellets occur in large heaps, then they should be categorized into the following categories: A (50-100), B (100-200) and C (>200).

? In areas where small livestock like sheep and goat are known to be grazed, it is possible that feacal pellets of these can be confused with wild ungulates especially those of chital. In such areas, a mention needs to be made that goat or sheep graze the area.

? In the last row of the data sheet the observer needs to report if ungulate/animal listed in the data sheet occurs in the sampled beat to the best of his knowledge irrespective of whether its pellets/dung were recorded in the plots.

Data Sheet - 3A

Vegetation ¼15 m. Plot)

Name of Observer : …… Date : ……. Forest Circle : …….. Forest Division : ….....
Range : …… Beat : ……. ID No. of Line Transect : …….
Name of Observer : …… Date : ……. Forest Circle : …….. Forest Division : ….....
Range : …… Beat : ……. ID No. of Line Transect : …….

Plot No.	Canopy Cover(0-1)	Tree Species (Descending Order of Dominance)					Shrub Species (Descending Order of Dominance)					Shrub Abundance 0 to 4 0-absent to 4-very high	Weed Species (Descending Order of Dominance)			Weed Abundance 0 to 4 0-absent to 4-very high
		1	2	3	4	5	1	2	3	4	5		1	2	3	
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																

Data Sheet - 3 B

Human Disturbance ¼15 m. Plot)

Name of Observer : …… Date : ……. Forest Circle : …….. Forest Division : ….....
Range : …… Beat : ……. ID No. of Line Transect : …….

Plot No.	Human Disturbances 0-4 Rating, 0-No, 4-Very high						
	Wood Cutting 0-4	Lopping 0-4	Grass/ Bamboo cutting 0-4	Presence of human/livestock/trail 0-4	Weed Abundance 0-4	People Seen Y/N	Livestock Seen Y/N
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Are there any permanent human settlements in the beat? (Yes/No). If Yes, how many?_____. Approximate human population_____,
Approximate livestock population _____ Cattle, _____ Goat/Sheep, _____ Other livestock.
Is there NTFP collection in the beat____ Yes/No. If yes, what NTFP is collected_____, _____, _____, _____,
Rate NTFP collection on a scale of 0-4, 0-No to 4-Very high_____, _____, _____, _____.

Data Sheet - 3 C

Recording Ground Cover ¼1 m radius or 2m diameter plot ½

Name of Observer %---------- Date :.....Forest Circle :.....Forest Division :.....
Range & Circle :..... ..Beat :.....ID No. of Line Transect :.....

Plot No.	Ground Cover (The following 5 columns should total 100%)					Dry leaf litter %	Grass Species (Report in descending order of numbers½			Herb Species (Report in descending order of numbers)			Remarks
	Dry Grass %	Green Grass %	Herb (Small Plants) %	Weeds %	Bare Ground %		1	2	3	1	2	3	
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													

Data Sheet - 4
Pellet Counts of Ungulates

Name of Observer %---------- Date :.....Forest Circle :.....Forest Division :.....
Range & Circle :..... ..Beat :.....ID No. of Line Transect :.....

Plot NO.	Forest Type	Terrain Type	Chital	Sambar	Wild Pig	Nilgai	Gaur	Barasingha	Barking Deer	Chinkara	Chowsingha	Mouse deer	Hare	Blackbuck	Wild buffalo	Elephant	Rhino	Langur	Cattle	Goat & Sheep	Other Domestic livestock	Cthers/Unid.
1																						
2																						
3																						
4																						
5																						
*Present / Absent																						

* To the best of your knowledge do the above mentioned species occur in the sampled beat irrespective of whether their dung was recorded or not.

1. Do goat/sheep graze the sampled area ? Yes / No
2. In case pellets are obtained in large piles then these could be categorized into the following categories:

No. of Pellets	Category
50-100	A
100-200	B
>200	C

EXCEL DATA ENTRY WORKSHEETS

CARNIVORE SIGN - FORM-1

Sl. No.	Forest Circle	Forest Division	Range	Circle	Beat	Tigress with cubs reported in past 12 months (Q1A) Y/N	Type of evidence for Tigress with cubs (Q1B)	No Cubs (Q1C)	Age of Cubs (Q1D)	How Tiger Presence Ascertained (Q2A)	Approx Date of Tiger Presence (Q2B)	Leopard with cubs reported in past 12 months (Q3A) Y/N	Type of evidence for Leopard with cubs (Q3B)	No of Leopard Cubs (Q3C)	Age of Leopard Cubs (Q3D)	How Leopard Presence Ascertained (Q4A)

					REPLICATE - 1											
Approx Date of Leopard Presence (Q4B)	No. of Livestock killed by Tiger in three months (Q5A)	No. of Livestock killed by Leopard in three months (Q5B)	No. of Livestock killed by Dhole in three months (Q5C)	No. of Livestock killed by other carnivores in three months	Date	Observers Name	Start Time	End Time	Total Kms. Walked	Time spent in any other activity	Tiger					
											Pugmark	Scat	Scrape	Rake	Sighting	Vocalization

DATA SHEET ENCOUNTER RATE ON LINE TRANSECTS – FORM-2

Sl. No.	Observers Name	Date	ID No. of Line Transect	Forest Circle	Forest Division	Range	Circle	Beat	Weather Condition Cloudy / Clear Sky	Start Time	End Time	Total Length (KM)

Beginning GPS						Ending GPS					
Lattitude N			Longitude E			Lattitude N			Longitude E		
Deg	Min	Sec	Deg	Min	Sec	Deg	Min	Sec	Deg	Min	Sec

General For The Beat

Species									
Chital						Sambar			
Forest Type	Terrain Type	Chital Total with Adult + Young	Chital Young One	Forest Type for each sighting	Terrain Type for each sighting	Sambar Total with Adult + young	Sambar Young ones	Forest Type	Terrain Type

FORM-3A & 3B VEGETATION & HUMAN DISTURBANCE IN 15M RADIUS PLOT

Sl. No.	Name of Observer	Date	Forest Circle	Forest Division	Range	Circle	Beat	ID No. of Line Transect	Are there any permanent human settlements Y/N	No. of permanent settlements	Total Human Population	Cattle/ Buffalo No.s	Goat & Sheep	Other Livestock	NTFP collection (0 to 4) (0= No NTFP collection, 4= very high NTFP collection)

Plot 1

NTFP Products collected			Trees species in decending order of abundance					Shrub species in decending order of abundance					Shrub density	Canopy cover	Weed Species in decending order of abundance		
1	2	3	5 high abundance	4	3	2	1 low abundance	5 high abundance	4	3	2	1 low abundance	0 to 4 scale (0=no shrubs & 4= very high density of shrubs	0 to 1 scale	3	2	1

Weed abundance (0 to 4) (0= No weeds, 4= very high weed density)	Wood Cutting (0 to 4) (0= No cutting, 4= very high cutting)	Lopping (0 to 4) (0= No cutting, 4= very high cutting)	Grass/ Bamboo Cutting (0 to 4) (0= No cutting, 4= very high cutting)	Presence of Human trail (Yes/No)	People seen (Yes/No)	Livestock seen (Yes/No)

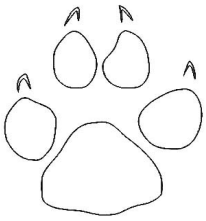
FORM-3C GROUND COVER (1M RADIUS PLOT)

Sl. No.	Name of Observer	Date	Forest Circle	Forest Division	Range	Circle	Beat	No. of Line Transect	Plot - 1											
									Ground Cover (The following 5 columns should total 100%)					Dry leaf litter %	Grass Species (Report in descending order of numbers)			Herb Species (Report in descending order of numbers)		
									Dry Grass %	Green Grass %	Herb (Smalls Plants) %	Weeds %	Bare Ground %		3	2	1	3	2	1

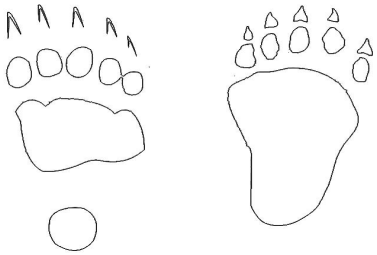
FORM-4 PELLET/DUNG COUNT IN 2X20M PLOT AT EVERY 400M ALONG THE TRANSECT

Sl. No.	Name of Observer	Date	Forest Circle	Forest Division	Range	Circle	Beat	ID No. of Line Transect	Do goat/sheep graze (Yes/No)

	Chital											Sambar										
Present/ Absent	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Present/ Absent	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Remark



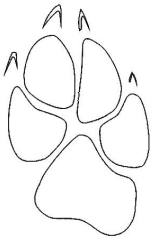
Dhole



Bear

Leopard

Tiger

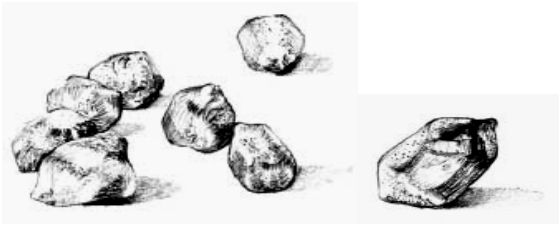


Hyena

Barking Deer

Chital

Chowsingha



Nilgai

Fecal pellets of wild ungulates and their characteristics

Sambar

Though sambar occur in most forested areas, their preferred habitat is forested hilly areas with ample water availability. Their fecal pellets are characterized by a barrel shape, the base of which is flattened to concave in shape. The tip of the pellet tapers to a flattish point. Adult sambar pellets range in size from 1.5 to 2 cm in length and 0.8 to 1.4 cm in diameter. Small size pellets from young sambar can sometimes be confused with chital pellets due to overlap in size.

Chital

Chital are restricted to flattish or undulating forested terrain. They normally avoid steep hilly terrain. Their fecal pellets are cylindrical with the bottom end rounded and the apical region tapering to a point. Adult chital pellets range in size from 1.2 to 1.8 cm, but are much slender in comparison to sambar and nilgai pellets. In degraded areas chital pellets can be confused with goat pellets.

Nilgai

Nilgai occur in open forests, scrub and thorn jungle, and degraded areas. They can also be found at low densities in prime forests. Nilgai have a tendency to defecate at fixed latrine sites forming dung piles. The fecal pellets of nilgai are similar in size to sambar but are distinguished by a cylindrical shape with flat or smooth angular surfaces. The base of nilgai pellets is not as flat as that of sambar. Adult nilgai pellets 1.5 to 2 cm in length with a diameter of 1 to 1.4 cm on the average. The color is often dark brown to blackish.

Barking Deer

Barking deer pellets are likely to be found throughout forested areas except in dry forested tracts. The fecal pellets are elongated and crinkled often with a twisted look and dented surface. The pellets taper towards both ends giving a spindle shape, the tips vary from being long and hook like to blunt. In a clump it is often common to encounter a large variation in size and shape between individual pellets from the same animal. They range in size between 1-1.8cm and about 0.4 to 0.7 cm in diameter.

Chausingha

Chausingha pellets are small in size. They vary in shape, being ovoid or slightly elongated. The length of the pellets vary between 0.6 to 1.2 cm and the diameter is between 0.6 to o.8 cm. There is a distinct habitat separation between chausinga and blackbuck and therefore less likely hood of confusing the pellets of the two species. Often habitats of chital, chausinga and barking deer may overlap.

ANNEXURE-VI

(MODEL CALCULATION)
ESTIMATION OF VISITOR CARRYING CAPACITY

(Example: KANHA TIGER RESERVE)

(a) **Physical Carrying Capacity (PCC)**: This is the "maximum number of visitors that can physically fit into a defined space, over a particular time". It is expressed as:

PCC = A X V/a X RF

Where, A = available area for public use

V/a = one visitor / M^2

Rf = rotation factor (number of visits per day)

In order to measure the PCC to Kanha, the following criteria must be taken into account:

- Only vehicular movements on forest roads are permitted
- The "standing area" is not relevant, but "closeness" between vehicles is important
- There is a required distance of at least 500 m ($^{1/2}$ km.) between 2 vehicles to avoid dust (2 vehicles / km.)
- At least 3 ½ hours are needed for a single park excursion
- The PA is open to tourists for 9 months in a year and 9 hours per day
- Linear road lengths within the tourist zone are more relevant than area, and the total lengths are:

Kanha	107.20 km.
Kisli	72.56 km.
Mukki	103 km.
Total	**282.76 or 283 km.**

- Due to constant vehicular use, the entire road length of 283 km. is prone to erosion, out of which around 90 km. is affected more

$$\text{Rotation Factor (Rf)} = \frac{\text{Opening period}}{\text{Average time of one visit}}$$

Physical Carrying Capacity (PCC) = 283 km. x 2 vehicles / km. x 2.6

= 1471.6 or 1472 visits / day

(b) **Real Carrying Capacity (RCC)**: RCC is the maximum permissible number of visits to a site, once the "reductive factors" (corrective) derived from the particular characteristics of the site have been applied to the PCC. These "reductive factors" (corrective) are based on biophysical, environmental, ecological, social and management variables.

$RCC = PCC – Cf_1 – Cf_2$ ---------- Cf_n,

Where Cf is a corrective factor expressed as a percentage. Thus, the formula for calculating RCC is:

$$RCC = PCC \times \frac{100 - Cf_1}{100} \times \frac{100 - Cf_2}{100} \times \ldots\ldots \quad 100 - Cf_n$$

Corrective Factors are "site-specific", and are expressed in percentage as below:

$$Cf = \frac{M_l}{M_t} \times 100$$

where: Cf = corrective factor; M_l = limiting magnitude of the variable

M_t = total magnitude of the variable

(i) **Road erosion**: Here is the susceptibility of the site is taken into account.

Total road length = 283 km. (M_t)

Medium erosion sink = 50 km. (weighting factor: 2)

High erosion risk = 40 km. (weighting factor: 3)

$M_l = 50 \times 2 + 40 \times 3 = 100 + 120 = 220$ km.

$M_t = 283$ km.

$$Cfe = \frac{220}{283} \times 100 = 77.8 \text{ or } 78\%$$

(ii) **Disturbance to Wildlife**: Here, species which are prone to disturbance owing to visitation are considered. The Central Indian barasingha, a highly endangered, endemic species found only in Kanha has a courtship period of about 1 month in winter, during which it is extremely sensitive to disturbance. Likewise, the peak courtship activity for spotted deer lasts for two months before the onset of regular monsoon. As far as tigers are concerned, newborns are seen between March and May and also during the rains, hence an average value of two months in a year can be considered as the matter phase.

$$\text{Corrector Factor (Cf)} = \frac{\text{limiting months / year}}{\text{12 months / year}} \times 100$$

Corrective Factor for barasingha

$$Cf\ w_1 = \frac{1}{9} \times 100 = 11.1\%$$

Corrective Factor for spotted deer

$$Cf\ w_2 = \frac{2}{9} \times 100 = 22.2\%$$

Corrective Factor for tiger

$$Cf\ w_2 = \frac{2}{9} \times 100 = 22.2\%$$

Overall corrective factor for disturbance of wildlife in Kanha National Park = Cf w = $Cf_1 + Cf_2 + Cf_3$

= 11.1 + 22.2 + 22.2 = 55.5 or 55%

(iii) Temporary Closing of Roads: For maintenance or other managerial reasons, visitation to certain roads may be temporary restricted within the park. The Corrective Factor in this regard is calculated as:

$$Cf_t = \frac{\text{limiting weeks / year}}{\text{total weeks / year}} \times 100$$

In Kanha, an average value of 2 limiting weeks per year may be considered as the "limiting weeks", and thus the corrective factor works out to:

$$Cf_t = \frac{\text{2 weeks / year}}{\text{36 weeks / year}} \times 100 = 5.5\%$$

Computation of RCC

$$RCC = 1472 \times \frac{100-78}{100} \times \frac{100-55}{100} \times \frac{100-5.5}{100}$$

= 1472 (0.22 x 0.45 x 0.95)

= 138.4 or 138 visits / day

(c)**Effective Permissible Carrying Capacity (ECC)**: ECC is the maximum number of visitors that a site can sustain, given the management capacity (MC) available. ECC is obtained by multiplying the real carrying capacity (RCC) with the management capacity (MC). MC is defined as the sum of conditions that PA administration requires if it is to carry out its functions at the optimum level. Limitations in management like lack of staff and infrastructure limit the RCC.

For Kanha, owing to the paucity of staff the MC is around 30%. Hence, ECC = 138 x 0.30 = 41.4 or 40 vehicles / day.

Thus, the Effective Permissible Carrying Capacity on any single day is only 40 vehicles, which should be allowed entry as below:

(Forenoon) = 25 vehicles (inclusive of both entry points)

(Afternoon) = 15 vehicles (inclusive of both entry points)

During peak season (winter months), the staff strength may be increased (only 10%) by deploying “special duty” personnel, and this would enhance the ECC to 55 vehicles per day. Further, increase in the number of vehicles would lead to deleterious effects on the habitat.

ANNEXURE-VII

List of Contributors

Primary Contributors

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Art Work

Courtesy : Shri Ananda Banerjee (Plates 1, 2, 3 and 4)

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