Madhya Pradesh Forest Department : MP Forest Department looks after the largest forest area and one of the largest protected area networks in the country. Kanha, Bandhavgarh, Pench, Panna and Satpura are their world famous tiger reserves. Madhya Pradesh has an ambitious programme to reverse all the recent local extinctions of its endangered wild animals through translocation. The gaur translocation, along with the reestablishment of tiger in Panna Tiger Reserve, is the first step in this endeavour.'

&Beyond: &Beyond (www.andbeyondafrica.com) is one of the globally recognised world's pioneering responsible luxury adventure tourism company. The company was established in 1990 and went by the name of Conservation Corporation Africa (CC Africa). The company owns and operates extraordinary lodges and camps in breathtaking parts of the world's wilderness areas in six African countries and India. &Beyond is deeply committed to responsible tourism. The company pioneered many different game (Cheetah, lion, elephant and buffalo) reintroduction techniques in Africa. Phinda Private Game Reserve was the testing ground for many of the concepts, ideas and future working models of the company and remains its flagship property to this day.

Wildlife Institute of India: The Wildlife Institute of India (http://www.wii.gov.in) was established in 1982 within the Government of India, Ministry of Environment and Forests in response to the country's need for a scientific foundation to its wildlife conservation efforts. The Institute offers training courses in wildlife management for foresters and conducts research project to help formulate priorities and guidelines for wildlife conservation. This is done from its campus in Chandrabani near Dehradun, Uttaranchal and at field sites throughout the country.

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Reintroduction of Gaur (*Bos gaurus gaurus*) in Bandhavgarh Tiger Reserve, Madhya Pradesh, India

TECHNICAL REPORT
2011

MADHYA PRADESH
FOREST DEPARTMENT

&BEYOND

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

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FOREWORD

For several years, I had been questioning the contribution of protected areas (PAs) to the preservation of our wild animals, in view of the fact that we had lost several species even from PAs. Although PAs are far richer in animal densities, compared with the surrounding forests, their richness is, primarily, inherited: we have tried to convert only richer ecosystems into PAs, in the hope that this will be helpful in preserving their richness. This has been helpful, no doubt, but losing species after species from the PAs themselves shows that something was missing from our managerial repertoire. Madhya Pradesh (MP) lost the gaur from Bandhavgarh, blackbuck from Kanha, great Indian bustard from Karera and tiger from Panna. The tiger had been lost from Madhav National Park also, in the 1960s. Nobody noticed or cried over these losses although all hell broke loose over the extinction of the tiger in Panna, following close on the heels of Sariska. As soon as Sariska happened, the country vowed to bring the tiger back. Plans for preventing the impending extinction of the tiger from Panna were already afoot even before the tragedy struck, although our bureaucratic systems did not allow a timely redress. However, nobody ever thought of bringing the gaur, bustard and blackbuck back to their earlier ranges. I was convinced that the management of PAs should not be limited to simple chaukidari (watchmanship); we should prevent local extinctions by more proactive means, such as supplementing dwindling populations; and we should re-introduce, if local extinctions do take place. I came to realize that extinctions of small populations will continue to happen, despite the best possible antipoaching actions, due to biological reasons such as predation, diseases, accidents and abnormal sex ratios, and that it is imperative for conservation that we continue to repopulate depleted habitats through translocation from other sources. Despite this conviction, I could not do anything because the country did not have any experience or expertise in the capture and translocation of herbivores at any significant scale. This shortcoming had been noticed long ago, when the Wildlife Institute of India (WII) tried unsuccessfully to develop this capability through its Indo-US collaboration, in the 1990s. Since then the country had almost stopped thinking about the re-introduction of endangered species in protected habitats, primarily because we did not have the ability to do so, until two things happened at the same time fortuitously.

In June 2005, I got posted as the Additional Principal Chief Conservator of Forests (Wildlife), and at about the same time, Conservation Corporation of Africa (now curiously renamed as '&Beyond'), a South African safari and game-management company, decided to expand their business to India, starting with wildlife lodges in MP. I met Sarath Champathi, chief naturalist of the Jungle Lodges and Resorts, Karnataka, during a visit to one of their lodges in September 2005. Sarath had already been recruited by &Beyond as their chief naturalist in India and was due to join them shortly. When he established contact with me , on joining his new job, I discovered that &Beyond did not only run wildlife lodges but also owned game reserves and had an impressive experience in wildlife management, especially the capture and translocation of large animals. &Beyond were planning to set up their first lodge in Bandhavgarh, in a joint venture with Taj Hotels, under the brand name Taj Safaris Ltd. (TSL), and I asked Sarath if his new company would help us re-introduce the gaur in Bandhavgarh. He jumped at the idea and agreed to revert to me shortly. He soon confirmed that &Beyond would be delighted to help us in our project. They offered to train our officers and veterinarians in South Africa and to provide the services of experienced capture and translocation experts, in addition to facilitating the donation of the customised vehicles and equipment through TLS. The Government of Madhya Pradesh and the Government of India (GoI) gladly approved the project. This was going to be the first significant conservation project to be implemented without financial help from the Government of India.

Other than retrieving the lost biodiversity of Bandhavgarh, the project was aimed at building the capacity of the MP Forest Department, and WII, in the field of capture and translocation large animals. It was also meant to show what public-private partnerships could accomplish. Mridula Tangirala, Director Operations at TSL, and Les Carlisle, Group Conservation Manager at &Beyond, worked tirelessly to obtain the approvals of their companies expeditiously. Les made several trips to India just to ensure that the construction of bomas and modification of trucks was exactly as required. When it seemed that the project was smoothly on its way, ominous noises started being made in the press. Reports of some gaur having been seen some 25 km from the park boundary appeared in the press in September 2008. This was used by certain quarters to brand the project as an unnecessary extravagance of the department. It was suggested that rather than translocate gaur from Kanha to Bandhavgarh, we should try to lure these animals to Bandhavgarh. The GoI, perhaps under pressure from the critics, developed cold feet on the project and cancelled the permission in February 2010, a few days before project implementation was scheduled to begin, citing non-compliance with certain conditions. However, the state government continued to persuade the GoI and, finally, a fresh permission was issued by GoI in October 2010. Everything should have been set to rest, but a fresh spate of reports, accusing the state officials of having a vested interest in the project, appeared in the press. These baseless reports were clearly aimed at subverting the project, although the motivation to harm such a win-win project still remains unravelled. It was only because the state strongly believed in the value of the project, in ushering in a new era of active conservation of wildlife, that the project could see the light of the day. However, the project could not have had a happy ending without the support of the Hon'ble Minister for Environment and Forests, Mr. Jairam Ramesh. Only his personal intervention could get the project back on track.

Encouraged by the success of this project, the state has already proposed the translocation of several other species to reverse local extinctions in Madhya Pradesh. The barasingha is set to return to Bori Sanctuary, and the blackbuck is going to return to Kanha. After the successful re-introduction of the tiger in Panna, we can even dream of creating whole new wildlife assemblages, from scratch, if secure space is available, through translocation of prey and predators from other sources, rather than waiting for ages to let it happen on its own. Let us hope that this project will prove to be a harbinger of change in our approach to conservation, which it was always meant to be. Perhaps we will no longer just wring our hands when the extinction of a particular species looms in front of us. We can now prevent or reverse such extinctions, thanks to the Gaur Project. Let us hope, however, that the next project will not take six years from conception to implementation! Adaptive and proactive management must become the hallmark of modern day PA management in India.

Dr. H.S. Pabla, IFS
Chief Wildlife Warden,
Madhya Pradesh

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DEFINING RE-INTRODUCTION

The IUCN/SSC's guidelines for re-Introductions were drafted by the Re-introduction Specialist Group of the IUCN's Species Survival Commission in response to the increasing occurrence of re-introduction projects worldwide and, consequently, to the growing need for specific policy guidelines to help ensure that re-introductions achieve their objective of conservation and do not have any adverse side-effects (IUCN, 1998). These guidelines define a 're-introduction' as 'an attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct'.

AIMS AND OBJECTIVES OF RE-INTRODUCTION

The principle aim of any re-introduction is to establish a viable, free-ranging population in the wild of a species, subspecies or race which has become globally or locally extinct, or extirpated, in the wild. It should be re-introduced within the species' former natural habitat and range and should require minimal long-term management. The objectives of any re-introduction programme include the following:

1. Enhancing the long-term survival of a species;
2. Re-establishing a keystone species (in the ecological or cultural sense) in an ecosystem;
3. Maintaining and/or restoring natural biodiversity;
4. Providing long-term economic benefits to the local and/or national economy;
5. Promoting conservation awareness; or
6. A combination of these.

PROJECT ACTIVITIES

a. Pre-project activities

The pre-project activities for re-introduction consists of the following:

(i) a feasibility study and background research;

(ii) identification of suitable release stock;

(iii) an evaluation of the re-introduction site;

(iv) identification and elimination, or reduction to a sufficient level, of previous causes of decline; and

(v) assessing the socio-economic and legal requirements.

The planning, preparation and release stages, which have been documented well in the IUCN/SSC document, are summarized below:

- Approval of relevant government agencies and coordination with national and international conservation organizations.
- Construction of a multi-disciplinary team with access to expert technical advice for all phases of the programme.
- Identification of short- and long-term success indicators and prediction of programme duration, in the context of the aims and objectives agreed upon.
- Securing adequate funding for all programme phases.

- Design of pre- and post-release monitoring programme so that each re-introduction is a carefully designed experiment, with the capability to test the methods with scientifically collected data. Monitoring the health of individuals, as well as their survival, is important; intervention may be necessary if the situation proves unforeseeably unfavourable.
- Appropriate health and genetic screening of release stock. Health screening of closely related species in the re-introduction area.
- If release stock is wild-caught, care must be taken to ensure that (a) the stock is free from infectious or contagious pathogens and parasites before shipment and (b) the stock will not be exposed to vectors of disease agents which may be present at the release site (and absent at the source site) and to which it may have no acquired immunity.
- Development of transport plans for delivery of stock to the site of reintroduction, with special emphasis on ways to minimize stress on the individuals during transport.
- Determination of release strategy (acclimatization of release stock to release area; group composition, number, release patterns and techniques; timing).
- Development of conservation education for long-term support; professional training of individuals involved in the long-term programme; public relations activities using the mass media and in the local community; and involvement where possible of local people in the programme.
- The welfare of the animals to be released is of paramount concern through all these stages.

b. Post-release activities

- Post-release monitoring is required for all (or a sample of) the individuals. This most vital aspect may be by direct (e.g. through tagging, telemetry) or indirect (e.g. spoor, informants) methods, as suitable.
- Demographic, ecological and behavioural studies of released stock must be undertaken.
- Studying the processes of long-term adaptation by individuals and the population.
- Collection and investigation of mortalities.
- Interventions (e.g. supplemental feeding; veterinary aid) when necessary.
- Decisions for revision, re-scheduling or discontinuation of programme where necessary.
- Habitat protection or restoration to continue where necessary.
- Continuing public relations activities, including education and mass media coverage.
- Evaluation of cost-effectiveness and success of re-introduction techniques.
- Regular publication in the scientific and popular literature.

GAUR RE-INTRODUCTION PROGRAMME

SPECIES INFORMATION

The gaur *(Bos gaurus gaurus),* commonly referred as the Indian bison, is the largest living bovine, confined to the Oriental bio-geographic region. The gaur belongs to the group of wild oxen, which includes the Asiatic buffalo, African buffalo, true cattle and bison, and has been classified as follows:

Classification:

Kingdom	:	Animalia
Phylum	:	Chordata
Class	:	Mammalia
Order	:	Cetartiodactyla
Family	:	Bovidae
Scientific name	:	*Bos gaurus*
Species authority	:	C.H. Smith, 1827
Common names	:	Gaur, Indian bison

BIOLOGY AND BEHAVIOUR

Gaur bulls are larger than the cows and weigh between 600 and 1000 kg; they measure 1.6 to 1.9 m at the shoulder, whereas the cows are shorter and weigh much less (Morris, 1947). Both sexes are horned, the horns being larger with more swath in the males (Sanderson, 1968). Adult males have two prominent dewlaps, a small one at the chin and a large one hanging below the throat. There is a shoulder hump which is more pronounced in the males. Newly born calves are light golden yellow in colour. The colour darkens with age, and adult females are dark brown whereas adult males are black. Both hind legs and forelegs are white to tan below the knees. Gaurs reach sexual maturity at 3 years of age and usually produce one and rarely two calves after a gestation period of 275 days. Weaning takes place at 7-9 months. Breeding takes place throughout the year. The gaur is known to have a maximum longevity of 30 years (Gad and Shyama, 2009; Srivastav and Nigam, 2010).

Gaurs are social animals, living in herds ranging in size from 2 to 20 individuals (Mustill, 1939; Belsare et al., 1984). Herds typically comprise a few cows, calves and one or two adult bulls and sub-adults. Solitary bulls occasionally associate to form bachelor herds which break up with the onset of the rut. The group leadership is dependent upon the size and age, and family groups are led by the eldest female, whereas bachelor groups are led by the largest male. Solitary males and all-male herds move to herds with females with the onset of the rutting season. Size rather than actual fighting is used by adult males to assert dominance. The dominant males isolate cows in oestrus by tending to them and use a range of behavioural patterns typical of ungulate reproductive behaviour, such as flehmen, rutting, tending and mounting, to successfully mate with the cows. A variety of vocalizations are used for communication.

Gaur are diurnal in their activity; however, human disturbance forces them to more nocturnal activity. They feed during the early morning and late evening or even throughout the night. They

have typical local and seasonal movements which are influenced by the availability of resources. They are obligatory drinkers and require to drink at least once every day. The frequency may increase during the peak of summer. Gaur are both grazers and browsers that feed on a variety of plant species. Gaur are known to de-bark trees and to frequent salt licks (Choudhury, 2002b).

CONSERVATION STATUS

The global population of the gaur is estimated at 13,000-30,000 animals; of these, only 5200-18,000 are reproductively active individuals (Duckworth et al., 2008). The population has declined overall by at least 30% during the last three generations. As a consequence, the gaur is categorized as Vulnerable (criteria A2cd+3cd+4cd ver. 3.1) in the IUCN Red List of Threatened Species, 2009. It is listed in Schedule I of the Indian Wildlife (Protection) Act of 1972 and is included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

THREATS

Gaurs face different threats in each of the landscapes that they occupy. Poaching is an omnipresent threat, be it for consumption, crop protection, medicinal use or trophy hunting. Habitat loss and fragmentation are threats which are ubiquitous. In North-east India the species is threatened with habitat degradation brought about by shifting cultivation (Choudhury,2000a; Imam,1985). In the rest of the gaur's range, conversion of forest areas to agricultural use or commercial plantations is another serious threat. The species is closely related to domestic livestock and is vulnerable to all the diseases that infect cattle. Rinderpest has been a serious threat to wild populations in the past; foot and mouth disease (FMD), anthrax and haemorrhagic fever have also been responsible for mortality. Gaur populations are also vulnerable to predation, especially at the calf and sub-adult stages.

GLOBAL DISTRIBUTION:

Historically, the distribution of the gaur covered the entire mainland of South and South-east Asia and Sri Lanka (Duckworth et al., 2008). The current distribution is restricted to scattered pockets in India, Nepal, Bhutan, Cambodia, China, the Lao PDR, peninsular Malaysia, Myanmar, Thailand and Vietnam. The actual distribution of the gaur is highly fragmented, and the species exists in small pockets within the areas of presence shown **(Figure 1).** Within the areas of actual occurrence, gaur densities are highly variable, with only a few places harbouring high-density populations.

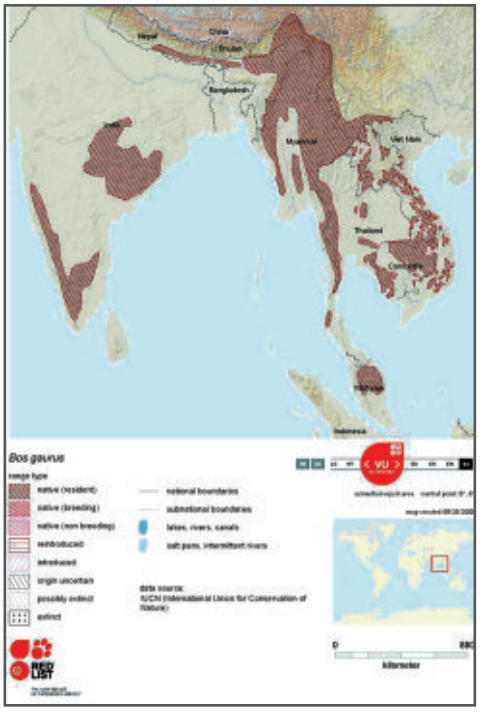


Figure 1: Distribution range of Bos gaurus

DISTRIBUTION IN INDIA:

Gaur inhabit a wide variety of habitats ranging from tropical wet, semi-wet evergreen and bamboo forests, tropical moist deciduous, tropical dry deciduous forests in central India and shola forests and tropical thorn forests on the eastern slopes in the Western Ghats (Hussain,1969, Johnsingh,1979, Khader,1969). In these habitats the species exists up to an altitude of 2500 m. The species, which is generally associated with idyllic, dense bamboo-rich forests, mixed with open glades and plenty of water, was once widespread throughout India, except the drier northern and north-western parts. With the decline in the health of our forest wealth, this species has also suffered grave losses in its numbers and range. According to Schaller (1967), gaurs were distributed in three widely separated geographical areas that corresponded to the major mountain systems in India: the Western Ghats, the central Indian highlands and the foothills of the Himalayas, including the hills south of the Brahmaputra River. A study carried out by the Wildlife Institute of India (WII) (Sankar et al. 2001) suggests that the gaur population in India is approximately 23,500. The gaur occurs in 101 existing and 27 proposed protected areas (PAs), in 15 states. The gaur range represents approximately 7.12% of the geographical area and 30% of the forested area of India. Of the gaur's range, 14.3% falls within PAs. The probable distributional range of the gaur in the country is given in **Figure 2.**

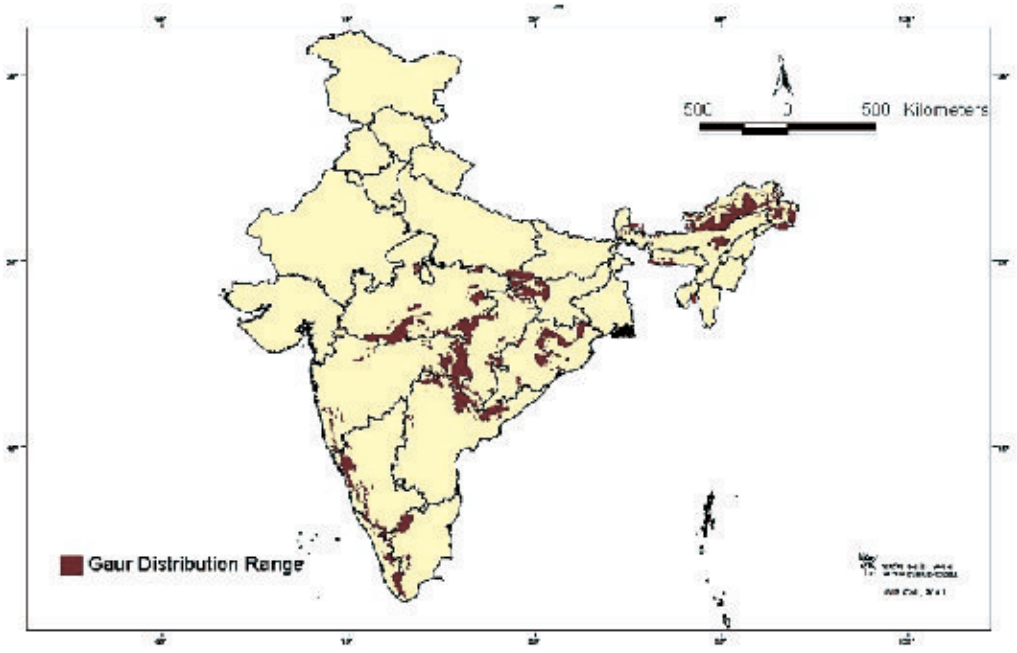


Figure 2: Probable distribution range of the gaur in India

However, the studies cited above have not documented the fragmentation and local extinction of the gaur. One recent instance of extinction is from Bandhavgarh Tiger Reserve (BTR), of Madhya Pradesh, which supported a small population consisting of 20-50 animals up to 1995. This population disappeared between 1995 and 1998 for unknown reasons. Brander (1923) reported

that the gaur had an extensive presence in the Betul and Khandwa districts of Madhya Pradesh at the beginning of the 20th century; the species is either extinct or unrecorded there at present. The species is possibly already extinct in Sanjay National Park, in eastern Madhya Pradesh, which earlier had a gaur population connected with the populations in Chhattisgarh and Jharkhand. The disappearance of the species has also been reported from Thattakad Wildlife Sanctuary, in Kerala, and Kanger Valley National Park, in Chhattisgarh (Sankar et al., 2001). At present, central India harbours approximately one fourth of the gaur population surviving in the country (Sankar et al., 2001). In Madhya Pradesh, the fragmented gaur population is found in 10 districts. There are unconfirmed reports of the existence of gaur in Katni and a small area called Kali Bhit at the junction of Betul, Harda and Khandwa districts.

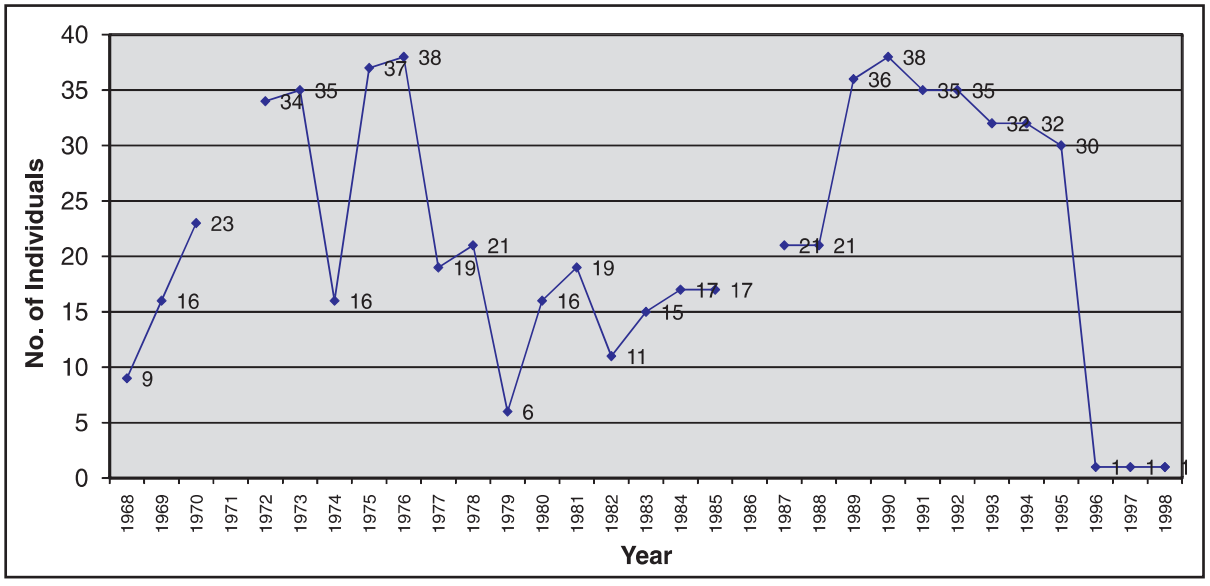
The known extinction of the gaur in three PAs in India, in a relatively short span of time, is a testimony to the fact that this species is losing ground very fast and urgent measures are required to stem this process. As this march of habitat destruction and poaching continues unabated, especially outside PAs, the decline of populations outside PAs is likely to continue in the foreseeable future. However, the dispersal of the species from PAs into the adjoining forests and inter-PA corridors may slow this process to some extent. Therefore, it is extremely important that suitable PAs continue to support gaur populations to replenish the losses outside. The loss or serious reduction of a population inside a PA, especially if the loss has happened as a result of some unexpected calamity, as appears to have happened in BTR, Madhya Pradesh, can be tackled by re-introduction or replenishment, but nothing much else can be done directly to bolster the existing population. The same applies to all the species which are showing trends of declining populations or local extinctions. Therefore, rather than watching helplessly and rueing the loss, conservation requires active programmes for re-introduction and re-establishment of important species from the areas where they have been recently lost, with or without habitat-related interventions. The IUCN/SSC guidelines strongly recommend such re-introductions.

The factors leading to the reduction in the range of this species are the usual ones: loss and degradation of habitat, poaching and diseases. The gaur is perhaps more prone than other species to losses from diseases due to its genetic proximity to domestic livestock. The past records indicate that populations of gaur have succumbed to epidemics of FMD, rinderpest and anthrax in many areas of its distribution. The obvious shrinkage in the range, number and densities of this magnificent species is a cause for serious concern and calls for urgent recovery and restoration plans.

HISTORY OF GAUR PRESENCE IN BANDHAVGARH TIGER RESERVE (BTR)

The gaur was historically found in BTR in small numbers. The population here was considered to be the only population to the north of Narmada River, in central India. According to the management scheme prepared by Sh. M. Dixit (1975), gaurs were localized in the hilly tract around the Bandhavgarh fort and were generally seen in Compartment No. 324 during summers after sunset

and before sunrise, when they came to drink water in the Charanganga River. According to the management plan prepared by Sh. A.K. Sonakiya (1992), the gaur population of Bandhavgarh National Park was considered threatened. The gaur was identified as an important target species for the management, but nothing, except the provision of general protection, has ever been done specifically for this species. Estimates of the gaur population in BTR from 1968 onwards are given in **Figure 3.**



*** *Population estimates for 1971 and 1986 are not available.**

Figure 3: Population Estimates of Gaur in BTR

Gaurs were usually seen in the Rajbahra, Bathan, Bhadrashila and Chakradhara areas of Tala Range, only in the open season. There is no definite information regarding where the species spent the rainy season. It was generally believed that they migrated to the Ghunghuti and Amarkantak areas (south-west of Bandhavgarh) during the monsoon, but they were occasionally recorded within the extended park area (Kallwah and Magdhi ranges) during the rainy season as well. The 1988 monitoring programme conducted by the forest department confirmed their presence in the Kaliwah/Magdhi area in the monsoon. However, the animals did not return to their post-monsoon range in 1995. According to the management plan prepared by Dr. U. Prakasam (2006), the last gaur, a male, was seen in Bandhavgarh in 1998. There have also been unconfirmed reports of some stray animals having been seen in rather unlikely places outside the park after 1995, but whether these animals were from the Bandhavgarh population, or not, is difficult to confirm.

CAUSE OF LOCAL EXTINCTION

It is well accepted that the disappearance of the species from BTR was sudden, not gradual. If the decline had been gradual, predation by tigers, degradation of habitat, disruption of the migratory route, etc. would have been the probable causes. Till recently, it was believed that something

happened to the population during its so-called migration season, when it was believed to migrate out of the park, in 1995. The construction of a thermal power plant near Pali, along with other associated developments, and the consequent disruption of the traditional migratory route (presumed), was believed to be one of the major reasons for the extinction of the species in Bandhavgarh. However, the sudden disappearance of the entire population, which in fact had been growing for the previous 15 years or so, cannot be explained by this factor. The only other possible factors can be a disease or an accident. There is no record of any epidemic of anthrax, rinderpest or any other livestock disease in the region during the relevant period, and no gaur deaths were reported then. Until a meeting of all the directors and assistant directors of the park of the period 1990-2000, serving or retired, was called in the office of the Chief Wildlife Warden in 2006, when this project was being planned, the most popularly accepted theory was that the species suffered some major setback in its monsoon range in 1995 as it did not return to the popular areas of the park after the monsoon. However, now it is confirmed that the animals did return after the 1995 monsoon as a herd of 13 was seen near the Tala gate on 1 November 1995 by the then Assistant Director of BTR. A few animals were also seen by the new Field Director in the subsequent December-January period. No animal was seen in the park after March 1996. The tragedy confirms the fact that small, isolated populations are vulnerable to local extinctions.

JUSTIFICATION FOR RE-INTRODUCTION IN BANDHAVGARH TIGER RESERVE

The loss of the gaur from Bandhavgarh National Park has had three main implications: (1) local extinction of an endangered species (Schedule I of the Wildlife Protection Act, 1972), (2) loss of gene flow and (3) fragmentation.

Bandhavgarh continues to be an excellent habitat and can therefore still support a reasonable gaur population. The proposal to re-introduce gaur into BTR was in conformity with the definition of 're-introduction' in the IUCN/SSC guidelines. The guidelines propose the establishment of 'a viable, free-ranging population in the wild of a species, subspecies or race, which has become globally or locally extinct' as the goal for re-introduction programmes. As per the guidelines, there can be one or multiple objectives for re-introduction. The proposal to re-introduce the gaur in BTR was in conformation with the following objectives, stated in the guidelines: (a) to enhance the long-term survival of a species and (b) to maintain and/or restore natural biodiversity. The proposal was also consistent with another recognized objective, namely, 'to provide long-term economic benefits to the local and/or national economy' to some extent. The re-introduction of the gaur into Bandhavgarh would enhance tourist satisfaction, resulting in better incomes for the park, local people and park-dependent businesses. The guidelines recommend a multi-disciplinary approach and prefer wild stock for the founder population. The guidelines also recommend that 'where the security of the re-introduced population is at risk from human activities, measures should be taken to minimize these'. Other elements of the guidelines, related to selection of stock, legal requirements, policies of the relevant governments, etc. were to be complied with as and when required.

FEASIBILITY STUDY

The ecological requirements for re-introduction of gaur at BTR were established and included the following:

1. a diversity of habitats with a variety of plant species needed by the gaur (based on a study carried out by the WII at Pench Tiger Reserve on the ecology of the gaur, 2001);
2. availability of ample cover and water, especially in summer; and
3. protection from anthropogenic factors (human disturbances, interaction with domestic livestock, poaching).

FOOD AND WATER REQUIREMENTS OF GAUR AT BANDHAVGARH TIGER RESERVE

The gaur is a generalist feeder but prefers to browse in the dry season and predominantly graze in the monsoon. Its diet chiefly includes shoots and the foliage of trees and shrubs and the buds and fruits of species such as *Diospyros melanoxylon* and *Aegale marmalos,* tender seeds of bamboos, herbs, grasses and the bark of trees such as *Adina cordifolia* and *Tectona grandis*. Gaurs visit salt licks periodically. Being an obligatory drinker, the gaur needs water every day and may visit water bodies twice a day during the hottest periods. During the hot hours of the day gaurs retire to the shelter under thick tree cover and ruminate. Feeding is more predominant during the early morning and evening hours. On average they feed for 15-18 hours a day. During the study carried out by the WII in Pench Tiger Reserve, a total of 78 species of plants belonging to 28 families were recorded as being eaten by the gaur (Sankar et al., 2001). Of the food plants recorded, the family Leguminoseae accounted for the highest number of individuals (18%), followed by the family Gramineae (15%). Direct feeding observations showed that the browse formed a major proportion in the diet of the gaur during summer (grass:browse ratio, 1:3). A total of 11 tree species, 3 shrubs, 3 climbers, 4 grasses and 1 herb species were recorded as summer food plants of the gaur. The availability of food plants of the gaur in BTR is given in **Table 1.**

In the year 1982-1983, gregarious flowering of the bamboo (*Dendrocalamus strictus*) took place in Bandhavgarh National Park. As a result, there was profuse regeneration of the bamboo. It provided adequate forage to almost all herbivorous species. As bamboo is a preferred food plant of the gaur, abundant food is available for it in BTR.

The long, prehensile tongue of the gaur is well adapted for browsing. The gaur prefers green grass when it is available, but it even feeds on coarse leaves, buds and fruits of trees such as *Aegle marmelos, Bauhinea* spp., *Cassia fistula, Cordia myxa, Diospyros melanoxylon, Emblica spp., Gmelina arborea, Terminalia bellerica* and *Randia dumetorum* (Krishnan, 1972; Brander, 1923; Schaller, 1967; Pasha, 1999). The tender seeds of the bamboo and herbs also contribute to the diet of the gaur. It also feeds on the bark of many tree species. In central India, the gaur is reported to feed on the bark of *Adina cordifolia* (Brander, 1923; Schaller, 1967), and in Mysore it feeds on the bark of *Wendlandia natoniana.* Sanderson (1968) reports that the gaur eats the bark of

Phyllanthus emblica. During the summer, teak (*Tectona grandis*) de-barking by the gaur is a well-known phenomenon in the central Indian highlands (Ranjitsinh, 1997; Pasha et al., 2001).

Table 1: Food plants of the gaur available in BTR

S. No.	Species	S. No.	Species
1	*Ougenia dalbergioides*	26	*Casearia tomentosa*
2	*Diospyros melanoxylon*	27	*Adina cordifolia*
3	*Bauhinia racemosa*	*28*	*Mitragyna parviflora*
4	*Grewia tiliaefolia*	29	*Randia uliginosa*
5	*Flacourtia ramontchii*	30	*Randia dumetorum*
6	*Aegle marmelos*	31	*Nyctanthes arbor-tristris*
7	*Bridelia retusa*	32	*Holarrhena antidysenterica*
8	*Cordia myxa*	*33*	*Vitex spp.*
9	*Zizyphus xylopyra*	*34*	*Lantana camara*
10	*Kydia calycina*	35	*Emblica officinalis*
11	*Abutilon indicum*	36	*Euphorbia hirta*
12	*Indigofera arborea*	*37*	*Ficus hispida*
13	*Millettia auriculata*	*38*	*Madhuca latifolia*
14	*Desmodium spp.*	39	*Curcuma reclinata*
15	*Abrus precatorius*	*40*	*Asparagus racemosus*
16	*Butea superba*	41	*Phoenix spp.*
17	*Dalbergia paniculata*	42	*Dicanthium spp.*
18	*Bauhinia vahlii*	43	*Andropogon spp.*
19	*Cassia tara*	*44*	*Sorghum haplense*
20	*Albizzia odoratissima*	45	*Apluda mutica*
21	*Albizzia procera*	46	*Cynodon dactylon*
22	*Anogeissus latifolia*	*47*	*Chloris dolycostachya*
23	*Terminalia arjuna*	48	*Cyperus spp.*
24	*Terminalia tomentosa*	49	*Themeda spp.*
25	*Syzygium cumini*		

The park authorities at BTR had initiated re-location of villages from in and around the reserve and focused on minimizing interctions with livestock. Various protection measures were taken by the park officials to ensure that the potential threats for the long-term survival of the re-introducted population were addressed.

KANHA TIGER RESERVE

Kanha Tiger Reserve (KTR) forms a part of the central Indian highlands, sprawling across Madhya Pradesh from west to east. The park is situated in the Mandla and Balaghat districts. Kanha Tiger

Reserve is located between 80° 26' 10" E and 81° 04' 40.00" E and between 22° 01' 5.00" N and 27° 27' 48.00" N and is situated in the Maikal Hills of the Satpura Range. It lies in the Deccan Peninsula-Central Highland zone (6E) of the bio-geographic classification of India (Rodgers and Panwar, 1988). The tiger reserve comprises two divisions, namely a core zone (940 km^2) and a buffer zone of (1009 km^2). Besides , Phen Wildlife Sanctuary, with an area of 110 km^2, serves as a satellite micro-core. The core area has seven ranges, namely the Kisli, Kanha, Sarhi, Mukki, Bhaisanghat, Supkhar and Phen Wildlife Sanctuary ranges, while the buffer area has five ranges, namely the Ghari, Khatiya, Khapa, Sijhora and Samnapur ranges. The reserve is an excellent interspersion of dadars (flat hill tops), grassy expanses, dense forests and riverine forests. It occupies most of the northern slopes of the main Maikal ridges of the Satpura Range. The valleys are encompassed by spurs of varying elevations extending from the main hill ranges. Halon Valley and Banjar Valley constitute the eastern and western halves, respectively, of the core of Kanha Tiger Reserve. The reserve prides itself in successfully conserving endangered species such as the tiger (*Panthera tigris*), central Indian barasingha (*Cervus duvaucelli branderi*) and the wild dog (*Cuon alpinus*). The park has a considerable population of gaur (*Bos gaurus*) spread over a vast ladscape. The gaur population as estimated in 2006 by the traditional block count method in Kanha Tiger Reserve included 1605 animals in the national park area, 46 in the buffer zone and 50 in Phen Wildlife Sanctuary.

PREPARATORY PHASE

Preparations for translocation of gaurs started in 2006-2007, with the Madhya Pradesh Forest Department initiating the following:

1. **Permissions for translocation of gaurs:** The gaur being a Schedule I animal under the Wildlife Protection Act, 1972 (as amended in 2006), permissions were required from GoI for its capture and translocation **(Annexure II).**

2. **Procurement of licence for import of drugs and equipment:** Narcotics are the drugs of choice for immobilizing wild bovids. They have short induction periods and have been successfully used in gaur capture operations in Nepal. The necessary clearances were obtained from the Drug Controller General of India, Ministry of Agriculture (Department of Animal Husbandry and Dairying) and the Narcotic Commissioner (Ministry of Finance, Central Bureau of Narcotics). Additionally, licences for importing a syringe projector (Dan Inject), donated by &Beyond (formerly known as CC Africa), were also obtained.

3. **Training of personnels:** With a view to establishing appropriate capture, handling, transport and translocation techniques and to training personnel in these operations, a training programme on the capture and translocation of wild animals was organized at Phinda Game Reserve, and a visit to national parks and game reserves in South Africa was organized during 15-30 May 2008 funded by & Beyond. Sh. Aseem Shrivastava, Field Director, BTR, Sh. Subaranjan Sen, Deputy Director, KTR, Sh. A.K. Nagar, Deputy Director, Panna Tiger Reserve, Dr. Sandip Agarwal, Veterinary Officer, Panna Tiger Reserve, Dr. Parag Nigam, Scientist, WII, Mr. Sarath Champati, Chief Naturalist & Head-Training, Taj Safaris and Mr. Kartikeya Singh, Head Naturalist, Mahua Kothi, Taj Safaris, were part of the training team. The visiting team was hosted by Les Carlisle and exposed to various techniques used to capture wild animals, along with live demonstrations of black rhino and

wild buffalo capture. Discussions were had with various South African wildlife experts including Dr. Dave Cooper (KZN Wildlife), Mr Jeff Cooke (Head, Game Capture, KZN Wildlife) and Dr. Douw Grobler, wildlife veterinarian. An action plan was prepared at Mountain Lodge Phinda to define each step of the translocation **(Annexure III).**

4. **Simulation of gaur population viability at BTR:** The action plan as prepared by the Madhya Pradesh Forest Department envisaged the capture and translocation of 20 gaurs (15 adult females and 6 adult males) from Kanha Tiger Reserve, Madhya Pradesh, and their introduction in BTR, Madhya Pradesh. The plan also envisaged bringing in more gaurs to Bandhavgarh, on a later date/stage, to maintain a viable population of approximately 50+ animals. Accordingly a simulation of the viability of the gaur population was carried out at WII **(Annexure IV).**

5. **Designing of transport trucks/containers:** Transport trucks **(Figure 4)** and containers were designed according to the animals' needs. The design was based on the specifications used in South Africa. The details are provided below:

- Standard container length of ±6.7 m.
- Roof of the container: minimum internal height of 2.2 m.
- Two external doors, one on the right rear side and one on the front right side of the front compartment.
- Doors 1.2 m wide suspended from a 2.4 m rail with rubber stoppers to prevent over-opening or over-closing.
- Each door provided with a U-shaped locking mechanism.
- Each door suspended by two 500 kg (minimum) rollers.
- Bottom of each door runs behind a 6 mm steel flat bar.
- 'D' rubber attached below each door, extending beyond the opening.
- Four hatches provided at the centre of the roof, 75 cm wide.
- Hatches raised and made waterproof.
- Latches to lock the hatches open.
- One adjustable partition with sliding door in each compartment.

Figure 4: Truck fabricated for transportation of gaurs

- Sliding door of central compartment operated from outside.
- All sliding doors 1.2 m wide, made of solid steel.
- Four side hatches, 30 cm × 70 cm, on both sides [Specify whether four hatches on each side or two hatches on each side] just above the base of the wall; front right compartment alone with only one hatch to facilitate the opening of the sliding door.
- Lower container wall with 4 mm gap to allow free flow of urine.
- Floor of solid checkered steel plate with 100 cm^2 grids made of round iron bars.
- Outer surface of the roof painted white and with anti-skid surface (sprinkle sand on wet paint) applied.
- Roof tapered by 5 cm from raised centre to side walls.
- Hollow tube (50 mm) welded between verticals to form a ladder to climb onto the roof.
- Mechanical louvers (75 cm) along both sides.

6. **Designing of stretcher:** A stretcher was specially designed for carrying immobilized animals from the site of capture to the vehicle and had a suitable provision for weighing the animals. The details are as follows:
   - Outside width of the stretcher not more than 110 cm.
   - A pipe of diameter 3 cm as a holding rail along the entire length on both sides.
   - Four 4 cm hollow pipe cross members, equally spaced.
   - Six 3 cm extensions to fit into the 4 cm cross members, 3 m in length.
   - 90 cm wide double canvas covers for the full length of the internal 90 cm wide poles. This canvas has eyeholes along the full length on both under sides to allow stitching of canvas.
   - Runners of 4 cm diameter pipe welded underneath the 90 cm bearers on 10 cm supports.
   - Two stretcher rails made of 5 cm channel iron, 90 cm centres braced at 1 m from each end, designed to fit into the door slots under the door's lower rail.
   - Length of the stretcher 2 m.

7. **Design of holding *boma* at KTR:** The holding *boma* was constructed of steel sections 2.5 m high by 3 m long made out of 50 mm × 75 mm × 3 mm rectangular hollow tubes. 1.5 m of the steel section was of solid 2 mm pressed steel plate. Each steel section had a total height of 2.5 m, with three verticals at 750 mm (50 mm × 50 mm × 3 mm) intervals and one horizontal at 1.5 m (50 mm × 50 mm × 3 mm). A 1 m expanded metal mesh above the steel section was welded to the front of the frame above the solid steel, with the smooth section facing inside the *boma*. This included 6 mm flat bar brackets with 30 mm holes reinforced with 6 mm gusset welding at 300 mm from the top and bottom of the frame on the left hand side and at 400 mm from the top and bottom of the frame on the right hand side. The connecting bolts were made of 25 mm round bars, 300 mm long and tapered on one end. Approximately 30 sections were used in the *boma.*

   Sliding gates: Three sliding gates 1.5 m wide sliding on a 3 m rail and 2.5 m high were part of the *boma*. The gates were made of 50 mm × 50 mm hollow square tubes with three rollers. The gates were made of solid 2 mm pressed steel. They were provided with locks

that could be operated from outside. A provision was made for fitting a solid shade cloth above the gate to the same height as the rest of the *boma*. Provision was made for the walkways to be attached to a few steel sections 300 mm wide and extending along the entire length of the section, 1.5 m thick and 2 m high. This was done to facilitate the loading of animals into the truck.

Loading ramp: The loading ramp was a 3 m section, of solid pressed steel at 2.5 m height. The same specifications applied to the walkway of the other sections. The floor was attached at the base of 3 m sections. Three supporting arches were attached at the top, made of 25 mm round bars. The loading ramp was of 3 mm solid pressed steel plate with iron rods. The loading ramp was filled with soil. Two sections were tapered from a 3 m base at an angle of 65° to accommodate the loading ramp. The *boma* was teardrop shaped and installed at a location with some shade. The height of the *boma* was increased by 1 m using 80% agrimesh. Wooden poles were used to reinforce the steel sections. The steel sections beyond the double door sliding gate were covered using the agrimesh all the way up to the entrance of the truck. Since gaurs are forest animals, this was done to give them a sense of having a space to hide in. The holding *boma* was further divided into two compartments with the help of bamboo mats and a sliding gate. This partition was covered with agrimesh to avoid any sharp edges protruding out in the *boma*. Branches with foliage were hung on the wires running across the *boma*. A provision for giving food, water and salt was made in the last compartment of the *boma*. Shade was provided using agrimesh at the far end of the *boma*. Transport trucks (TATA LPT 1615) in standard container flat bed configuration with twist locks set at standard 6 m container distances. A transport truck (TATA 407 four by four) was kept as a recovery vehicle for transport from the field to either the big truck or the holding *boma.*

8. **Design of enclosure at BTR:** A survey for a suitable site for a soft release of the gaur in BTR was carried out by the MPFD officials. A site with good vegetation, cover and water was selected at the borders of Tala and Magdhi ranges. A 50 hectare plot was selected, power fenced and prepared for the release **(Figure 5)**. An off-loading ramp was prepared at the

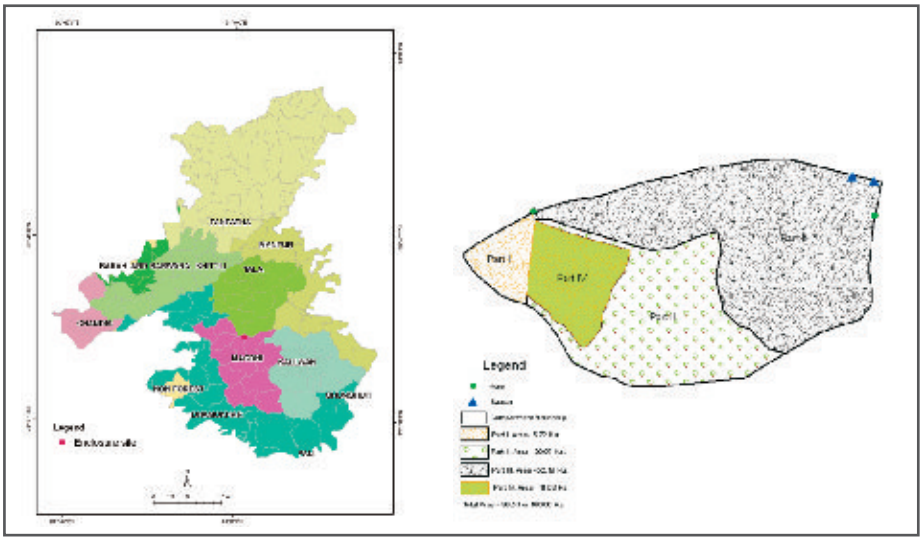


Figure 5: (A) Gaur reintroduction enclosure site in BTR and **(B)** enclosure design at Magdhi Range

site **(Figure 6)**. A small 2.5 hectare plot was fenced inside the larger enclosure. This was done to facilitate closer observations of the animals during the initial few days.

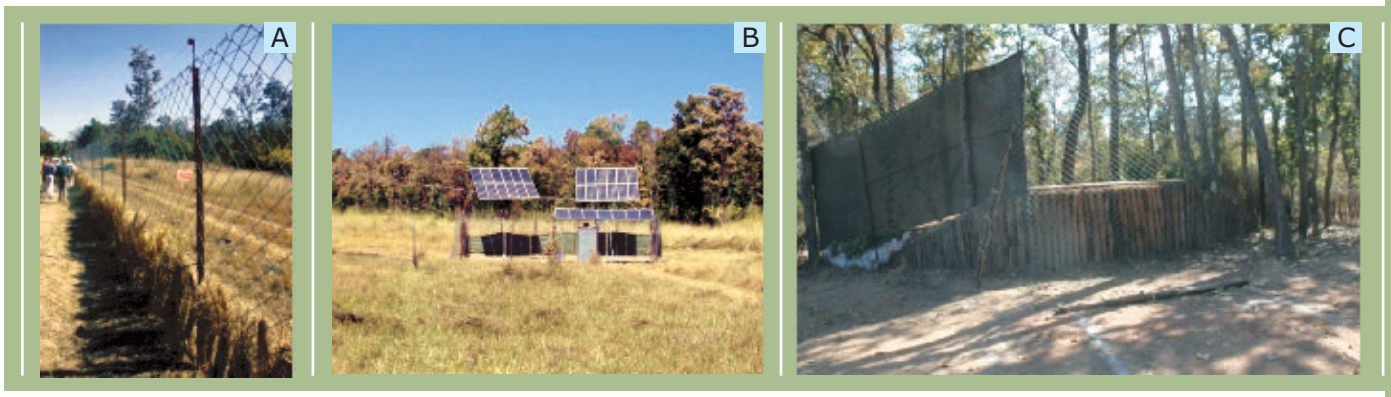


Figure 6: Enclosure at Tala range in BTR (A) Power fencing at enclosure (B) Solar Panel at the site (C) Off-loading ramp

9. **Procurement of radio-collars:** A total of 15 radio-collars were procured for the project. These included two Telonics (USA) satellite/GPS/VHF collars and 13 Telonics (USA) VHF radio-collars. The WII was accorded responsibility for procurement of collars and monitoring of the re-introduced gaur at BTR.

10. **Development of veterinary protocols for capture and translocation:** A detailed plan of operation (veterinary protocols) for capture and translocation of gaurs from Kanha to BTR for the purpose of re-introduction was prepared by Dr. Parag Nigam, Scientist, WII, and Dr Dave Cooper, EKZN wildlife veterinarian, South Africa, and reviewed and vetted by the Madhya Pradesh State Forest Department **(Annexure V).**

11. **Training of field staff:** Training was provided to the field staff at Kanha and Bandhavgarh tiger reserves on various aspects between 6 and 19 January 2011 as summarized below.

a. Teams for monitoring animal herds, capture and darting, loading/off-loading of immobilized animals, emergency management, weighing **(Figure 7)**, transport, logistics/support, off-loading at Bandhavgarh and post-release monitoring were identified, and specific roles were assigned.

b. The darting team was trained to dart from the back of an elephant and from a vehicle at variable distances before the actual operation.

Figure 7: Checking functionality of weighing balance before the operation

12. **Reconnaissance of the route:** A dry run of the transport truck was carried out between Kanha and Bandhavgarh to assess the road condition, suitability of the vehicle and halting points during the journey and to optimize the vehicular speed. Dr Les Carlisle, along with Mr. Kartikeya Singh and the field staff, carried out the reconnaissance survey. Based on the reconnaissance, it was proposed to commence the journey with the animals late in the evening so as to avoid human and vehicular disturbance and to ensure that the journey was during the cooler hours.

13. **Checking veterinary supplies and equipment:** A thorough check of drugs (immobilization and emergency), accessories and functioning of the equipment was done **(Figure 8)** according to the veterinary protocols **(Annexure V).**

Figure 8: (A) Medicine box (B) Checking veterinary supplies prior to operation

CAPTURE, TRANSPORT AND RELEASE: FIELD OPERATION

The team assembled at Kanha Tiger Reserve on 18 January 2011 before the final operation. The entire sequence of events for the field operation was discussed at length. Specific duties were assigned; medicines and equipments re-checked and a mock field trail with ground staff carried out. The field operation started on 21 January 2011. A total of 22 immobilizations were carried out at Kanha between 21 and 27 January 2011, of which 19 animals were successfully translocated to BTR.

Selection of animal and site: The patrolling team headed by Sh. H.S. Negi, Field Director, Kanha Tiger Reserve, was assigned the responsibility for locating a gaur herd. Nine captive elephants were used for the search operations at different areas based on the information provided by the patrolling party. Once a herd was located, the size, composition, terrain conditions for darting and distance from the road were considered prior to the actual operation. In case the herd characteristics were appropriate but the herd was not in suitable terrain (undulating and thick cover), the herd was gently pushed to suitable terrain with the help of elephants. The selection of an individual for capture was done on the basis of its condition, age and weight **(Figure 9)**. The final selection of the animal was made after detailed discussions amongst the team members.

Figure 9: Selecting suitable animal from herd

Immobilization: The selected animal was approached on the back of an elephant for darting. Etorphine hydrochloride (Captivion, Wildlife Pharmaceuticals (Pty) Ltd., 9.8 mg/ml) mixed with

azaperone (Stressnil, Janssen Pharmaceutica NV, 40 mg/ml) at appropriate doses was remotely injected employing 3.0 ml nylon darts using a Dan Inject projector (model JM). The animal was left undisturbed till it reached a condition safe for handling.

All the information collected during the field procedure was recorded in the format provided in the veterinary protocols. A total of 22 immobilizations were carried out at Kanha Tiger Reserve **(Figure 10).** The details of the immobilizations are summarized in **Table 2.**

Of these 19 animals were successfully translocated to BTR though one adult female was revived immediately after capture as a young calf was seen following her after darting (Sr. No. 6). Another female (Sr. No. 8) had to be immobilized again (Sr. No. 17) for loading on to the container as she resisted leaving the boma even after repeated efforts. A sub-adult female (Sr. No. 2) died due to shock resulting from aspiration pneumonia. The details of the captured and radio-collared gaurs are given in **Table 2.**

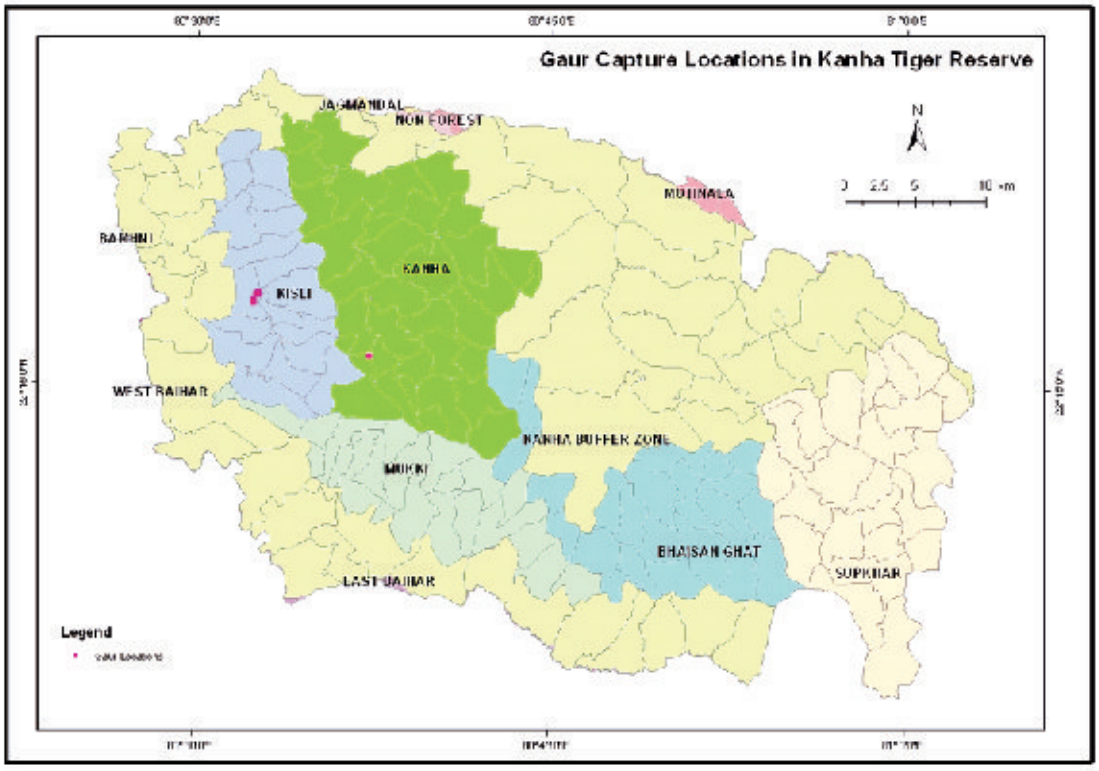


Figure 10: Capture locations in Kanha Tiger Reserve, Madhya Pradesh (Kanha and Kisli ranges)

Table 2: Details of gaur capture, collaring and release

Sr. No.	Date	Range	Sex	Approximate age (years)/ ed weight (kg)	Etorphine HCl (mg)	Naltrexone (mg)	Collar type and frequency	Remarks
1	20-01-11	Kisli	Female	3-4/400	5	100	VHF 150.28	Translocated to BTR
2	20-01-11	Kisli	Female	3-4/400	4	80	-	Died (aspiration pneumonia)
3	20-01-11	Kisli	Male	3-4/350	3	60	VHF 150.80	Translocated to BTR
4	20-01-11	Kisli	Female	3-4/300-350	3	60	VHF 150.90	Translocated to BTR
5	20-01-11	Kisli	Male	3-4/300-350	3	60	-	Translocated to BTR
6	21-01-11	Kisli	Female	5-6/600	5	100	-	Released after capture (animal seen with a calf)
7	21-01-11	Kisli	Male	4-5/500	4	80	(GPS) 150.00	Translocated to BTR
8	23-01-11	Kisli	Female	6-7/>600	5.5	120	VHF 150.60	Translocated to BTR
9	23-01-11	Kisli	Male	>1.5/150	1.5	30	-	Translocated to BTR
10	24-01-11	Kanha	Female	4/400-450	4	80	VHF 150.22	Translocated to BTR
11	24-01-11	Kanha	Female	4-4.5/400-450	4	80	VHF 150.4	Translocated to BTR
12	24-01-11	Kanha	Female	4-4.5/500	3.5	70	VHF 150.24	Translocated to BTR
13	24-01-11	Kanha	Female	5-5.5/350-400	2.5	90	VHF 150.30	Translocated to BTR
14	25-01-11	Kanha	Female	5-6/500	5	100	VHF 150.20	Translocated to BTR
15	25-01-11	Kanha	Female	6-7/550	5.5	110	-	Translocated to BTR
16	25-01-11	Kanha	Female	>1.5/150-200	2	40	-	Translocated to BTR
17	25-01-11	Kanha	Female	6-7/600	5	100	-	Immobilized for loading onto container
18	27-01-11	Kanha	Female	3-3.5/300-350	3	60	-	Translocated to BTR
19	27-01-11	Kanha	Female	5-6/500	4.5	90	VHF 150.26	Translocated to BTR
20	27-01-11	Kanha	Female	2.5-3/200	1.75	35	-	Translocated to BTR
21	27-01-11	Kanha	Female	2-2.5/200	1.4	30		Translocated to BTR
22	27-01-11	Kanha	Male	6.7/>600	5.5	110	(GPS) 150.10	Translocated to BTR

Summary of Immobilization:

1. Induction time (time from darting till animal attaining lateral recumbency) : 2.5-11 minutes
2. Approach time (time from darting till animal finally approached) : 3-13 minutes
3. Operation time (time after approach till animal given antidote) : 4-38 minutes
4. Recovery time (time after giving antidote till animal stood) : 1-5 minutes
5. Total time for operation : 15-47 minutes

Procedures Post-immobilization: After ensuring that the animal had been sedated sufficiently so that it was safe to handle it, the animal was immediately blindfolded and maintained in sternal recumbency **(Figure 11).** Proper positioning of the animal was critical during the entire operation as it ensured patent airways and normal eructation of ruminal gases and fluids. After ensuring that the physiological parameters were stable, the immobilized animal was shifted onto the stretcher and loaded onto the small vehicle for taking it to the boma or directly loaded onto the transport truck **(Figure 11).** All the animals captured at Kisli range were brought to the boma, whereas the animals captured at Kanha range were directly shifted into the transport truck **(Figure 12).**

Figure 11 : (A) Animal in sternal recumbency (B) Loading of immobilized animal onto small truck

The condition of the animal and level of sedation were assessed continuously during the operation. Where needed, supplemental anaesthesia with ketamine HCl (Ketamil, Troy Laboratories, 100 mg/ml) was given intravenously to the animal, and in case of respiratory depression, partial antagonism with butorphanol tartarate (Butrum, Aristo Pharmaceutical Pvt. Ltd., 2mg/ml) was effected.

Figure 12 : Animal properly restrained on the small truck

Trimming of horns: So as to avoid any chance of injury during transport, the tips of the horns of selected animals (adults) were trimmed and rounded.

Collaring: The animals were collared for monitoring subsequent to their release at Bandhavgarh **(Figure 13).** Two Telonics (USA) satellite/GPS/VHF collars and 10 Telonics (USA) VHF radio-collars were deployed on the animals. The details are summarised in **Table 2.** The satellite radio-collars are programmed to give animal locations every day through ARGOS satellites for the initial three months and subsequently every third day.

Figure 13 : Radio-collar being fitted onto the animal at the boma

Biological sampling and laboratory investigations:

Biological samples were collected from the immobilized animals and subjected to detailed analyses at the Centre for Wildlife Forensic and Health (CWF&H), Madhya Pradesh, and Pashu Chikitsa Vigyan Vishwavidyalya, Jabalpur **(Table 3 and 4).**

Figure 14 : Laboratory investigation at CWF&H, Jabalpur

Table 3: Haematology and serum biochemistry of Gaur (n=18)

A. Haemogram	Ranges Obtained	Normal Ranges* (Cattle)
Total erythrocyte count (Million/µl)	4.0-9.81	6.3-11.55
Haemoglobin (g/dl)	8.8-13.8	8.7-14.5
Packed cell volume (%)	31-43	33-47
Erythrocyte sedimentation rate (Wintrobe) mm./hrs	0-3	0
Total leucocyte count (Thousand/µl)	6.1-16.8	5-12
Neutrophils (%)	30-67	10-52
Lymphocytes (%)	27-57	39-77
Monocytes (%)	2-10	1-18
Eosinophils (%)	2-10	0-14
Basophils (%)	0-0	0-1
Mean corpuscular volume (fl)	25.6-60.3	30.5-46.5
Mean corpuscular hemoglobin (pg)	6.5-19.2	8.50-13.3
Mean cell hemoglobin concentration (g/dl)	12.9-39.4	10.50-28.7
B. Biochemical Analysis		
Glucose (mg/dl)	31.4-120.6	45-75
Phosphorus (m.mol/L)	4.2-13.4	3.2-12.4
Calcium (mg/dl)	3.6-8.4	9.7-12.4
Chloride (m.mol/L)	82.9-88.9	97-111
Cholesterol (mg/dl)	149.6-200	80-120
Creatinine (mg/dl)	0.2-3.1	0.8-2.0
Total protein (g/dl)	5.3-9.2	6.74-7.7.4
Albumin (g/dl)	2.3-3.8	3.03-3.55
Total bilirubin (mg/dl)	0.4-3.3	0.2-1.2
Direct bilirubin (mg/dl)	0.1-0.6	0.1-0.6
Blood urea nitrogen (mg/dl)	21.3-54.1	20-30
Uric acid (mg/dl)	1.9-3	0.0-2.0
Alanine Aminotransferase (u/L)	19.1-45.9	14-38
Aspartate transaminase (u/L)	18-124.4	78-132
Alkaline phosphatase (u/L)	49-263.8	40-160

*Normal values of cattle*Benjamine, M.M.1978. Outline of veterinary clinical pathology, pp-44 Edn III in Iowa University Press IOWA, USA

Table 4: Sero-Diagnosis: Gaur (n=18)

S. No.	Disease	Tests	Results
1	Brucellosis	Rose bengal plate agglutination test, Standard tube agglutination test	Negative for Brucellosis
2	Tuberculosis	Single intra-dermal test for tuberculosis	The animals were observed for 48 hours; however none of the animals showed reaction to tuberculin.
3	Foot and Mouth Disease	Haemagglutination (HA) / Haemagglutination inhibition test (HI)	Under investigation
4	Blue Tongue	Enzyme-linked immunosorbent assay	No antibodies found
5	Endo-Parasites	Sedimentation/Flotation method	No significant level of parasitic ova observed.

Genetic studies: Understanding genetic diversity has been one of the important aspects of conservation planning and re-introduction programmes. Information obtained from studies carried out to this end is valuable for correlation with changing land use matrices and as baseline data for re-introduction in the future of more individuals. Biological samples (blood, dung and hair) were collected for genetic analysis from immobilized animals. Of these, blood samples (n=19) were subjected to genetic analysis using mitochondrial genes (12S rRNA, 16S rRNA, cytB and control region) and nuclear markers (microsatellite DNA) at the forensic facility at WII, Dehradun. Eleven highly polymorphic microsatellite loci developed for bovids for mutli-locus genotyping were used in the study. Preliminarily analysis indicates a relatively high genetic diversity (0.578) among the gaurs translocated from Kanha as compared with other studies undertaken on gaurs in Vietnam (mean observed heterozygosity, 0.269) (Nguyen et al., 2007). Further analysis is required and will provide information regarding the genetic diversity of the population, allele sharing among individuals and parent-offspring relationships. This information will form the basis for the selection of individuals in future translocation programmes.

Medication and drug reversal: A short-acting tranquilizer, azaperone (Stressnil, Janssen Pharmaceutica NV, 40 mg/ml) was used with the primary immobilizing drug (etorphine HCl) in the immobilization dart. Subsequently medium- and long-acting tranquilizers were used to attain the desired level of tranquilization during transport and at the release site. These included haloperidol (Talendol, Morvel Laboratories (P) Ltd., 5 mg/ml) and perphenazine enanthate (Perphenazine 100, Kyron Laboratories, South Africa, 100 mg/ml). Additionally a long-acting antibiotic and supplemental drugs (multi-vitamins, etc.) were also administered to the animals.

After all the procedures were carried out, the animals were given an antidote Naltrexone (Trexonil, Wildlife Pharmaceuticals, 50 mg/ml) in the ratio of 20:1 of etorphine either intravenously or intramuscularly. The details of recovery are provided in **Table 2.**

Release into *boma*: All the animals captured at Kisli range (same herd) in Kanha Tiger Reserve were brought into the *boma* prior to transport to Bandhavgarh. This was done to ensure that the animals recovered from the effects of capture and that the proper level of tranquilization had been achieved. Since these are herding animals, it was presumed that animals in a group would be subjected to minimal stress during loading and transport.

Loading of animals: The captured animals in the boma were coaxed into the transport truck. Though the initial lot could be loaded comfortably, one of the females (Sr. No. 17) could not be loaded into the transport truck despite all efforts. The animal had to be immobilized again and was subsequently loaded onto the truck. It was ensured that a female with a calf and a mature bull were not mixed with other animals in the truck and taken independently.

Figure 15: Loading of immobilized gaur into the transport truck

Direct loading onto transport truck: Animals captured from the Kanha range were directly loaded onto the transport truck **(Figure 15).** This was done since the animals captured were from same herd and moreover the distance from the boma was great. It was ensured that the animals had the proper level of tranquilization prior to transport.

Transport Considerations: The distance between Kanha and Bandhavgarh was approximately 220 km, and it took on average 6 hours to reach Bandhavgarh. The journey was commenced in the late evening so as to avoid any human and vehicular disturbance and to reach the release site during the early morning hours. Special care was taken to maintain a uniform speed during the journey, with the speed adjusted according to the local road conditions. The animals were monitored throughout the journey.

Figure 16: Release of first lot of gaur at BTR on 22 January 2011

Release of animals: The truck with the animals was placed appropriately at the off-loading ramp at the release site (enclosure at Magdhi range). On reaching Bandhavgarh, after an initial stabilization and after the fitness of the animals was verified, they were released into the 2 ha enclosure **(Figure 16 & Table 5).**

Table 5: Details of release of gaur at BTR

Sr. No.	Date of capture at Kanha Tiger Reserve and number of animals captured	Date of release at BTR and number of animals released	Remarks
1 2	20/1/11 (05) 21/1/11 (02)	22/1/11 at 0235 hours (3 males and 2 females)	One died and one adult female was released at Kanha itself.
3 4	23/1/11(02) 24/1/11 (04)	25/1/11 at 0638 hours (4 females)	An adult female with a calf could not be loaded and hence was left at Kanha.
5	25/1/11 (03)	26/1/11 (1 male and 4 females)	An adult female that did not get into the truck was immobilized again and loaded manually with the other animals.
6	27/1/11 (05)	28/1/11 (1 male and 4 females)	

The age classes of the gaur reintroduced in BTR are given in **Table 6.**

Table 6: Age classes of re-introduced gaur at BTR

	Age class (years)			
	1.5-3.5	3.5-5	>5	Total
Male	1	2	2	5
Female	2	5	7	14
Total	3	7	9	19

The animals were maintained in the smaller enclosure till 30 January 2011, after which a small part of the enclosure was opened for the animals to move into the bigger (50 ha) enclosure. The herd was monitored intensively in the enclosure by the joint team of WII and frontline staff of BTR. On 9 March 2011, an adult cow (GF 14) delivered a calf inside the enclosure. The animals were released from the enclosure on 20 March 2011.

Monitoring the re-introduced herd: Intensive monitoring of the gaur herd will be carried out to understand their movements, home range, activity, population structure and food habits. The radio-collared gaurs will be monitored for three years by a research team of WII research fellows and forest officials in Bandhavgarh using the homing-in and triangulation techniques. Approximately 40 radio-locations of each radio-collared individual will be collected per season (summer, winter and monsoon) to study the home range and movement pattern of the gaurs. At

each animal location, the major vegetation types, terrain, other habitat variables, distance to water, distance to human habitation, distance to road, etc. will be recorded. The food plants eaten by the gaurs will be recorded to study their food habits.

LESSONS LEARNT

Unexpected things can happen during capture operations. It is important to be alert and confident when handling animals. Small efforts can save potentially dangerous situations. A brief on some of the incidents that happened during the gaur capture and translocation operation is given below.

Maintenance of sternal recumbency: Maintenance of sternal recumbency was the most critical, urgent and important aspect of immobilization of gaurs. Proper positioning ensures normal eructation of ruminal gases that would otherwise result in bloat and can lead to further complications. Also it ensures that the regurgitated rumen contents flow out of the mouth and are not aspirated. The first animal moved for a distance after being darted and came to sternal recumbency close to a *nallah.* As the sedation progressed, the animal slipped into the *nallah* **(Figure 17 A).** The animal was saved by a timely dash by Mr. Les Carlisle and Mr. H.S. Negi, who immediately brought the animal to sternal recumbency. Similarly, another animal was brought down physically to sternal recumbency by Mr. Les Carlisle when it was moving around aimlessly for a long time and could have injured itself **(Figure 17 B).**

Figure 17. (A) Animal slipping into the dry *nallah* during drug induction
(B) Gaur being physically restrained

Altered behaviour following darting: Animals behave differently under sedation during induction. Narcotics, being potent drugs, produce rapid induction in 3 to 5 minutes before the animal can be approached safely for handling. The sequence of events following darting includes incoordination, aimless walking, a high stepping gait and staggering prior to coming to sternal recumbency. One of the animals (a large female) chased people and elephants during induction

and moved out of the herd (200 m) into an open area and ended up under the transport truck. Such erratic inductions need to be envisaged and appropriately addressed. The animal was closely monitored by Mr H.S. Negi from the back of an elephant, and it was ensured that the animal was not disturbed till the sedation was deep enough for safe handling.

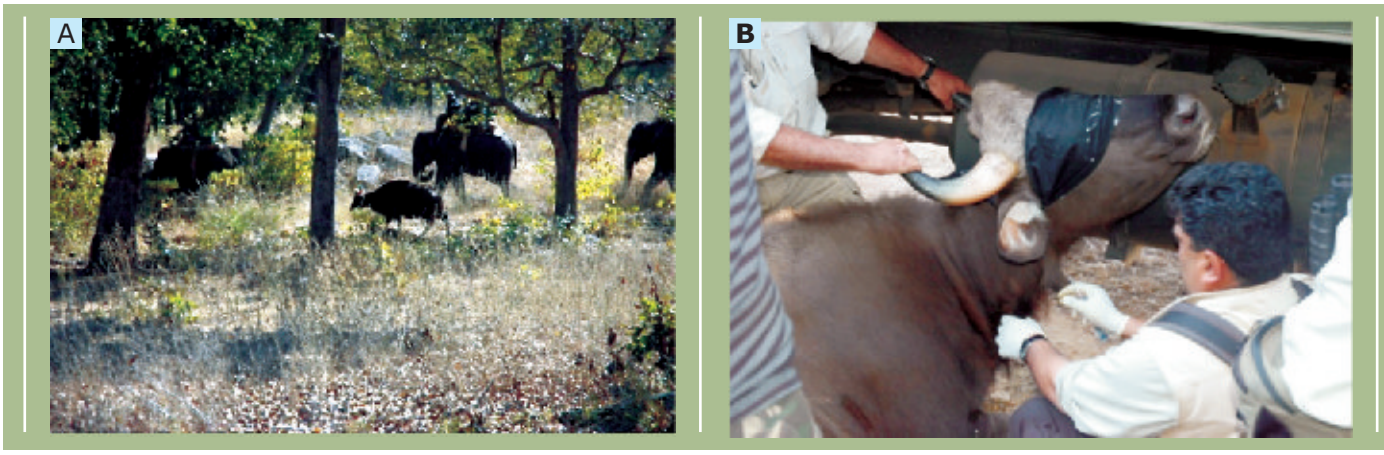


Figure 18: (A) Gaur being prevented from straying out using captive elephants
(B) Animal resting under the truck being sampled

Emergency management: One of the animals, though immobilized properly, displayed muscular tremors and respiratory distress (laboured breathing) on approach. This emergency was immediately responded to by administering a partial antagonist (butorphanol) intravenously, and the animal was stabilized almost immediately.

Salient Points:

1. This translocation of gaurs from Kanha to Bandhavgarh is the first successful mass translocation of gaurs ever attempted in its entire distributional range in South Asia.
2. A narcotic, namely etorphine hydrochloride, has been found to be suitable for immobilization of gaurs.
3. The use of short and long-acting tranquilizers in the translocation operation has proved to be effective in minimizing stress in the animals.

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Project Proposal : A Plan for Re-introduction of Gaur in Bandhavgarh Tiger Reserve

1. INTRODUCTION

Gaur *(Bos gaurus gaurus)*, popularly known as bison or the Indian bison, is the largest species of cattle on the Indian sub-continent and is one of the most majestic and beautiful creations of nature. The species, which is generally associated with idyllic, dense bamboo rich forests, mixed with open glades and plenty of water, was once wide spread throughout India, except the drier north and northwest. With the decline in the health of our forest wealth, this species has also suffered grave losses in its numbers and range. As per Schaller (1967), gaur was distributed in three widely separated geographical areas that corresponded to the major mountain systems in India: the Western ghats, the Central Indian highlands and the foothills of the Himalayas, including the hills south of Brahmaputra River. As per a study done by the Wildlife Institute of India (Ecology of Gaur in Pench Tiger Reserve, M.P., 2001), the gaur population in India is currently estimated at approximately 23,500. It occurs in 101 existing and 27 proposed Protected Areas, covering 15 states. The gaur range covers approximately 7.12% of the geographical area and 30% of forest cover of India. The Protected Areas cover 14.3% of the area of distribution of gaur. The present distribution range of gaur as prepared by WII, Dehradun is given as **Annexure-I.**

However, these studies have not documented the fragmentation and much local extinction of the species, which may ultimately result in eliminating it from one or more of the ranges indicated by Schaller and WII. One such recent extinction has been from Bandhavgarh National Park of Madhya Pradesh, which supported a small population consisting of 20-50 animals up to 1995 but disappeared between 1995 and 1998 for unknown reasons. Similarly, Dunbar Brander (1923) reported the extensive presence of gaur in Betul and Khandwa districts of Madhya Pradesh in the beginning of the 20th century, where the species is either extinct or unrecorded at present. The species is perhaps already extinct from Sanjay National Park in eastern Madhya Pradesh, which earlier connected it with the populations in Chhattisgarh and Jharkhand or it is just on the brink. Disappearance of the species has also been reported from the Thattakad Wildlife Sanctuary in Kerala and the Kanger Valley National Park in Chhattisgarh.

At present Central India (MP, Chhattisgarh and Maharashtra) harbours approximately one fourth of the present gaur population surviving in the country (Ecology of Gaur in Pench Tiger Reserve, M.P., 2001). In Madhya Pradesh, fragmented gaur population is found in 10 districts. There are unconfirmed reports of its existence in Katni and a small area called Kali Bhit at the junction of Betul, Harda and Khandwa districts.

The factors leading to the reduction in the range of this species are the usual ones: Loss and degradation of habitat, poaching and diseases. This species is perhaps more prone to losses from diseases due to its genetic proximity with the domestic livestock. Past records

indicate that populations of gaur have succumbed to epidemics of foot and mouth diseases (FMD), rinderpest and anthrax in many areas of its distribution. The obvious shrinkage in the range, number and densities of this magnificent species is a cause for serious concern and calls for urgent recovery and restoration plans. Otherwise, we may reach a crisis which we now associate with the other important symbols of Indian natural heritage, such as the tiger, lion, elephant etc.

2. HISTORY OF GAUR PRESENCE IN BANDHAVGARH TIGER RESERVE

Gaur was historically found in Bandhavgarh National Park in small numbers. This population was considered to be the only population to the north of Narmada river, in Central India. As per the Management Scheme prepared by Shri M. Dixit IFS, (1975) gaurs were localized in the hilly tract around the Bandhavgarh Fort and were generally seen in compartment No. 324 during summers after sunset and before sunrise when they came to drink water in Charanganga river and grazed in the green grassy patch. As per the Management Plan prepared by Shri A.K. Sonakiya IFS, (1992) the gaur population of Bandhavgarh National Park was considered threatened. The gaur was identified as an important target species for the management, but nothing, except general protection, has ever been done specifically for this species. The population estimates of gaur in Bandhavgarh National Park from 1968 onwards are given:

S. No.	Year	No. of Gaur	S. No.	Year	No. of Gaur
1	1968	9	17	1984	17
2	1969	16	18	1985	17
3	1970	23	19	1986	0
4	1971	0	20	1987	21
5	1972	34	21	1988	21
6	1973	35	22	1989	36
7	1974	16	23	1990	38
8	1975	37	24	1991	35
9	1976	38	25	1992	35
10	1977	19	26	1993	32
11	1978	21	27	1994	32
12	1979	6	28	1995	30
13	1980	16	29	1996	1
14	1981	19	30	1997	1
15	1982	11	31	1998	1
16	1983	15			

Gaurs were usually seen in Rajbahra, Bathan, Bhadrashila and Chakradhara areas of Tala range only in the open season. There is no definite information where the species spent the rainy season. It was generally believed that they migrated to Ghunghuti and Amarkantak areas (south west of Bandhavgarh) during the monsoon, but were occasionally recorded within the extended park area (Kallwah and Magdhi anges) during the rainy season as well. The 1988 monitoring program confirmed their presence in the Kaliwah/Magdhi area in the monsoon. However, the animals did not return to their post monsoon range in 1995. As per the Management Plan prepared by Dr. U. Prakasam in 2006, the last gaur, a male, seen in Bandhavgarh was in 1998. There have also been unconfirmed reports of some stray animals having been seen in rather unlikely places outside the park after 1995, but whether these animals were from the Bandhavgarh population, or not, is difficult to say.

3. CAUSE OF LOCAL EXTINCTION

Unfortunately there has been no study to understand the causes of the extinction of the species from Bandhavgarh. Therefore, we can now make only a reasonable guess as to what led to this tragedy. As the disappearance of the species was almost sudden, it appears something happened to the population during its so-called migration season out of the park. If the decline had been gradual, predation by tigers and degradation of habitat, disruption of the migratory route etc. would have been the probable causes. The construction of a thermal power plant near Pali, along with other associated developments, and the consequent disruption of the traditional migratory route (presumed), is believed to be one of the major reasons for the extinction of the species from Bandhavgarh. However, the sudden demise of the entire population, which in fact had been growing for the previous 15 years or so, cannot be explained by these factors. The only other possible factors can be a disease or an accident. There is no record of any epidemic of anthrax, rinderpest or any other livestock diseases in the region during the relevant period and no dead bodies were reported. Although it is unlikely that nearly 30 animals could have died in an accident, but such a thing can happen if the accident is related to a natural calamity, such as a flood. As the disappearance happened during the monsoon season, which happens to be the migratory season as well, the chances of the population having been wiped out in a flood look reasonable. However, the only river that crossed their presumed migratory path is Johilla, which is not a large river, although flash floods are possible even in small rivers, especially where they descend from the hills. As the migratory route is only a guess, the actual migration may also have been happening across larger rivers such as Son or Narmada. If that is correct, then the flood theory will look more plausible. However, the tragedy confirms the fact that small, isolated, populations are too vulnerable to be taken for granted and urgent safeguards must be taken to protect them well in time.

4. JUSTIFICATION FOR RE-INTRODUCTION

The loss of gaur from Bandhavgarh National Park has had three main implications: Local extinction of an important species (schedule I of the Wildlife Protection Act, 1972), increasing the chances of further extinctions, loss of gene flow and fragmentation.

(a) Loss in biodiversity of the National Park

(b) Decline in tourist satisfaction,

As mentioned above, the gaur range has been shrinking continuously over the last century. Despite the success of the conservation efforts of the 20th century, we have no records of

any species reoccupying its traditional range. If this is allowed to continue, the vulnerable species are likely to become gradually further endangered.

The known extinction of gaur in three or four Protected Areas, in a relatively short span of time, is a testimony to the fact that this species is losing ground very fast and urgent measures are required to stem this process. As the march of habitat destruction and poaching continues unabated, especially outside protected areas, decline of populations outside protected areas is likely to continue in the foreseeable future. However, the dispersal of the species from protected areas into the adjoining forests and inter-PA corridors may slow this process to some extent Therefore, it is extremely important that suitable protected areas continue to support gaur populations to replenish the losses outside. The loss or serious reduction in population inside PAs, especially if the loss has happened as a result of some stray calamity, as appears to have happened in BNP, can be tackled by reintroduction or replenishment but nothing much can be directly done to bolster the intervening populations. The principle applies to all the species which are showing trends of declining populations or local extinctions.

Therefore, rather than watching helplessly and rueing the loss, conservation requires active programs for reintroduction and reestablishment of important species from the areas where they have been recently lost, with or without habitat related interventions. IUCN/SSC guidelines strongly recommend such reintroductions. Bandhavgarh continues to be an excellent habitat for the species therefore can still support a reasonable gaur population.

The IUCN/SSC guidelines define re-introduction 'as an attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct'. The proposal to reintroduce gaur into Bandhavgarh National Park is fully in conformity with this definition. The guidelines propose establishment of 'a viable, free ranging population in the wild of a species, subspecies or race, which has become globally or locally extinct' as the goal for reintroduction programs. As per the guidelines, there can be one or multiple objectives for re-introduction; this proposal conforms with the following objectives stated in the guidelines: a) to enhance the long-term survival of a species; b) to maintain and/or restore natural biodiversity. The proposal also meets another recognized objective, viz. 'to provide long-term economic benefits to the local and/or national economy' to some extent. The reintroduction of gaur into Bandhavgarh will enhance tourist satisfaction, resulting in better incomes for the Park, local people and Park dependent businesses. The guidelines recommend a multidisciplinary approach; prefer wild stock as the founder population. The guidelines also recommend that 'where the security of the re-introduced population is a risk from human activities, measures should be taken to minimize these'. Other elements of the guidelines, related to selection of the stock, legal requirements, policies of the relevant governments etc. shall be complied with as and when required.

5. ACTION PLAN

The reintroduction process shall involve the following steps:

(a) Capture nearly 20 animals through chemical immobilization in Kanha National Park and put them into a loading and recovery pen for one or two days.

(b) Transportation to Bandhavgarh, in specially modified vehicles.

(c) Holding in a small pen (100m by 100m), called Boma, for pre-release observation and treatment.

(d) Release into a large enclosure for approximately 2 months, approximately 100- 150 ha, for acclimatization and social bonding.

(e) Final release into the national park.

(f) Monitoring.

(I) Source Population: The gaur population of Kanha National Park appears to be the best source, Kanha is the nearest Park with sufficiently large gaur population. Both the Parks are situated in the same climatic belt and have similar vegetation. Both the Parks have nearly similar predator densities and the same species, namely, tiger, leopard and wild dog. The Parks are only around 200 km apart, which is a convenient distance for the transportation of the animals. However, subsequently a few individuals can also be brought from Pench' and Satpura Tiger Reserves to augment genetic diversity.

(II) Herd Size for Re-introduction: As per the study done by Schaller in Kanha National Park, the sex ratio of adult animals was found to be around 40 bulls per 100 cows. Approximately the same sex ratio was noticed in the Bandhavgarh population also. Hence it is proposed that initially a herd of 15 adult cows between ages 3-5 years and 6 bulls, between ages 3-5 years may be reintroduced during rainy season. Efforts shall be made to get as many animals from a single herd as possible. After careful monitoring of the reintroduced population, more animals can be reintroduced as per requirement, to improve the gene pool, so that a viable population of about 50+ animals is established on a long-term basis. Minimum number of 20-21 animals is based on the premise that a large herd shall be able to cope with high levels of predation. This is also based on the empirical observation that the Bandhavgarh population remained relatively stable and grew to more than 30, when its size reached 15 or more animals.

(III) Food and Water Requirement of Gaur: Since gaurs were present in Bandhavgarh, their food and water requirements can be easily fulfilled here. The details are provided in **Appendix-I.**

(IV) Release Site: The gaur population of Bandhavgarh lived mainly in the Tala range, although it is believed to have regular migration into other parts of the park, especially during monsoon. Therefore, the ideal release site shall be in Tala range. The only constraint in Tala range is the extremely high tiger density, which will be a major threat to survival of the species, especially in the beginning. Therefore, a suitable site on the southern side of the Tala range or on the northern side of the Magdhi range, with sufficient water and forage shall be selected for the construction of the release facilities. Adjoining compartments 259 (270.000 ha.) and 260 (220.500 ha.) of

Magdhi Range and 249 (364.500 ha.) of Kallwah range, have been tentatively selected this purpose and shall be finalized in consultation with other experts. These areas were previously used by gaurs (Pabla H.S., 1998 - Development of a user friendly wildlife monitoring methodology for Protected Areas in India) and the tiger density is comparatively low in this patch. After the animals are released from the enclosure, they will, hopefully, discover a suitable location for settlement. There is the possibility of the animals settling down outside the park or close to the fringes of the park. Even that should be acceptable. If the animals stray too far from the park, necessity and measures to bring them back shall be considered.

(V) **Legal Requirements:** The gaur is included in Schedule-I of Wildlife (Protection) Act, 1972. As per Section 12 of Wildlife (Protection) Act, 1972, the permission of Government of India shall be required before undertaking the capture operations. As there is likely to be some mortality during the operations, GOI permission for capturing and transporting 25 animals shall be obtained.

(VI) **Capture Methodology:** There is no experience in capture and translocation of big herbivores, over long distances in India, except the rhino introduction from Assam to Dudhwa National Park in UP. However, translocation of big game is a common practice in Africa. Therefore, technical support of African experts shall be enlisted in implementing this project.

In India, a mixture of ketamine and xylazine (HBM Mixture) is usually considered the drug of choice for most carnivores and herbivores. With the availability of an antidote, the convenience of this mixture has increased. However, etorphine is the most popular drug used for chemical immobilization of most species in Africa and other countries. As the project is aiming to access technical support from Africa, it will be wiser to go for etorphine in this project. In African buffalo, the dosages of 1mg of etorphine per 100 kg of buffalo is being used, allowing group dosage decisions of 6-9 mg for adults, 3-6 mg for sub adults and 1-2 mg for juveniles. The African experts have suggested starting doses of the same level for gaur as well. If the required knock down times is less than 10 minutes after administration of the drug, then these dosages could be considered. A knock down time averaging no more than five minutes shall be attempted.

The experience of the African scientists also has been that with a reversible drug it is better to go slightly heavy on the dose than it is to go light because in that case the animal can be got quickly and could be reversed if required. If dosage is light the animal could run too far too quickly and capture myopathy is inevitable. It is expected that the gaur being a black skinned animal will also overheat really quickly. Animals under a light dose typically

have stiff legs and necks rendering them very difficult and dangerous to handle for loading purposes.

(VII) Recovery from the Field Procedure: After immobilization the gaur is dragged or rolled onto an aluminum sled/stretcher and lifted onto the back of the 4x4pick up truck. A recovery team of at least 12 men with one specialist and team leader is required per gaur. Some mechanical assistance for the loading procedure will be useful, with sliding rails and winches attached to each recovery vehicle and then winching the sled/stretcher straight onto the recovery vehicle. Men are still required to get the gaur onto the sled and clear any obstructions etc.

The gaur is then driven to the recovery and loading pen and off loaded and the antidote administered. The recovered gaur is then moved into the holding and loading section of the pen. A short acting tranquillizer must always be administered with any long acting tranquillizer at the start of the required tranquilization period. The short acting drug then initiates the sedative effect until the long acting one can maintain the sedation.

Once all the gaurs are in the pen, the decision to load for transport can be taken. This decision will include two things:

- Full recovery from the effects of the capture process.
- Sufficient time for the long acting tranquillizer to have taken effect on all of the animals before the loading can take place.

This period is typically 24-48 hrs.

(VIII) Transportation : The gaurs are now coaxed down the chute and up the loading ramp into the transport trucks. Two transport trucks are needed with capacity to fit five gaurs per truck. The drivers and escorts are then in control until their destination. One specialist, one vet and one support or recovery vehicle should accompany each truck. One departmental vehicle to provide escort and communication at all times is required to follow the convoy.

It is important that the drivers do not swerve and brake hard all the time as this will knock the gaur off their feet and cause real problems for their well-being.

Sudden noise such as hooting is also really stressful for animals in transit and these issues will have to be addressed locally on the road.

(IX) Release: The gaurs are off loaded into the post-transport pens for recovery from the effects of the transport. Once all the gaurs are in the pen and have

completely recovered from the sedation they are ready for release into the enclosure. The pen gates (at least 4) are opened early in the morning and the animals left to find their own way out. Hidden photographers and cameras will record this historic event.

(X) Risks and Threats: The operation has to contend with the following procedural as well as post procedure uncertainties:

1. Some mortality or injury during chemical capture and transportation is possible either from the effect of drugs or from accidents.
2. The gaur population has been susceptible to various contagious diseases such as anthrax, rinderpest and foot and mouth disease. Hence the reintroduced animals can be vaccinated during capture operation so that the threat of losing this population to diseases is considerably reduced.
3. Wherever gaurs and tigers are found together, tigers are known to predate upon gaurs, especially the young calves. This is another major threat. But since the source population is from Kanha National Park, it is adapted to co-exist with tigers and hence capable of surviving in the presence of tigers.
4. The reintroduced stock may disperse, with or without herd formation, and disappear without reproducing in the new surroundings. Also they may breed for a few years then stop breeding and gradually disappear. Or else, they breed but do not spread and eventually disappear entirely.
5. The reintroduced population may need addition of new animals at different intervals to maintain a viable population over a long-term basis.

6. MONITORING

Monitoring of the reintroduced population is a must to analyze the factors associated with success or failure of its survival. The most common method for monitoring the individuals would be collaring both by radio and satellite collars of all the adult bulls and a selected number of cows and calves, if breeding takes place.

The health, behaviour, movements, interaction with other species shall be continuously monitored through a team of wildlife biologists, who will be part of the team to be constituted for project implementation. The Wildlife Institute of India or some other institution involved in wildlife research, shall be approached to become partners in the project to provide scientific inputs both for planning and implementation of gaur reintroduction, as well as for monitoring and establishment of reintroduced animals. Latest equipments and techniques shall be used for monitoring.

Based on results of monitoring, corrective measures can be taken for the welfare of the reintroduced stock.

7. PROJECT COST

The estimated cost of the plan is around Rs. 335.00 lakh. The details are provided in **Appendix-II.** These are very broad, indicative estimates, mainly to understand the scale of operations. Actual estimates, based on detailed planning, may be significantly different from these estimates.

8. TECHNICAL AND FINANCIAL COLLABORATION WITH & BEYOND AND TAJ SAFARIS

As mentioned above, there is limited, if any, experience available in India in undertaking such ambitious reintroduction programs, while translocation of big game is a routine management activity in Africa. Therefore, technical collaboration with experienced experts in Africa will be required to implement the project successfully. The estimated cost of the project is too high for the department to be able to finance it conveniently out of its own resources. &Beyond (previously known as The Conservation Corporation of Africa (CC Africa), which is a well known wildlife tour operator in South Africa, has informally indicated its interest in the project. The company owns its own private game reserves in Africa and has vast experience in such operations. One of their experts has already visited India for consultations with the department. They have offered to provide on-the-job training to the forest department staff, advise the department in the technical specifications of the infrastructure and equipment required, provide expert services during actual operations etc. free of cost. They have even offered to finance the project substantially, in partnership with their Indian partners, the Tata Group, through donation of vehicles etc. However, their formal participation shall be discussed, after the project is approved by the government. A letter of support from &Beyond previously known CC Africa and partner Taj Safaris, on the project is attached as **Appendix-III.** Mr. Les Carlisle is likely to be the technical advisor for the project.

9. MAN POWER AND TRAINING

The department has recently constituted regional wildlife rescue squads, equipped with immobilization facilities etc., to respond to emergencies related to wildlife. On the same lines a Central Wildlife Capture and Transportation Unit shall be constituted to undertake such operations in future. The unit shall be trained in all aspects of the job by the &Beyond (CC Africa) and Taj Safaris experts. It will consist of one senior park manager, one veterinarian and two or three technical officers (Assistant Conservator of Forests or below). As the department does not have its own cadre of veterinarians, an officer on long-term deputation to the department from the Department of Veterinary Services shall be deputed for the purpose.

10. PROJECT DURATION

The project is proposed to be implemented over 3 years, including the monitoring period. The operation is proposed to be carried out in the month of June-July 2007.

FOOD AND WATER REQUIREMENT OF GAUR

Gaur is a generalist feeder but prefers to browse in dry season and predominantly graze in monsoon. Their diet chiefly includes shoots and foliage of trees, shrubs and buds, fruits of species like *Diospyros melanoxylon* and *Aegale marma/os*, tender seeds of bamboo, herbs, grasses and bark of trees like *Adina cordifolia* and *Tectona grandis*. They visit salt licks periodically. Being an obligatory drinker, gaur needs water every day and may visit water bodies twice a day during the hottest periods. During the hot hours of the day gaur retire to the shelter under thick tree cover and ruminate. Feeding is more predominant during the early morning and evening hours. On an average they feed for 15-18 hours a day.

During the study done by WII in Pench Tiger Reserve, a total of 78 species of gaur food plants belonging to 28 families were recorded. Of the food plants recorded, family Leguminoseae accounted for the highest number of individuals (18%) followed by Gramineae (15%). Direct feeding observations showed that the browse formed a major proportion in the diet of gaur during summer (grass: browse ratio, 1:3). A total of 11 tree species, 3 shrubs, 3 climbers, 4 grasses and 1 herb species were recorded as summer food plants of gaur. The availability of food plants of gaur in Bandhavgarh Tiger Reserve is given below.

In the year 1982-83, the gregarious flowering of bamboo (*Dendroca/amus strictus*) took place in Bandhavgarh National Park. As a result, the regeneration of bamboo came up profusely. At present, the regenerated bamboo plants have become shrubby and bushy. They provide good and ample forage to almost all herbivores species. As bamboo is a preferred food plant of gaur, there is abundant food availability for gaur in Bandhavgarh Tiger Reserve.

The long, prehensile tongue of gaur is well adapted for browsing. Gaur prefers green grass when available but even feeds on coarse, and buds, fruits of trees like, *Aegale marma/os, Bauhinea spp., Cassia fistula, Cordia myxa, Diospyros melanoxylon, Emblica spp., Gmelina arborea, Terminalia bellerica* and *Randia dumetorum* (Krishnan 1972, Brander 1923, Schaller 1967, and Pasha 1999). The tender seeds of bamboo and herbs also contribute to the diet of gaur. The gaur also feeds on bark of many tree species. In central India the gaur is reported to feed on the bark of *Adina cordifolia* (Brander 1923 and Schaller 1967) and in Mysore on the bark of *Wendlandia natoniana*. Sanderson (1983) reports gaur of eating the bark of *Phyllanthus emblica.* During the summer season teak (*Tectona grandis*) debarking by gaur is a well-know phenomenon in central Indian highlands (Ranjitsinh 1997 and Pasha et. al. 2000 a).

Food Plants of Gaur Available in Bandhavgarh Tiger Reserve

S.No.	Species	S.No.	Species
1	*Ougenia dalbergioides*	26	*Casearia tomentosa*
2	*Diospvros melanoxvlon*	27	*Adina cordifolia*
3	*Bauhinia racemosa*	28	*Mitragyna parviflora*
4	*Grewia tiliaefolia*	29	*Randia ulignosa*
5	*Flacourtia ramontchii*	30	*Randia dumetorum*
6	*Aegle marmelos*	31	*Nyctanthes arbortristris*
7	*Bridelia retusa*	32	*Holarrhena antidysenterica*
8	*Cordia mvxa*	33	*Vitex spp.*
9	*Zizyphus xylopyra*	34	*Lantana camera*
10	*Kvdia calycina*	35	*Emblica officinalis*
11	*Abutilon indicum*	36	*Euphorbia hirta*
12	*Indigofera arborea*	37	*Ficus hispida*
13	*Millettia auriculata*	38	*Madhuca latifolia*
14	*Desmodium spp.*	39	*Curcuma reclinata*
15	*Abrus precatorius*	40	*Asparagus racemosus*
16	*Butea superba*	41	*Phoenix spp*
17	*Dalbergia paniculata*	42	*Dicanthium spp.*
18	*Bauhinia vahlii*	43	*Andropogon spp.*
19	*Cassia tara*	44	*Sorghum haplense*
20	*Albizzia odoratissima*	45	*Apluda mutica*
21	*Albizzia procera*	46	*Cynodon dactylon*
22	*Anogeissus latifolia*	47	*Chloris dolycostachya*
23	*Terminalia ariuna*	48	*Cyperus spp.*
24	*Terminalia tomentosa*	49	*Themeda spp.*
25	*Syzygium cumini*		

Appendix-II

BROAD COST ESTIMATES

Particulars	Cost (Rs. in lakhs)	Remarks
A- Development of Infrastructure		
Construction of reinforced chain link fencing 5 kms @ Rs. 15.00 lakh/km /	75.00	100 to 150 ha
Path along the chain link fencing 5 kms Rs. 5000/km	0.25	
Construction of Recovery/Loading pen in Kanha NP	1.00	50 by 50 m
Construction of Temporary Holding Pen *(Boma)* in BNP	5.00	100 by 100 m
Construction of Temporary quarters for watch and ward	4.00	Two units
Sub Total A	**85.25**	
B- Equipment, Vehicles etc.		
4x4 pick-up trucks 3 Nos.@ Rs. 10.00 lakh	30.00	To be suitably modified
Transport vehicles 2 Nos. @ Rs. 20.00 lakh	40.00	To be suitably modified
Escort cum field Vehicle 1 No. @ Rs. 10.00 lakh	10.00	
Immobilization equipment, Accessories and Drugs	10.00	
Radio/Satellite Telemetry Equipment	20.00	
Computers, accessories and software	10.00	
Misc. Equipment and Consumables	0.75	
Sub Total B	**120.75**	
C- Personnel		
Field assistances 2 @ Rs. 10000/month	7.20	
Labourers 4 @ Rs. 5000/month	7.20	
Drivers 1 @ Rs. 10000/month	3.60	
Sub Total C	**18.00**	
D- Other expenses		
POL and maintenance of vehicle	30.00	POL costs shall vary between and active and passive phases of the project
Training and international travel of	10.00	
Indian staff Consultancy Technical Support	10.00	
Seminars and Conferences	5.00	
Research and Monitoring	20.00	
Habitat Improvement	20.00	
Casual Labour	1.00	
Unforeseen Expenses @ Rs. 5.00 Lakh/annum	15.00	
Sub Total D	**111.00**	
GRAND TOTAL	**335.00**	

PERMISSION LETTER FROM GOVT. OF INDIA

NATIONAL TIGER CONSERVATION AUTHORITY

(STATUTORY BODY UNDER THE MINISTRY OF ENVIRONMENT & FORESTS, GOVT. OF INDIA)

Dr. RAJESH GOPAL
Addl. P.C.C.F. & Member Secretary

Bikaner House, Annexe-V,
Shahjahan Road, New Delhi-110011
Tele Fax: 011-23384428
Email: dirpt-r@nic.in

No.1-17/2010-NTCA Dated the October 6, 2010

To

The Chief Wildlife Warden,
Madhya Pradesh,
Van Bhavan,
Bhopal.

Subject: Translocation of gaur from Kanha Tiger Reserve to Bandhavgarh Tiger Reserve regarding..

Reference: (1) Letter No.1-4/2007/WL-I, dated 19-9-2007 from the Wildlife Division, Ministry of Environment & Forests, Govt. of India.
(2) Letter No.1-4/2007/WL-I, dated 3-2-2010 from the Wildlife Division, Ministry of Environment & Forests, Govt. of India.
(3) Endorsement No. Tech-I/2010/3363, dated 13-7-2010 from the CWLW, Madhya Pradesh.
(4) Letter No. Estab/4806, dated 5-10-2010 from the CWLW, Madhya Pradesh.

Sir,

Reference is invited to the correspondence cited above. In view of the steps taken by the State for complying with the preconditions laid by the Ministry of Environment & Forests for translocation of gaur from Kanha to Bandhavgarh Tiger Reserve, I am directed to convey the permission for carrying out the said translocation in accordance with the approval granted vide reference first cited, subject to the conditions contained therein.

Yours sincerely,

(Dr. Rajesh Gopal)
APCCF & Member Secretary (NTCA)

Copy to : (1) APS to MEF
(2) PPS to Secretary (E&F)
(3) PPS to DGF & SS
(4) IG (Wildlife), MoEF

(Dr. Rajesh Gopal)

Copy for information to:

(1) PS to the Chief Secretary, Govt. of Madhya Pradesh, Bhopal.
(2) PS to Addl. Chief Secretary, Forest Department, Govt. of Madhya Pradesh, Bhopal.
(3) PS to PCCF, Madhya Pradesh, Bhopal.
(4) Field Director, Kanha/Bandhavgarh Tiger Reserves.

(Dr. Rajesh Gopal)
APCCF & Member Secretary (NTCA)

ACTION PLAN FOR GAUR TRANSLOCATION

As agreed on the 26th May 2008 at Phinda Mountain Lodge, South Africa

Team Members: Aseem Shrivastava, Field Director Bandhavgarh Tiger Reserve Umaria, MP. (Team Leader), Subharanjan Sen, Deputy Director Kanha Tiger Reserve, Mandla, MP., Mr. A. K. Nagar, Deputy Director, Panna Tiger Reserve, Panna, MP., Dr. S.K. Gupta, Veterinarian, Panna Tiger Reserve, Panna, MP., Dr. Parag Nigam, Veterinarian, Wildlife Institute of India, Dehra Dun, Les Carlisle, Group Conservation Manager, andBeyond, Sarath Champati, Chief Naturalist & Head-Training, Tajsafaris and Kartikeya Singh Chauhan, Head Naturalist, Mahua Kothi.

Inputs From: Dr. Dave Cooper (KZN Wildlife), Mr Jeff Cooke (Head Game Capture, KZN Wildlife), Dr. K. Sankar (WII Dehradun)

- **Pre-capture Requirements**

  Man Power

  1. Identify the capture team and external resource persons
  2. Assign roles to each of the members of the capture team
  3. Scenario training and drills
  4. Check lists and sequencing of events
  5. Amount of man power required will be determined by the above points
  6. Recruitment of research personnel by July 2008

- **Pre-capture Process**

  1. Pre-capture workshop to be held in Kanha in August.
  2. Three or four animals to be immobilised and loaded to test the feasibility of drugs, team and the technique (This is to validate the current procedures to be applied in context to parks in Madhya Pradesh). These animals may be selected from different herds and different areas.
  3. These three or four animals to be deployed with radio transmitters for gathering behaviour information and movement patterns pre and post capture. (MP forest dept. to fund telemetry equipment procured through Wildlife Institute of India)
  4. Licences to import drugs to be procured ASAP.
  5. Health, Genetic and Disease samples to be taken when the animals are immobilized, and would inform the translocation decisions.
  6. Additional equipment required for monitoring immobilized animal to be procured (Pulse oxy-meter, Suction unit, laser thermometer, endo-tracheal tube)

List of drugs suggested by Dr. Dave Cooper, Wildlife Veterinarian, Kwazulu Natal Wildlife Services, agreed by the team, necessary procurement policies to be followed.

ITEM	REQUIRED Units
LENTRAX 100 ml @ 20 ml/gaur	6vlx100 ml
STRESNIL 100 ml @ 3 ml/Gaur	2vlx100 ml
PERPHENAZINE 20 ml @ 3 ml/Gaur	3vlx20 ml
NALORPHINE 10 ml	1vlx10 ml
NALTREXONE 20 ml	1vlx20 ml
DOPRAM	2
A3080 100 mg @ 6 mg/Gaur	3 mg
Diprenorphine HCL	6

Alternatively use of existing capture drugs to be used.

- **Capture Process**

1. Thorough pre-operation briefing to be conducted.
2. Darting will be done from the vehicles/elephant back.
3. The immobilised gaur will be loaded on to stretchers and pulled by the elephants to the nearest road when in inaccessible position.
4. The gaur will be revived in the recovery vehicle if required.
5. The gaur will then be offloaded in the holding boma.
6. This process will be duplicated until we have sufficient gaur for translocation.

- **Release Quarantine Pens at Bandhavgarh National Park**

1. Pen will be 100 hectares
2. The pen will be electrified on the inside and the outside
3. On the inside the electrics will be two strands set at 1 m and 50 cm above the ground, and offset at a 15 cm from the fence
4. The electric fence on the outside will be tiger proof and will consist of four strands, 20 cm, 75 cm above the ground and top of the fence with the last strand running along the top of the poles.
5. The offloading ramp will be at a 30^0 slope, 1.4 m high and 2.5 m wide.
6. The pen will have water for the animals.

7. Feed will be supplemented if necessary.
8. The fence will duplicate boundary chain link fence of Bandhavgarh.
9. The pen will have patrolling roads on the inside and outside of the boundary.
10. Boundary fence to be patrolled by the management vehicles at least twice in a day.
11. Two gates at two different places 3 m wide to access the release pens (Gates to open inside the release pens)
12. Final release of the gaur into Bandhavgarh to be accomplished by removing 60 meters on one side of the pen.
13. The final drive must be undertaken slowly and carefully to allow the gaur to walk out and not run out.
14. Access will be limited to authorized people only.

- **Holding *Boma* at Kanha National Park**

1. *Boma* will consist of steel sections 2.5 m high by 3m long made out of 50 mm x 75 mm x 3 mm rectangular hollow tubes
2. 1.5 m of the steel section will be solid 2 mm pressed steel plate horizontal steps to be pressed into each steel section.
3. Each steel section will consist of full 2.5 m high 3 verticals at 750 mm (50 mm x 50 mm x 3 mm) and one horizontal at 1.5 m (50 mm x 50 mm x 3 mm) intervals.
4. 1m expanded metal above the steel section welded to the front of the frame above the solid steel, with the smooth section facing inside the *boma*.
5. 6mm flat bar brackets with 30 mm holes reinforced with 6 mm gusset to be welded at 300mm from the top and bottom of the frame on the left hand side and 400 mm from the top and bottom of the frame on the right hand side.
6. The connecting bolts will be made of 25 mm round bar, 300 mm long and tapered on one end.
7. 15 sections to be made.
8. **Sliding gates:** Three sliding gates to be supplied 1.5 m wide sliding on a 3 m rail and 2.5 m high.
9. Gates will be made of 50 mm x 50 mm hollow square tubes with three rollers
10. Gates will be solid with 2 mm pressed steel
11. Provision to be made for solid shade cloth above the gate to the same height as the rest of the *boma*.
12. Provision to be made for the walkways to be attached to every section 300 mm wide and full length of the section, 1.5 m and 2 m high.

13. **Loading ramp:** To be two 3 m sections, solid pressed steel full 2.5 m height. The same walk way to be specified for the other sections. Floor to be attached at the base of 3 m sections. Three supporting arches to be attached at the top, made of 25 mm round bar.

14. Woven rubber mat floor bolted with flat iron stripes.

15. Two section to be tapered from a 3 m base at an angle of 65^0 to accommodate the loading ramp.

16. Transport Trucks (LPT 1615) in standard container flat bed configuration with twist locks set at standard 6 m container distances.

17. Transport Truck (407 4x4) to be fitted in standard container flat bed configuration with twist lock set at 3 m container distance.

- **Transport Trucks/Containers**

1. Standard container length of ±6.7 m.

2. The roof of the container to be minimum of 2.2 m internal height.

3. Two external doors, one on the right rear side and one on the front right side of the front compartment.

4. Doors to be 1.2 m wide suspended from 2.4 m rail with rubber stoppers to prevent over opening or over closing.

5. Each door to be provided with U shaped locking mechanism.

6. Each door to be suspended by two 500 kg (minimum) rollers

7. Bottom of each door to run behind 6 mm steel flat bar.

8. 'D' rubber to be attached below each door extending beyond the opening

9. 4 hatches to be provided in centre of the roof, 75 cm wide.

10. Hatches to be raised and waterproof

11. Latches to be provided to lock the hatches open.

12. 1 adjustable partition with sliding door to be provided in each compartment

13. Centre compartment sliding door to be operated from the outside.

14. All sliding doors to be standard at 1.2 m wide made of solid steel.

15. Four side hatches 30 cm x 70 cm to be provided on both sides just above of the base of the wall, except for the front right compartment, only one hatch to facilitate the opening of the sliding door.

16. Lower container wall to be cut by 4 cm to allow free flow of urine.

17. Floor to be woven rubber mat bolted down with flat bar at 1.5 m interval or alternative non slip surface.

18. Outside of the roof to be painted white and anti-skid surface (sprinkle sand on wet paint) applied.

19. Roof to be tapered by 5 cm from raised centre to side walls.

20. 50 mm hollow tube to be welded between verticals to form a ladder to climb onto the roof.

21. 75 cm mechanical louvers to be provided along both sides

22. 50 mm high density foam to be attached to the roof between supports to insulate the roof

- **Recovery Truck Design (Tata 407 4 x4)**

1. Container half the size of the main truck 3.35 m
2. 1 rear door and one side door as per above
3. 1 adjustable internal partition as per above
4. Roof as per above
5. Side walls as per above
6. All as per above

- **Stretcher**

1. Outside width of the stretcher not to be more than 110 cm.
2. 3 cm diameter pipe holding rail full length on both sides
3. Four 4 cm hollow pipe cross members, equally spaced.
4. Four 3 cm extensions specified to fit into the 4 cm cross members, 3 m in length.
5. 90 cm wide double canvas cover to be provided for the full length of the internal 90 cm wide poles. This canvas to have eyeholes along the full length on both under sides to allow stitching of canvas.
6. Runners of 4 cm diameter pipe, to be welded underneath the 90 cm bearers on 10 cm supports.
7. Two stretcher rails made of 5 cm channel iron, 90 cm centres braced at 1 m from each end, designed to fit into the door slots under the doors lower rail.
8. Length of the stretcher to be 2 m.

- **Calendar of Activities**

June

- 407 (4x4) truck flat bed with twist lock in the corners to be appropriated (Sarath)
- Big truck flat bed with twist lock to be ordered (Sarath)
- Recruitment of researchers by the end of month (Dr. Nigam, WII)

- Stretcher to be fabricated by end of month (Mr. Sen, KTR)
- Process for drug procurement licence to be initiated ASAP (MPFD & WII)
- Fabrication of holding boma steel sections and loading ramp (Mr. Sen, KTR)
- Holding bomas to be finished by end of August.

July

- Fabrication of containers on 407 and Big truck.

August

- Release boma to be completed in Bandhavgarh
- Pre-capture workshop to be held in Kanha.
- Trial immobilization and radio collaring of 3-4 animals to be completed before 20th August.

September

- Monitoring of gaur to continue

October

- Assess whether project is possible in November

November

- If conditions and location of gaur is unsuitable postpone operation till February 2009.

Mr. Aseem Shrivastava _____

Mr. Shubaranjan Sen _____

Mr. A K Nagar _____

Dr. Parag Nigam _____

Dr. S K Gupta _____

Mr. Les Carlisle _____

Mr. Sarath Champati _____

Mr. Kartikeya Singh _____

SIMULATION OF GAUR POPULATION VIABILITY AT BANDHAVGARH TIGER RESERVE

The action plan as prepared by the Madhya Pradesh Forest Department envisaged capture and translocation of 20 gaurs (15 adult females and 6 adult males) from Kanha Tiger Reserve, Madhya Pradesh and re-introduction in Bandhavgarh Tiger Reserve, Madhya Pradesh. It was proposed to hold the animals in to a small pen (100 X 100 m), called *Boma* in Bandhavgarh, for pre-release observations and subsequently release them in to a large enclosure (100 X 150 ha) for approximately 2 months, for acclimatization and social bonding. After 2 months, the animals will be released in to the National Park (southern side of the Tala range or on the northern side of the Magdhi range). The plan also envisages, after careful monitoring of the reintroduced stock, to bring in more gaurs to Bandhavgarh, on a later date/stage, to maintain a viable population of approximately 50+ animals.

In view of the above proposal, a simulation of gaur Population Viability in the re-introduced population in Bandhavgarh was assessed in 2 scenarios at the Wildlife Institute of India, Dehradun:

1. Reintroduction of 50 animals with a sex ratio of 60% females and 40% males.
2. Reintroduction of 20 animals with the same sex ratio and subsequent supplementation of 30 more animals at an interval of 10 animals/2years.

The results of the analysis are shown in **Analysis report 1.** The simulation of scenarios indicate that reintroduction of 50 gaurs will survive well with natural predation (Fig 1, Analysis report 1). In case a small population is introduced (20 or less), care needs to be taken to reduce excess predation. Simulation indicates that excess predation of just one adult female in initial population of 20, that has shown an initial growth rate of 3.5% and later -5.4% (Fig. 3, Analysis report 1) with an extinction probability of 97% thereby the population going extinct in 14-16 years time (Fig. 3, Analysis report 1). The scenario with predation of one adult female and supplementation of 30 animals at an interval of 10 animals/2years (6 females and 4 males) has shown growth rate 5.04% and the probability of survival is 99%. Thus, it is important to have predator-proof fencing and maintain population of 15 to 20 animals in fence for future supplementation. The supplementation of 5 to 10 animals at an interval of 2 to 4 years will reduce any predation or disease related catastrophes. The gaur population is susceptible to most of the livestock related diseases and local extinctions in Indian sub-continent have been ascribed to diseases and habitat loss.

The reported Male: Female ratio in gaur in Kanha (Schaller 1967) and Pench (Sankar *et al* 2000) is 80:100 and 60:100 respectively. The reported Female: Calf ratio in gaur in Kanha (Schaller

1967) and Pench (Sankar *et al* 2000) is 100:42 and 100:24 respectively. Hence it is suggested that the male:female:calf ratio of gaur to be translocated to Bandhavgarh from Kanha to be 70:100:30. This may be further amplified as 7 males (3 adult males, 4 adult females), 10 females (6 adult females, 4 sub-adult females) and 3 calves.

The percentage frequency of gaur remains in tiger scats varied from 8.3% to 17.4% in Kanha (Schaller 1967) and Nagarhole (Karanth and Sunquist 1995) respectively. Since, there may be predation on the re-introduced gaur population by tiger and leopard, it is suggested that not all the 20 gaurs should be released in to wild. Instead, it is proposed to release 2 adult males, 2 sub-adult males, 4 adult females, 2 sub-adult males, and 2-3 calves in the beginning. It is recommended to keep an adult bull, 4 adult females and 2 sub-adult females in the enclosure to maintain a breeding stock, and the same may be released in 2-3 installments in to wild over a period of 1-3 years, to make the re-introduction programme a success.

The Wildlife Institute of India (WII) has been recommended by the Madhya Pradesh Forest Department to become a partner in the project to provide scientific inputs both for planning and implementation of gaur re-introduction, as well as monitoring and establishment of re-introduced animals. The MoEF, Govt. of India, endorsed the recommendation of Madhya Pradesh Forest Department, to involve WII in the entire translocation and re-introduction of gaur.

It is proposed to fit 2 adult male gaurs with satellite collars and 13 adult females with VHF collars (make Telonics, USA). Studies conducted by WII in Pench Tiger Reserve, Madhya Pradesh revealed that an adult male gaur traveled in a day up to 19 km and had annual home range of 300 km^2. Hence, it is proposed to fit satellite radio-collars on 2 adult gaur males. The radio-collared gaurs (n=15), may be monitored for 3 years by a research team of WII comprising of 2 research fellows, 2 field assistants and 2 forest officials in Bandhavgarh by homing-in and triangulation techniques. Approximately 40 radio-locations of each radio-collared individual may be collected per season. On each animal location, major vegetation types, terrain, other habitat variables, distance to water, distance to human habitation, distance to road etc., may be recorded. While monitoring, the food plants eaten by gaur may be recorded to study their food habits.

GAUR POPULATION VIABILITY ANALYSIS

The simulation was run for following scenarios:

1) Reintroduction of 50 animals with a sex ratio of 60% females and 40% males.

2) Reintroduction of 20 animals and subsequent supplementation of 30 more animals at an interval of 10 animals/2years.

All scenarios were simulated with option of predation and no predation proof options.

1) Reintroduction of 50 animals with a sex ratio of 60% females and 40% males :

In 100 simulations of Population all survived, with a probability of success of 1.0000 **(Figure 1)** with adult sex ratio of 73 males/100 females in 100 years. Mean growth rate (r) was 0.0459 (0.0006 SE; 0.0590 SD). The deterministic growth rate was 5.3.

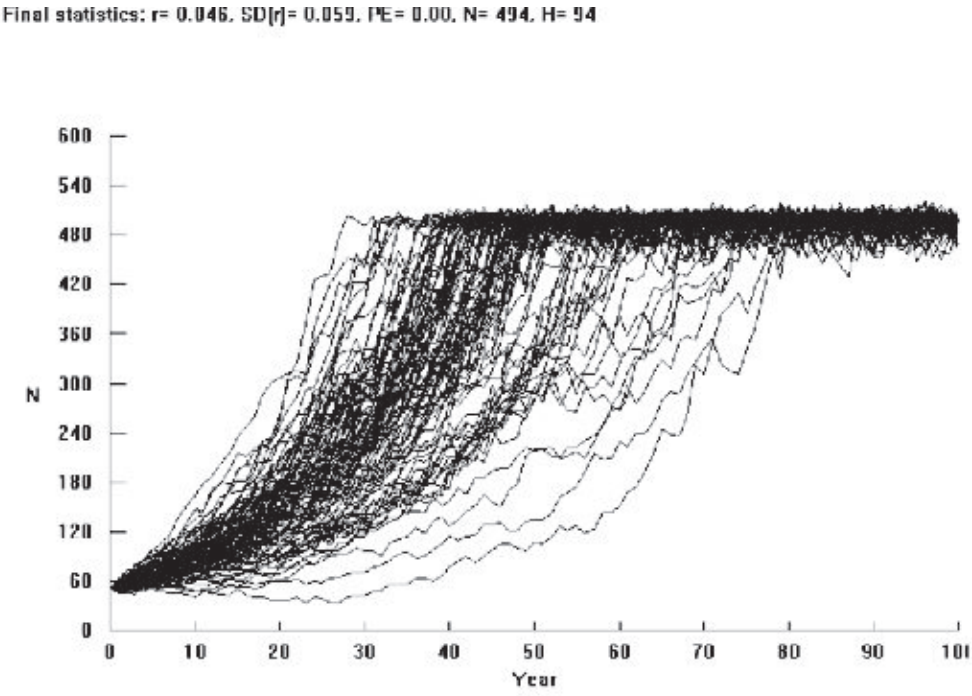


Figure 1: Simulations (100) for 50 reintroduced gaur over 100 years.

We added one adult female predation every year, this scenario gives a probability of extinction of 0.2900 (0.0454 SE).

2) Reintroduction of 20 animals and subsequent supplementation of 30 more animals at an interval of 10 animals/2years:

In 100 simulations of Population for 100 years, the population recorded growth rate of 3.5% (SE 0.08) **(Figure 2)**. Six went extinct with a probability of over all survival being

0.9400 (0.0237 SE) and adult sex ratio of 76 males/100 females. Mean time to first extinction was 56.50 years (7.24 SE, 17.73 SD).

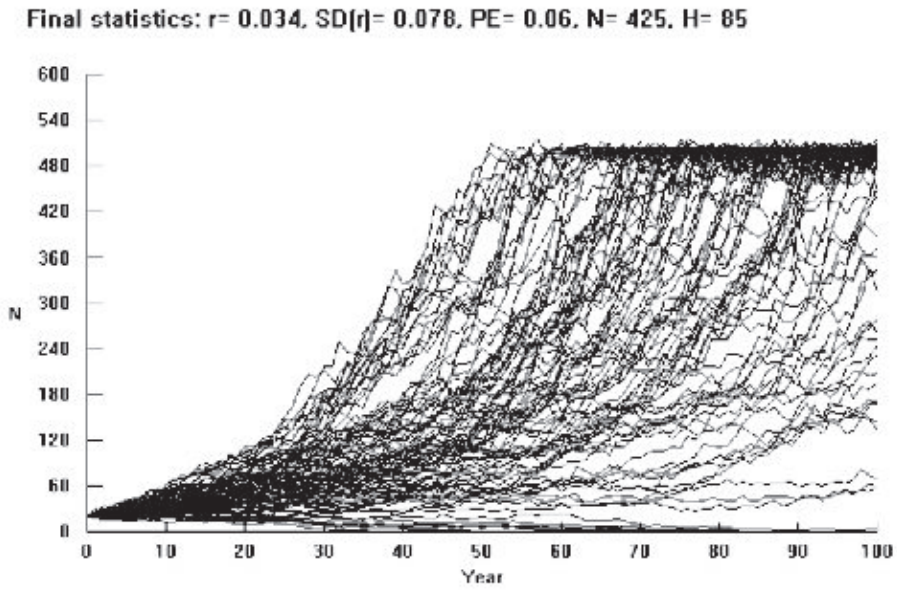


Figure 2: Simulations (100) for 20 reintroduced gaur over 100 years.

Predation

The predation scenario of one adult female every year in 100 simulations has shown probability of extinction of 97% (1.71 SE) the growth rate was -5.4% (SE=0.032) **(Figure 3)**. Median time to first extinction was 14 years and mean was 15.90 years (0.73 SE, 7.22 SD).

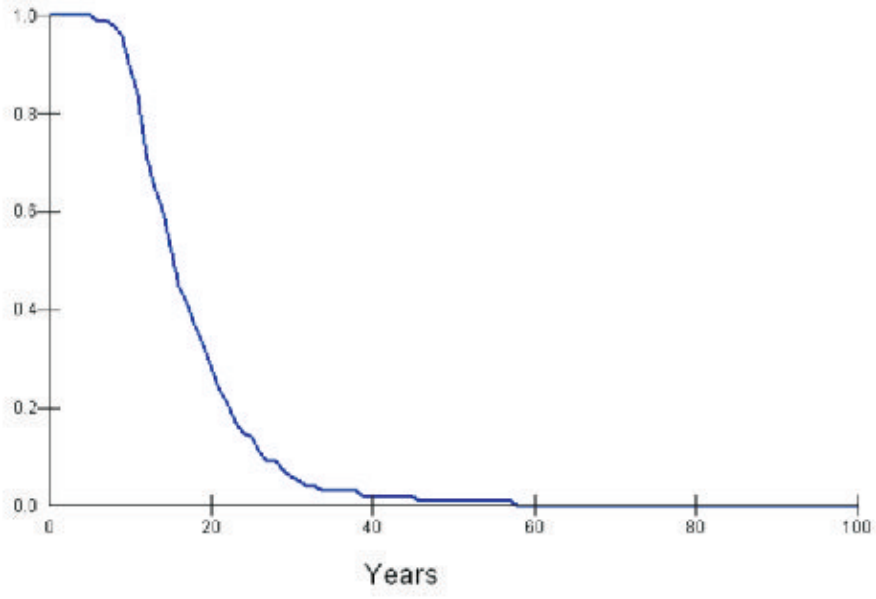
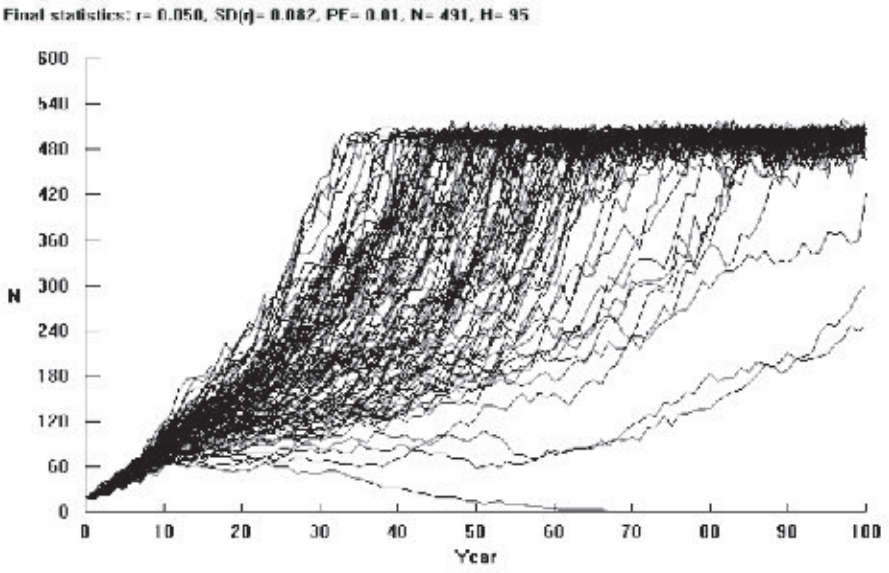


Figure 3: Probability of survival of gaur with a scenario of 1 adult female is predated every year with initial growth rate of 3.5 %.

Supplementation

The scenario with predation of one adult female and supplementation of 30 animals at an interval of 10 animals/2years (6females and 4 males) has shown growth rate 5.04% (0.08% SE, 8.17 SD). The probability of survival is 99%. The female biased ratio of supplementation will further improve the situation.



The simulation of scenarios indicate that reintroduction of 50 gaurs will survive well with natural predation (Fig 1). In case small population is introduced 20 or less care need to be taken to reduce excess predation. Simulation indicate that excess predation of just one adult female in initial population of 20 with a growth rate of 5% cause high extinction rate (29%). The extinction rate was 97% in initial population of 20. Thus it is important to have predator proof fencing and maintain population of 15 to 20 animals in fence for future supplementation. The supplementation of 5 to 10 animals at an interval of 2 to 4 years will reduce any predation or disease related catastrophes. The gaur population is susceptible to most of the livestock related diseases and local extinctions in Indian sub-continent has been ascribed to diseases and habitat loss.

Parameters used for simulating various scenarios.

1. population(s) simulated for 100 years, 100 iterations

Extinction is defined as no animals of one or both sexes.

Inbreeding depression modeled with 3.14000 lethal equivalents per individual, comprised of 1.57000 recessive lethal alleles, and 1.57000 lethal equivalents not subject to removal by selection.

EV in reproduction and mortality will be concordant.

First age of reproduction for females	: 3 for males: 4
Maximum breeding age (senescence)	: 15
Sex ratio at birth (percent males)	: 50 and 20

Population 1: Population 1

Polygynous mating;
% of adult males in the breeding pool = 40
% adult females breeding = 60
EV in % adult females breeding: SD = 10

Of those females producing progeny, ...
Mean number of progeny per breeding female per year = 1
SD in number of progeny = 1

% mortality of females between ages 0 and 1 = 40
EV in % mortality: SD = 5
% mortality of females between ages 1 and 2 = 10
EV in % mortality: SD = 2
% mortality of females between ages 2 and 3 = 8
EV in % mortality: SD = 2
% mortality of adult females (3<=age<=15) = 4
EV in % mortality: SD = 1
% mortality of males between ages 0 and 1 = 40
EV in % mortality: SD = 10
% mortality of males between ages 1 and 2 = 20
EV in % mortality: SD = 5
% mortality of males between ages 2 and 3 = 10
EV in % mortality: SD = 2
% mortality of males between ages 3 and 4 = 8
EV in % mortality: SD = 1
% mortality of adult males (4<=age<=15) = 4
EV in % mortality: SD = 1

EVs may be adjusted to closest values possible for binomial distribution.

Initial size of Population 1: 50
(set to reflect stable age distribution)

Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	
	3	3	2	2	2	2	1	2	1	1	1	1	1	0	1	23	Males
	3	3	3	2	3	1	2	2	1	2	1	1	1	1	1	27	Females

Carrying capacity = 500
EV in Carrying capacity = 50

VETERINARY PROTOCOLS FOR CAPTURE & TRANSLOCATION OF GAUR *(Bos gaurus gaurus)* FOR THE PURPOSE OF REINTRODUCTION FROM KANHA TIGER RESERVE TO BANDHAVGARH TIGER RESERVE

JANUARY 2011

Partners: Madhya Pradesh Forest Department, &Beyond (formerly known as CC Africa) and Wildlife Institute of India

Compiled by:

Dr. Parag Nigam, Scientist, Wildlife Institute of India, Dehradun, U.K., India

Dr Dave Cooper, EKZN Wildlife Veterinarian, South Africa

1. **Location of the animal and observation for selection and suitability:** The herds identified for translocation will be tracked by the MP Forest Department team. This will be done employing captive elephants, vehicles as well as foot patrolling teams. Due consideration will be given for terrain and habitat where visibility is maintained for 10-15 minutes in case the animal moves following darting. GPS locations of the herds/ animal following darting would be recorded. Trackers will also be deployed to observe the movement of the animal following darting. Behavioral aspects such as excitement etc will also be considered. High ambient temperature will be avoided and the operation will be preferred in the early forenoon hours or as deemed fit by the capture team taking due precautions. Visual examination of health any apparent physical injuries of the animal will be done using a binocular. Approximate weight will be assessed for calculation of drug doses. Decision to immobilize animal will be jointly taken by Madhya Pradesh Forest Dept. in consultation with other experts and the veterinary experts.

   Note: All equipment for radio collaring, dealing with emergencies, collecting samples, crating the animal, for transporting the animal and any other procedures would be in place before the animal is darted.

2. **Approach to the target animal:** Captive elephants will be used to approach the animal approximately 25-30 meters with care/caution and an overriding degree of patience. Hindquarters will be preferred for tele-injection as it is a well muscled area. The dart will be projected perpendicular to the target surface to prevent deflection and to ensure deep intramuscular injection.

3. **Equipment and drugs:** Aluminum darts 5-7 ml/Light weight plastic darts of 3-5 ml. capacity using gun powder/air powered projector (Dist Inject Mod 60 N and Dan Inject Mod JM) will be used for remote I/M injection on the hindquarters from a distance of 25-30 meters. Appropriate sized needles would be used. CAPTIVION (Etorphine hydrochloride 9.8 mg/ml) will be used as a drug of choice for sedation and immobilization. Due care will be taken while handling drug to avoid any chance of spillage or accidental exposure. The human drug emergencies during field immobilization is summarized below. The teams will ensure availability of human antidote (Naloxone hydrochloride/ Naltrexone) at all times and in case of any eventuality below mentioned steps would be taken. TREXONIL

(Naltrexone 50 mg/ml) would also be used as an antidote to revive animals off sedation following crating.

Emergency and supportive drug will be kept handy at all times.

A complete immobilization record, particularly including each drug given, amount given, time of administration and physiological parameters would be maintained during the procedure. These details will be recorded in the format provided. It would be appropriate to ensure human safety considerations to meet any eventuality at all the time.

Emergency drugs and equipment would be available during the entire operation. These may include following:

Drugs& Medicaments

Immobilization drugs: Etorphine and Naltrexone-(Available in kit), Xylazaine HCl, Ketamine HCl, Yohimbine HCl

Antibiotics: Fortified Procaine penicillin, Ampicillin-cloxacillin parentral and intra mammary infusion

Emergency drugs: Butorphanol tartrate, Doxapram, Atropine sulphate, Hyaluronidase, Haloperidol, Fluphenazine, Naloxone ,Epinephrine, Prednisolone, Dexamethasone besides haemostyptics, antiseptics, antipyretics, NSAIDs , vitamin-mineral supplements (Details may be worked out in conjunction with veterinarian),

Medical supplies: Oxygen cylinders, Disposable syringes, tuberculin syringes, gloves, surgi-pads, needles, gauze etc.

Equipments

Drug delivery equipment-Projectors/ Jab stick etc.
Thermometer, Stethoscope,
Pulse oximeter with tongue probe
Cattle electric prodder
Suction pump to remove any obstruction in pharyngeal cavity
Endo tracheal tubes with inflatable cuffs size 16,18 mm
Stomach tube, trochar & cannula
Ropes, Torches, swiss tool, water sprayers
Radio-collars, GPS, Binoculars, measuring tapes
Generator/ electric supply at base camp
Communication system
Laboratory equipments : Would be provided by Jabalpur Veterinary College
Sample collection kit: Sample collection vials, vaccutainers (plain and EDTA), storage/ shipment boxes, ice packs, tapes, Zip lock bags etc

Human Drug Emergencies During Field Immobilization

Accidents during drug handling: Wildlife immobilization involves handling and use of drugs Immobilizing drugs are potent poisons and dangerous to both humans and animal if not appropriately used or handled. A person may accidently inject the drug (either to self or to other persons) during loading of syringes/darts or may accidently come in contact with drug during extracting or mixing and even as a result of drug spillage. It is important to avoid spraying, squirting, or spilling drugs when loading. Certain drugs (Fentanyl) can be absorbed through intact skin (as it is often made up in Dimethylsulfoxide); certain drugs (narcotics- etorphine, carfentanil) gain entry through break in continuity of skin (cuts and abrasions) while most of them can be readily absorbed through intact mucous membranes of eye, nose and mouth. All the drugs used in immobilization must always be handled with the greatest of care taking due personal protection. Use of eye protectors and gloves while handling narcotics should always be practiced. It is important that the individuals using or handling immobilizing drugs have a clear understanding of the drug protocols, the dangers associated and the emergency response required. Entire team involved in the operation should also be briefed about the potential hazards of immobilization beforehand.

Accidents during use and handling immobilization equipment and accessories: Accidents may happen during handling of remote drug delivery equipments and the accessories either as a result of their malfunctioning, improper use or even due to operators fault. There are frequent reports though unpublished of individual being exposed to various hazards resulting from improper handling. For example, incorrect placement of syringe charge/improper dart assembly may result in squirting or spilling of drug leading to accidental poisoning; handling of equipment and accessories by inexperienced individual or casual and careless approach on part of experienced operator may result in accidental injection or injury. It is important that only authorized personnel should be allowed to carry loaded and unprotected darts. While handling narcotics, metal darts should only be used to avoid accidental release/squirting of drugs. Metal syringes should be handled with care as accidental bursting of syringe charges has been occasionally encountered. Additionally, the loaded syringes should always be properly marked and appropriately carried to avoid any confusion, inappropriate handling or accidental injuries. Proper care should be taken while handling used darts, syringes and needles to avoid any accidental injection/injury.

Therefore, all darting equipments and projectile syringes/ darts should be used with the utmost care, cleaned and maintained well and used by authorized individuals having necessary skills and experience in handling equipments and accessories.

Prevention and Management

Accidents during field immobilization can be effectively avoided by having a thorough knowledge of the drug protocol and the procedures, awareness on hazards associated with drug immobilization and undertaking preventive measures for personal protection (eye and hands) and during handling (drugs, loaded darts, immobilized animal). A first aid kit is an important component of any immobilization operation to meet any eventuality and should have following:

FIRST AID KIT

Emergency drugs: When narcotics are used atleast 20 mg Naloxone and Naltrexone should be part of the first aid kit besides 250 mg hydrocortisone, 40 mg diazepam (VALIUM), 5 mg atropine, 20 mg adrenalin.

Other medical supplies: Stethoscope, thermometer, intravenous saline (0.9%) solution-2 litres, IV drip set -2, disposable syringes-2,5 & 10 ml, hypodermic needle, 18g & 21g, adhesive plaster and scissors, sterile bandage/gauge 2"& 4", antiseptic lotion and haemostyptics

Medical supplies to meet respiratory depression
Portable Oxygen cylinders with mask¸ Doxapram HCL (CAROPRAM/ DOPRAM)-4vials and muscle relaxants.

Besides above, communication, transport and medical support aids in responding to any emergencies.

In the event of any accident, the basic principles of management include keeping the patient calm and comfortable, arranging for medical support, limiting drug absorption by washing any contact surface with large quantities of water or application of tourniquet, administering antidotes if symptoms of poisoning are noted, proper positioning of the patient (horizontal sideways position to prevent choking in case the patient vomits or on his back to provide cardiopulmonary resuscitation CPR). A person needs to be trained in providing CPR before hand.

Note: *Antidotes should be given only if there is certainty of administration of etorphine or similar substance and symptoms of poisoning appears. The antidote for narcotic substances can aggravate the condition if given for compounds against which they have no effects, or produce misleading symptoms in subjects who have no need for them. If the symptoms of poisoning do not appear within three minutes after the injection of a narcotic substance or mixture, it is unlikely that treatment with a specific antidote is required.*

Morkel, 1993 suggested mnemonic HAD-ABC as a sequence for responding in case of emergency.

H	Help	Immediately call for help
A	Absorption/Antidote	Limit absorption and give antidote if required
D	Drip	Establish drip as soon as possible if indicated
A	Airway	Establish and maintain adequate airway
B	Breathing	Monitor breathing and apply artificial respiration if needed
C	Circulation	Administer cardiac massage if there is heart failure

Table: Likely drug accidents during field immobilization (Adapted from Morkel, 1993)

Name of drug	Symptoms of poisoning in human	Prevention and Care	Management of accidental poisoning	Remarks
Etorphine hydrochloride M-99, Etorphine + ACP = Large Animal IMMOBILON	Dizziness, in-coordination, nausea, vomiting, pinpoint pupil, slow, shallow or stertorous breathing, cyanosis of mucous membranes, clammy cold skin, sweating, weak or imperceptible pulse due to fall in blood pressure, loss of consciousness, and ultimately coma. Note: As little as 0.1 mg of etorphine may be fatal to an adult man. The depressant effect may be enhanced if combined with sedative	General field precautions as above Always handle drug in presence of another person who is qualified and aware of providing first aid in case of accident. Prior to loading of narcotic into the dart, load Naloxone HCL (NARCAN) in a separate syringe to meet any emergency, if any.	Immediately make the second person aware of the problem and ensure medical supervision at the earliest. If etorphine has come in contact of skin, wash immediately but if it has come in contact with mucous membrane, treat with antidote and wash thoroughly. In case the drug has been absorbed, immediately inject 0.8 mg naloxone (2 ampoule of NARCAN) into the most available muscle, and 0.8 mg into a vein of the forearm. In case of non-availability of naloxone, 5mg naltrexone can give positive results. This may be repeated every three minutes (up to 4 times) until improvement occurs. Keep the patient calm and in shade. The patient should be made to lie on his side in a horizontal position. Take the patient to nearest medical facility at the earliest	Drugs used in wild animals are different from the ones used in human. The medical practitioner may not be aware or knowledgeable about these drugs. It is relevant to provide all the knowledge and information, including package inserts etc.

4. **Induction phase:** The time interval between injection (darting) and the point when the animal is rendered immobile is induction period. The total time for the completion of induction may vary from 7-15 minutes. A close observation will be kept by the team for any movement of the animal.

5. **Handling and care of the immobilized animal:** The animal will be approached quietly and following steps will be followed:

- Approach animal from behind and remove the dart.
- Blindfold the eyes to protect the cornea from direct sunlight, dust and injury
- Assess the state of animal, the degree of relaxation and the rate and depth of respiration. If the respiratory depression is pronounced, a partial dose of antagonist will be used to correct respiration. Signs of immobilization include stumbling, vocalization, sagging of the hid quarters and animal coming in sternal recumbency. It should be ensured that animal is subjected to no disturbance during induction.
- Position of body, head and neck. The animal will be placed in sternal recumbency. This will help prevent the development of ruminal tympany. Ropes may be used to assist in processing the animal. The head and neck will be extended to maintain patent airways.
- Age of the animals will be estimated by standard tooth-wear ptrocedure
- Clear any obstruction, if any from the mouth using suction pump or manually and entubate the animal till collaring and biological samples have been taken.
- Monitoring vital signs. Vital signs such as respiration, heart rate and body temperature will be taken and monitored. Rectal temperatures >40 °C are cause of concern and attempts should be made to cool the animal. The animal has to be specifically monitored for signs of bloat/ tympany. In case of emergency necessary veterinary protocols for management will be ensured. The animal should be monitored for hypoxemia, ideally with a pulse oximeter.
- The animal will be examined for any wounds and injuries and appropriate medical measures will be taken.
- Animals would be subjected to Tuberculin testing in immobilized state. Intra-dermal tuberculin test will be performed following immobilization using PPD.
- Tagging of animals destined for translocation. This would also help in identifying animals showing reaction to tuberculin.

6. **Radio collaring and biological sampling:** This step will involve radio collaring of the immobilized animal and taking all body measurements. Complete physical examination of the animal will be done at this stage followed by collection of biological samples for reference. Following samples would be collected: Blood in vaccutainers (both plain and EDTA) for haematology, serum biochemistry, serology and genetic studies, dung sample in 10% formalin for assessing parasitc load and diet analysis, hair sample without preservatives for genetic and forensic study, nasal swab for culture.

7. **Laboratory Investigations**

   a. **Routine haematology:** at site

   b. Serum biochemistry and serology- to be carried out at Jabalpur Veterinary college

   c. **Disease screening :** FMD, Blue tongue, T.B, H.S, B.Q, Brucellosis, Salmonellosis, endo and ectoparasites, haemoprotozoans- to be carried out at Jabalpur Veterinary college.

   d. **Microbiological examination:** at Jabalpur Veterinary college

   e. **Genetic studies:** at WII

   (Separate budget would be required to carry out laboratory investigations)

8. **Shifting of the animal to stretcher:** The animal will be shifted to a stretcher and placed on sternal recumbency. In case a need is felt, acaricides would be poured/ sprayed on the animal to remove ecto-parasites. Efforts would be made to weight of the animal subsequent to which the animal will be shifted to a transport vehicle placed at road head.

9. **Assessment of anesthesia:** After shifting the animal to a transport vehicle, assessment of anesthesia will be done using following methods:

   - **Monitor tissue perfusion:** Anesthetic drugs frequently depress the contractile force of the heart and vasodilatation results in decreased tissue perfusion. Evaluation of tissue perfusion will be done by observation, auscultation, palpation and capillary refill time. Bison anaesthetized with carfentanil-xylazine have been reported to have slightly higher heart rate (Average heart rates of 75 beats per minute). This information would form a basis in the present case i.e. similar trends may be encountered with Etorphine anaesthesia.
   - **Monitor gas exchange:** Respiratory rates are highly variable during anesthesia. The animal should be monitored for hypoxemia, ideally with a pulse oximeter. Normal hemoglobin saturation is 95-98%; below 85% is considered hypoxemic. Mucus membranes need to be monitored for cyanosis
   - Quality of respiration will be evaluated by observing animal's chest movement.
   - **Monitor CNS depression:** Most effective monitors of CNS depression are evaluation of muscle tone, anal and eye reflexes.
   - Monitor for signs of bloat

   [Caulkett,N. (2001). Bison (Artiodactyla:Bovidae) In: Heard,D (Ed.) Zoological restraint and Aneasthesia. International Veterinary information service (www.ivis.org) Ithaca, New York, USA)].

10. **Managing post immobilization emergencies:** The major emergencies reported include development of bloat, capture myopathy, trauma, aspiration, hyperthermia and hypoxemia. These needs to considered prior to intervention and appropriately addressed.

11. **Reversal of anesthesia:** Specific drugs TREXONIL will be used to reverse the anesthesia once animal is crated.

12. **Transport of animal:** The animal will be transported by specially designed vehicle to holding bomas where they would be released.

13. **Holding animals in Kanha:** The animals will be held in the holding bomas till the result of tuberculin testing and laboratory reports are received. Moreover the animal would be out of any drug effect as re-narcotization has been reported following use of narcotics. Re-

narcotization is not usually a problem if naltrexone is used to antagonize as it has a long half life. It is important to ensure adequate fodder and water in the holding bomas. Animals need to be kept undisturbed in the holding boma. Minimum time for which the animals need to be maintained in holding bomas should range from 48-72 hrs. This would ensure receipt of laboratory results as well as enable to interpret the results of tuberculin test, that may depending on circumstances require immobilization. Animals deemed fit would be crated in the transport vehicles.

14. Transport to Bandhavgarh: Transportation of animals would be initiated during late evenings.Approximate distance between Kanha and Bandhavgarh is 250 km and road journey would take 8-10 hours. The vehicles will be moved at a constant speed avoiding sudden brakes and jerks as far as possible. Animal will be monitored intensively inside the container. Proper measures and equipment will remain in place to deal with any emergencies and management for the best care of the animal.

15. Release of Animal at Bandhavgarh: Once the animals reach destination, they would be released in specially designed enclosures and maintained till they are out of transportation stress, anesthetic effect and show signs of normalcy as evident behaviorally. Subsequently the animals would be released into the wild and monitored intensively as per the proposal/action plan.

16. Additional information:

a. Arrangement for documentation of entire operation (cameras) and necessary press/media briefing will be coordinated by MPFD.

b. MPFD will identify various teams for carrying out the operation.

(Tracking, darting, collaring, biological sampling, laboratory investigations, loading and offloading, logistic upkeep and maintenance, monitoring animal in holding bomas, transport)

c. MPFD will Meeting budget demands for carrying out the laboratory investigations

Darting Area for Gaur

Stepwise details of the proposed operation is as follows:

Plan of operation

Location and selection of the animal. Approach to the target animal, assessment of terrain, visibility and ambient temperature.Visual health examination and observation on behavioural aspects

↓

Remote injection of narcotic and observation on the induction phase close observation for any movement of the animal

↓

Handling and care of immobilized animal, monitoring of sedation physical measurement, biological sampling, radio collaring and measurement of weight

↓

Shifting to transport vehicle using a stretcher and transportation to holding Bomas

↓

Holdling animal in Boma till results of tuberculin testing and laboratory investigations are recieved

↓

Animal transport by Road

↓

Journey time

↓

Animal released in enclosure at Bandhavgarh
(complete examination of the animal, injection of any medicaments if needed)

↓

Monitoring of the released animal in the enclosure

↓

Release into the open forest and monitoring

Note : 1. Medical and first-aid support to be arranged by Madhya Pradesh Forest Dept. throughout the operation

2. Security, law and order during the translocation operation as may be required (civil administration to be arranged by FD, Kanha)

3. Management of communication and public relation by Madhya Pradesh Forest Dept.

DATA SHEET FOR RECORDING AND MONITORING IMMOBILIZED ANIMAL

Area Details Date .....

Location ..... GPS Lat.....Long.....

Collar Frequency/make/colour.....

Purpose of capture .....

Ambient temperature ..... Day (cloudy, bright) .....

Animal Details

Species ..... Physical condition .....

Emotional state before drugging ..... Sex .....

Approximate age ..... Breeding status .....

Weight (kg) Estimated ..... Actual .....

Body Measurements

Nose tip to Base of tail ..... Nose tip to base of horns .....

Tail length..... Dentition/wear & tear .....

Neck girth (U).....M).....(L)..... Chest girth .....

Height (Shoulder blade to heel) ..... Hind limb length .....

Any other signs:

Immobilization Details

Sr. No.	Name of Immobilizing Drug(s)	Time of Injection	Total volume	Route & site	Mg used
1.					
2.					
3.					

Behaviour at the time of darting
(running, walking, standing, excited) .....

Induction time when animal goes down .....

Sequence of events following darting

.....

.....

.....

Animal Monitoring

Time	Signs shown following immobilization	Respiration Shallow/ deep/ irregurlar & rate	Temperature (^{o}F)	Pulse (rate)

Name of reversal Drug (s)	Time of Injection	Drug dose & volume given	Route	Site

Details about recovery event till animal regains consciousness /shows signs of recovery

.....

.....

Name of other supportive Drug(s)/ antibiotic(s) etc. given	Volume used	my used	Route & site

Biological Sampling

Name of sample	Preservative used	Examination required	Handed over to	Remarks

Team Members & Signature

RAPID HEALTH SURVEY PRIOR TO ACTUAL OPERATION

Veterinary Officer, Kanha would carry out a rapid health survey of the different Gaur herds at Kanha. The survey would include body condition evaluation as per the format provided. The location of each herd would be marked and plotted on a map. Additionally dung samples (with GPS locations) would be collected for parasitological and microbiological examination that would be carried out at Jabalpur Veterinary college. VO would liase with the college to get the tests done. The information so collected would help in guiding selection of herds for translocation. The work needs to be carried out during early December so that results are available timely.

Generalized description and evaluation of different parts of ungulates (Adapted from Riney et al, 1960)

BODY PART	POINT=0	POINT-1	POINT-2	SCORE
FLANK AREA	Depression barely visible. Flank area outline is indistinct	Flank area slightly concave & outline visible	Depression concave and tucked in	
RIBS	Thoracic surface is smooth and ribs are difficult to see	Ribs are visible but not all can be counted with ease	Ribs prominent with distince inter-costal depression	
PELVIC GIRDLE	Bony projections of pelvic girdle are barely visible	Pelvic girdle outline slightly visible	Bony projections of pelvic girdle are clearly visible	
VERTEBRAL COLUMN	When seen laterally, it runs smooth without any breaks. Lumbar process visible	Lateral processes of lumbar vertebrae are visible but not prominent	Lateral processes of lumbars very prominent. Dorsal processes of vertebrae seen	
LUMBAR SHELF	No depression in shelf. Appears almost round from behind	Slight depression on either side	Depression deep and concave	
Skin and coat	Smooth and shiny	Skin dry and rough	Haggard appearance, rough and dry	
			Body Condition Index	

Interpretation: 0-4= 'Good'; 5-7= 'Fair'; 8-10= 'Poor'

Body Condition Evaluation form

Protected Area_____ Species_____

Date	Locality	Age & Sex	Scores for different body parts									BCI	Remarks
			1	2	3	4	5	6	7	8	9		

1-FLANK 2-RIBS 3-PELVIC GIRDLE 4-VERTEBRAL COLUMN 5-TAIL CONTOUR 6-LUMBAR SHELF
7-TEMPORAL DEPRESSION 8-SKIN 9-SHOULDER SPINE

Investigator/Signature

LIST OF OFFICIALS INVOLVED IN GAUR REINTRODUCTION

(1) International Experts

No.	Name	Designation
1.	Mr Les Carlisle	Group Conservation Manager, & BEYOND, South Africa
2.	Dr. Dave Cooper	Senior Wildlife Veterinarian, Ezemvelo ,KwaZulu-Natal Wildlife Game Capture Unit
3.	Dr. Jeff Cooke	Head, Game Capture Unit, Ezemvelo KZN Wildlife

(2) MP Forest Department Officials

No.	Officer/Staff Name	Designation
1.	Dr. HS Pabla	PCCF (Wildlife), MP
2.	Shri Dharmendra Shukla	APCCF (Wildlife), MP
3.	Dr. HS Negi	Field Director, Kanha TR
4.	Shri NS Dungriayal	Field Director, Satpura TR
5.	Shri JS Chouhan	Director, Van Vihar NP, Bhopal
6.	Shri Alok Kumar	Field Director, Pench TR
7.	Shri CK Patil	Field Director, Bandhavgarh TR
8.	Shri HS Mohanta	Deputy Director, Kanha TR
9.	Shri KS Alawa	Deputy Director, Buffer, Kanha TR
10.	Shri AK Nagar	Deputy Director, Satpura TR
11.	Shri M Pathak	Deputy Director, Bandhavgarh TR
12.	Shri RK Mishra	Deputy Director, Bandhavgarh TR
13.	Shri K.S.Alwa	Deputy Director, Bandhavgarh TR
14.	Shri VS Parihar	Deputy Director, Panna TR
15.	Shri OP Tiwari	Deputy Director, Pench TR
16.	Shri RS Uikey	ACF, Bandhavgarh TR
17.	Shri DP Shukla	ACF, Bandhavgarh TR
18.	Shri HP Shukla	ACF, Bandhavgarh TR
19.	Shri BS Gaur	ACF, Bandhavgarh TR
20.	Dr. Sandeep Agrawal	Veterinary Doctor, Kanha TR
21.	Dr. Akhilesh Mishra	Veterinary Doctor, Pench TR
22.	Dr. Sanjeev Gupta	Veterinary Doctor, Panna TR
23.	Dr Atul.K. Gupta	Veterinary Doctor, Van Vihar national Park, Bhopal
24.	Dr. J.P. Tripathi	Veterinary Doctor, Bandhavgarh
25.	Dr. Nitin Gupta	Veterinary Doctor, Bandhavgarh TR
26.	Dr. Rakesh Shukla	Research Officer, Kanha TR

27.	Shri LL Uikey	Assistant Director (Halon), Kanha TR
28.	Shri Anand Goswami	Assistant Director (Phen), Kanha TR
29.	Shri VK Kankaria	Assistant Director (Malanjkhand), Kanha TR
30.	Shri Raghavendra Bisen	Park Superintendent, Kanha TR
31.	Shri Surendra Kumar Khare	Range Officer Mukki
32.	Shri Sunil Kumar Sinha	Range Officer Kisli
33.	Shri Sudhir Kumar Mishra	Range Officer Kanha
34.	Shri Om Prakash Patel	Range Officer Sarhi
35.	Shri Vikram Singh Solanki	Range Officer Khatia
36.	Shri M.K. Mishra	Range Officer Magdhi
37.	Shri S.C. Pandey	Range Officer. Magdhi
38.	Shri L.K. Pandey	Range Officer Magdhi
39.	Shri K.K. Suhaney	Range Officer Magdhi
40.	Shri R.K. Tripathi	Range Officer Tala
41.	Shri Tarendra Kumar Tiwari	Dy. Ranger, RA Kisli
42.	Shri N.K. Gautam	RA Milli, Bandhavgarh
43.	Shri R.S. Paraste	RA Magdhi, Bandhavgarh
44.	Shri B.B. Pandey	RA Magdhi, Bandhavgarh
45.	Shri Ramlal Maravi	Forest Guard, Kopedabari
46.	Shri Mahesh Markam	Forest Guard, Kisli
47.	Shri Birjhu Lal Khairwar	Orderly, Digdola
48.	Ku. Laxmi Maravi	Forest Guard, Rest House In-charge
49.	Shri Sangram Singh	Forester
50.	Shri Gajraj Singh	Beat guard Magdhi
51.	Shri Saroj Kumar Patle	Computer Operator, Kanha
52.	Shri Sandeep Singaur	Computer Operator, Kanha
53.	Shri Ashish Upadhyay	Computer Operator, Bandhavgarh
54.	Shri Rajkumar Gadhewal	Range Clerk
(3)	**Wildlife Institute of India, Dehradun**	
No.	**Name**	**Designation**
1	Dr. K Sankar	Scientist-F
2	Dr. Parag Nigam	Scientist -D & Veterinarian
3	Shri Aseem Shrivastava	Scientist-F
4	Mr B.Navaneethan	Junior Research Fellow, WII
5	Ms Preeti S. Virkar	Junior Research Fellow, WII

(4)	Taj Safaris and & Beyond	
No.	**Name**	**Designation**
1	Ms. Mridula Tangirala	Director-operations, Taj Safaris and & Beyond
2	Mr. Sarath Champati	Chief Naturalist & Head-Training, Taj Safaris
3	Mr. Kartikeya Chauhan	Head Naturalist, Mahua Kothi, Taj Safaris
(5)	**Jabalpur Veterinary College**	
No.	**Name**	**Range**
1	Dr. AB Shrivastava	Director, Centre for Wildlife Forensic and Health, & Dean, College of Veterinary Science and Animal Husbandry, MPPCVV, Jabalpur
2	Dr K.P. Singh	Wildlife Biologist, Centre for Wildlife Forensic and Health, MPPCVV, Jabalpur
3	Dr Himanshu Joshi	Scholar, Centre for Wildlife Forensic and Health, MPPCVV, Jabalpur
(6)	**Kanha/ Bandhavgarh Drivers:**	
No.	**Name**	**Place**
1.	Shri Santosh Yadav	Kanha
2.	Shri Jairam Yadav	Kanha
3.	Shri Bantu Thakur	Kanha
4.	Shri Avtar Gop	Kanha
5.	Shri Manish Sarvey	Kanha
6.	Shri Govind	Kanha
7.	Shri Prasant Yadav	Kanha
8.	Shri Shankar	Kanha
9.	Shri Shiv Kumar	Bandhavgarh
10.	Shri Raj Kishor	Bandhavgarh
11.	Shri Santosh Kr. Yadav	Bandhavgarh
12.	Shri Dronacharya Tiwari	Bandhavgarh
13.	Shri Narayan Soni	Bandhavgarh
14.	Shri Sabir Khan	Bandhavgarh
15.	Shri Lakhan Lal Rai	Bandhavgarh
16.	Mohd. Izhar	Bandhavgarh
17.	Shri Manish Kr. Dwivedi	Bandhavgarh
18.	Shri Basant Pandey	Bandhavgarh
19.	Shri Krishn Kr. Mishra	Bandhavgarh

(7) Kanha TPF (Tiger Protection Force) staff:			
No.	**Name**	**No.**	**Name**
1.	Shri Dulichand Yadav	2.	Shri Gangaram
3.	Shri Barelal Kushre	4.	Shri Peetam Singh
5.	Shri Chaitram Maravi	6.	Shri Bheemsen
7.	Shri Sukkhu Maravi	8.	Shri Narsingh Vadali
9.	Shri Mahilal Dhurvey	10.	Shri Nainsingh Saiyam
11.	Shri Patiram Tekam	12.	Shri Chaitram Maravi
13.	Shri Mangal Prasad Yadav	14.	Shri Chhabidas Bairagi
15.	Shri Shyam Tekam	16.	Shri Rajendra Yadav
17.	Shri Sooraj Lal Bhanware	18.	Shri Dheeraj Pattavi
19.	Shri Ramu Yadav	20.	Shri Dipesh Ahirwar
21.	Shri Balsingh Dhurvey	22.	Shri Tulsiram Tekam
23.	Shri Shivdayal Maravi	24.	Shri Ghanshyam Khairwar
25.	Shri Sukhman Singh Yadav	26.	Shri Samharu Yadav
27.	Shri Shivlal Maravi	28.	Shri Birsingh Parte
29.	Shri Jhanak Lal Markam	30.	Shri Tularam Yadav
31.	Shri Ramsingh Dhurvey	32.	Shri Rajendra Kumar Yadav
33.	Shri Shanilal Yadav	34.	Shri Shyam Lal Vishvkarma
35.	Shri Surendra Patta	36.	Shri Beeran Yadav
37.	Shri Tikaram Yadav	38.	Shri Rameshvar Yadav
39.	Shri Indal Singh Maravi	40.	Shri Ram Prasad Yadav
41.	Shri Indal Singh Chicham	42.	Shri Ramesh Yadav
43.	Shri Santosh Sonwane	44.	Shri Ayodhya Prasad
45.	Shri Subhilal Markam	46.	Shri Sukhdev
47.	Shri Dhansingh Valke	48.	Shri Shobharam Markam
49.	Shri Jawahar Lal Yadav	50.	

(8) Bandhavgarh TPF (Tiger Protection Force)staff:			
No.	**Name**	**No.**	**Name**
1.	Shri Sunil Uikey	2.	Shri Abhishek Parihar
3.	Shri Jai Singh Uikey	4.	Shri Ram Naresh Kushwaha
5.	Shri Gautam Uikey	6.	Shri Babulal Chaudhary
7.	Shri Prakash Uikey	8.	Shri Dalveer Singh
9.	Shri Manjulal Uikey	10.	Shri Gopaldas Khatri

11.	Shri Kuwar Singh	12.	Shri Mukesh Yadav
13.	Shri Hirad Singh	14.	Shri Ram Milan Patel
15.	Shri Sumit Shrivastava	16.	Shri Ramsakha Yadav
17.	Shri Janpad Jaiswal	18.	Shri Yogendra Singh Baghel
19.	Shri Prem Prakash Kewat	20.	Shri Sarvottam Chaudhary
21.	Shri Kaushal Baiga	22.	Shri Rajendra Tiwari
23.	Shri Sudarshan Singh	24.	Shri Ajay Singh
25.	Shri Suresh Dwivedi	26.	Shri Rajesh Singh
27.	Shri Krishnpuri Goswami	28.	Shri Sheikh Shahzad Khan
29.	Shri Rajkumar Jaiswal	30.	Shri Umesh Yadav
31.	Shri Dinesh Yadav	32.	Shri Hakim Singh
33.	Shri Durgesh Yadav	34.	Shri Ajay Singh Chhatri
35.	Shri Dinesh Jaisawal	36.	Shri Akhilesh Mishra

(9) Kanha Muster Roll & KWS (Kanha Workers Society) staff:

No.	Name	No.	Name
1.	Shri Sukhchain Maravi	2.	Shri Guhdad Katre
3.	Shri Sukhchain Dhurvey	4.	Shri Sundar Yadav
5.	Shri Suraj Gautam	6.	Shri Dhobi Singh Dhurvey
7.	Shri Atar Singh	8.	Shri Chhannu Singh Maravi
9.	Shri Roop Singh Markam	10.	Shri Baburam
11.	Shri Kuwan Singh	12.	Shri Girani
13.	Shri Sukkal Singh Markam	14.	Shri Kashiram
15.	Shri Tam Singh Parte	16.	Shri Beniram
17.	Shri Suwan Yadav	18.	Shri Girani Bhalavi
19.	Shri Premsingh	20.	Shri Jagulal

(10) Bandhavgarh EDC (Eco Development Committee) Members:

No.	Name
1.	Shri Vishram Chaudhary
2.	Shri Ram Sewak Baiga
3.	Shri Santosh Baiga
4.	Shri Jagat Ram Baiga
5.	Shri Mani Ram Yadav
6.	Shri Mahendra Singh
7.	Shri Dunna Baiga