THE STATUS AND DISTRIBUTION OF THE GREATER ONE-HORNED RHINO IN NEPAL

Published By:

National Trust for Nature Conservation (NTNC)

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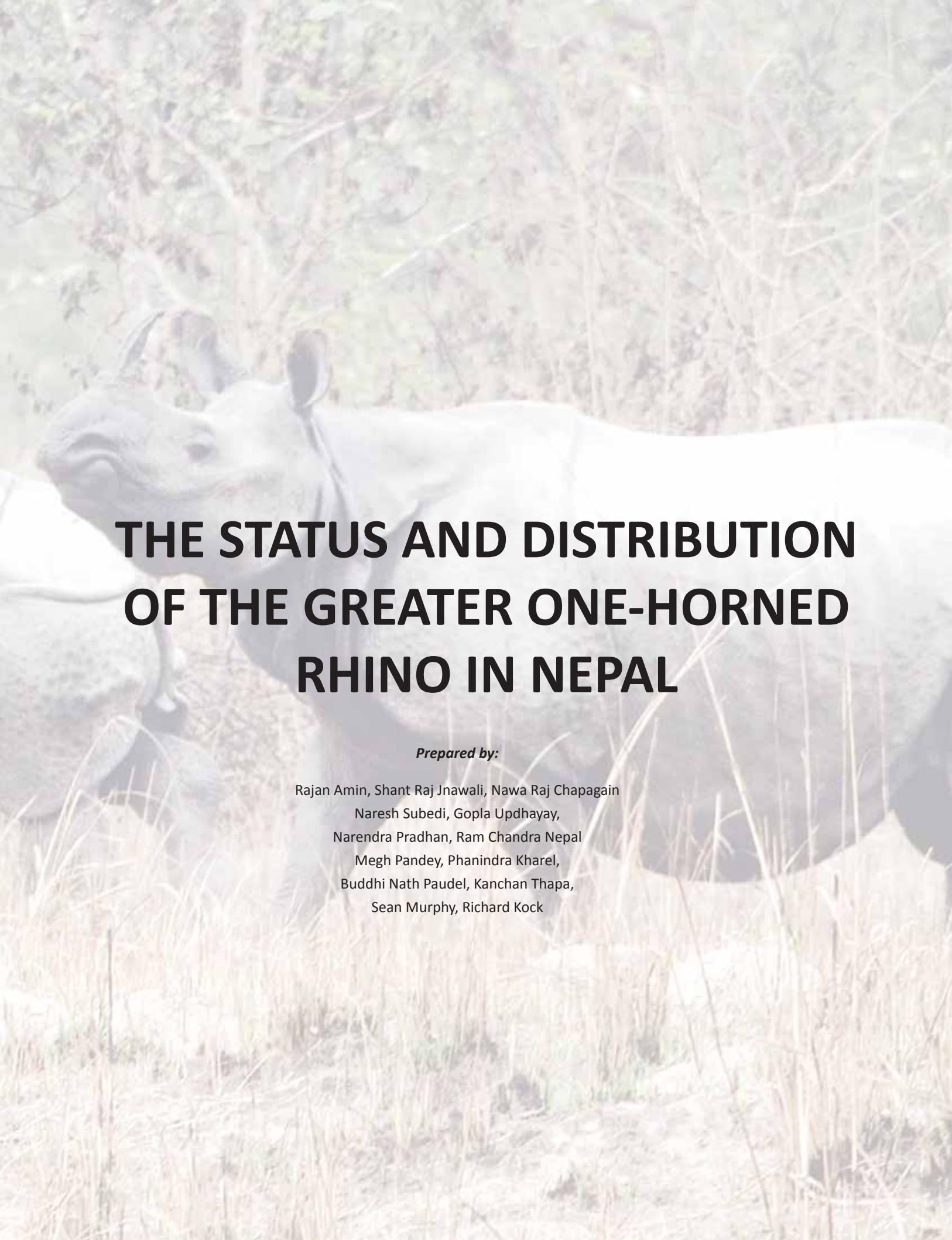
Citation : DNPWC 2009: The Status And Distribution of The Greater One-Horned Rhino in Nepal
Department of National Parks and Wildlife Conservation,
Kathmandu, Nepal.

Photographs Contibution : Andrew Gell, DNPWC, NTNC, ZSL



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Foreword

The Greater One-horned Rhinoceros is perhaps the most enduring emblem of Nepal's rich biological heritage. Not only is it important to conservationists for its ecological value but it also holds a universal appeal for ordinary people. Despite their iconic status these rhinos are highly vulnerable as witnessed by the recent declines. The Government and people of Nepal, supported by national and international conservation partner organizations have over decades, contributed significantly to the conservation of this species and are, despite the enormous socio-economic and political challenges, dedicated to ensure long term survival of this animal and its habitats. The country currently is in the process of drafting a constitution and is moving towards a federal republic and thus crucial decisions have to be taken in a carefully planned and sequenced manner. This milestone in the history of Nepal will lead to greater stability and prosperity and provide enabling conditions for conservation of all natural resources.

While human encroachment of rhino habitat, degradation of habitats due to infestation of invasive alien plant species and livestock grazing are a serious concern, a growing threat in recent years has been poaching fuelled by the international illegal trade of its horn. The political instability and the insurgency of the past decade has also added to the conservation challenges.

To proceed with an effective conservation management plan based on detailed scientific data on the rhino and its habitat, the Department of National Parks and Wildlife Conservation (DNPWC) undertook the National Rhino Census 2008 in collaboration with National Trust for Nature Conservation (NTNC), Zoological Society of London (ZSL) and WWF Nepal. Although Government contributed considerable resources to this national census of rhino, the requirements were clearly beyond our capacity and it is with pleasure that we recognize the support of NTNC, ZSL and WWF Nepal, whose timely and continuous assistance gave impetus to the rhino conservation initiatives of the country. Special thanks are due to the members of Coordination Committee, Technical Committee and all members involved in the census for their untiring efforts to collect the data on the rhino and its threats.

This rhino census report is a major outcome in our quest towards the conservation of the Endangered Greater One-Horned rhino, a flagship species of the Terai and will contribute significantly to long term conservation and sustainable development of this ecosystem.

I strongly believe that this report shows us clearly where we are and where we have to go. It provides a strong basis for the decision making process in our rhino conservation endeavors to ensure we achieve the necessary population growth and security for the species' long term survival.

Mr. Yuba R. Bhusal
Secretary, Ministry of Forest and Soil Conservation
Singhadarbar, Kathmandu

Acknowledgements

It is my great pleasure that Department of National Parks and Wildlife Conservation (DNPWC) takes this opportunity to thank all the contributors of 'The Status and Distribution of the Greater One-Horned Rhino in Nepal'. First of all, I express my sincere gratitude to partner organizations National Trust for Nature Conservation (NTNC), World Wildlife Fund Nepal (WWF) and Zoological Society of London (ZSL)/ Darwin Initiative (DI) for their support at different stages of the national rhino count. The participation of Buffer Zone Management Committees, Buffer Zone User Groups and Buffer Zone Community Forest User Groups from both Bardia and Chitwan, Nature Guide Association (Chitwan), Hotel Association Nepal are highly appreciated.

My appreciation to the efforts of all personnel who have contributed to the rhino count. Special thanks to Dr. Shant Raj Jnawali (NTNC), Mr. Nawa Raj Chapagain (NTNC), Dr. Narendra Man Babu Pradhan (DNPWC), Mr. Buddhi Nath Paudel (DNPWC), Mr. Kanchan Thapa (WWF Nepal), Dr. Rajan Amin (ZSL), Dr. Richard Kock (ZSL), Dr. Sean Murphy (CABI) for their tremendous efforts during planning, field operation as well as preparation of this report. I would also like to specially thank Mr. Shyam Bajimaya (former Director General, DNPWC) for his invaluable support during the rhino count.

I express my sincere thanks to Mr. Megh Bahadur Pandey and Mr. Fanindra Raj Kharel Chief Conservation Officers from Chitwan National Park and Bardia National Park respectively at the time of Rhino Count for their support during field operation. Likewise my many thanks to Mr. Ram Chandra Nepal (then Project Coordinator BCC), and Mr. Naresh Subedi (Office In-Charge BCP).

The Rhino Count would not have been completed without the financial support of the Zoological Society of London/Darwin Initiative (DI) and WWF Nepal program.

All the field staff (wildlife technicians, elephant staff and other supporting staff) and volunteers deserve special thanks for their tremendous effort to complete the field operation smoothly and successfully.

Mr. Gopal P. Upadhya
Director General
Department of National Parks and Wildlife Conservation

Glossary

Biological Management : In the context of this document, refers to the pro-active management of rhino populations (primarily through adjusting rhino stocking densities, but also managing the densities of other browsers and habitat management) to maintain rapid, healthy population growth, to minimise inbreeding and loss of genetic diversity. Rhino removal and introduction decisions are based on a population's breeding performance, social behaviour, genetic relationships, the rhino density relative to an area's habitat carrying capacity, vegetation conditions etc.

Breeding Performance : Defines female reproductive performance of a population measured by female ages at first calving, intervals between calving and the average proportion of adult females calving per year. These indicators are affected by habitat quality, stocking densities, adult female to male ratios and age of the females. High rates of biological growth result from good breeding performance.

Census : Process of obtaining an estimate of population size, either through attempting to count all individuals or a portion of individuals and then subsequently adjusting these counts using some statistical process.

Clean Rhino : A rhino with no individual identification features.

Demographic : Pertaining to the study of population characteristics including structure (age, sex), growth rates, density, fertility and mortality, distribution and migration.

Ecological Carrying Capacity : The maximum number of a species (rhino) that can be (sustainably) supported by the resources of a specific area.

Endangered : IUCN Red List category of threat. A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the IUCN criteria (A to E).

***Ex-situ* :** In captivity and/or out of the natural range of a species.

Founders : Rhinos used to establish a new population. Effective founder number refers to the number of founders which are capable of breeding or have bred, i.e. those that contribute or are likely to contribute to the population's original gene pool and also which as far as it is known are unrelated.

Genetically Viable : Having a realistic chance of avoiding problems associated with inbreeding, while also retaining sufficient genetic diversity to enable populations to retain fitness to be able to continue to respond to future threats. A population of rhino requires a certain amount of genetic diversity, and consequently a minimum number of individuals which can ensure the continued survival of a population or species.

Growth Rate : The natural increase in a population's size, being the net result of additions from breeding and losses from natural mortalities, expressed as a percentage of the population size at the start of a year.

Habitat : A habitat is a space (which includes food, water and shelter) suitable for the survival and reproduction of an organism **or** the local environment in which a specified organism, population, or species lives, characterized by physical and chemical features, and the presence of certain other species.

Home Range : The area in which an animal usually resides and moves in search of water, food and shelter. Home range is different from territory – the latter being an area actively defended (usually by a dominant male).

Intensive Protection Zone (IPZ) : A defined zone within a larger protected area where law enforcement staff are deployed at moderate to high density specifically for protecting rhino. The concentration of rhinos within an IPZ reflects natural patterns of distribution and movement, and is not the deliberate result of fencing and other methods of confinement.

Invasive Alien Plant Species : Introduced plant species that are rapidly expanding outside of their native range. Invasive species can alter ecological relationships among native species and can affect ecosystem function and human health. A plant species is regarded as invasive if it: (1) has been introduced by human, birds etc. to a location where it did not previously occur naturally and (2) spreads widely throughout the new location. Certain invasive species can smother and replace indigenous species and can significantly lower carrying capacities for rhinos and other species impacting negatively on conservation of biodiversity.

In-situ : The natural habitat of a species. Wild rhino being conserved in natural habitat within the historic range of the species.

Metapopulation : A number of sub-populations of a species managed collectively as one single population with occasional movement of animals from one sub-population to another.

Notching : A method of surgically cutting 'V' shaped notches from specific positions on a rhino's ear which enables the animal to be coded numerically and easily identified (and monitored) in the wild.

Sanctuary : A small part of a protected area in which rhino are deliberately confined through perimeter fencing, the use of natural barriers or other methods of confinement and where law enforcement staff are deployed at high density to protect the rhino population. The confinement of rhino within a sanctuary permits close observation and relatively intense management and protection of the rhino.

Social Carrying Capacity : Maximum number of a rhinos that can be supported in a given area without the behavioural characteristic of rhinos compromising their reproductive performance. In practical terms the primary concern is the social carrying capacity of adult males.

Species : A taxonomic group whose members can interbreed and produce viable fertile offspring; also based on genetic and morphological differences between species.

Translocation : Movement of individual rhinos from one area to another, either to improve chances of survival, to establish new populations, to keep established populations productive or to introduce new blood into a population. Rhinos may be translocated to other areas of suitable habitat and to where they may be better protected from poachers. Translocation is a necessary component of metapopulation management.

Abbreviations & Acronyms

AsRSG	Asian Rhino Specialist Group
BCC	Biodiversity Conservation Centre
BZMC	Buffer Zone Management Committee
DNPWC	Department of National Parks & Wildlife Conservation
HWC	Human Wildlife Conflict
NP	National Park
NTNC	National Trust for Nature Conservation
VDC	Village Development Committee
WR	Wildlife Reserve
WS	Wildlife Sanctuary
WWF	World Wildlife Fund - Nepal
ZSL	Zoological Society of London

Executive Summary

Greater one horned rhinoceros *(Rhinoceros unicornis)* is one of the highly threatened large mammals in South Asia. Once common in the floodplains of Sindh, Ganga and Brahmaputra river systems between Indo-Pakistan border in the west and Indo-Burma border in the east including the lowland Terai of Nepal, the greater one horned rhinoceros (hereafter referred to as rhino) are now confined in a few fragmented forest and grassland patches, mainly in the protected areas in India (Assam: Kaziranga National Park - NP, Pobitora Wildlife Sanctuary - WS, Orang NP; West Bengal: Jaldapara WS, Gorumara WS; Uttar Pradesh: Dudwa NP) and Nepal (Chitwan NP, Bardia NP and Shuklaphanta Wildlife Reserve - WR). Kaziranga NP holds the largest population of about 2000 individuals.

Rhino populations are greatly threatened due to uncontrolled poaching, degradation and loss of available habitats. Rhino populations in Chitwan NP and Bardia NP dramatically declined due to poaching during a period of social and political instability. The Chitwan population of 544 individuals in 2000 dropped to 372 in 2005. In Bardia, only 31 animals (out of a population of probably >100 from the 83 animals reintroduced between 1986 and 2003) were recorded during census in mid 2007. In addition, rhino habitat is being degraded due to invasive alien plant species. *Mikania micrantha* in Chitwan and *Lantana camara* in Bardia have heavily encroached most of the potential rhino habitats and community forests in the buffer zones.

The Department of National Parks and Wildlife Conservation (DNPWC) has been conducting rhino census at an interval of 5 years since 1994. The 2008 National Rhino Census was carried out by DNPWC in collaboration with National Trust for Nature Conservation (NTNC), WWF & Zoological Society of London (ZSL).

The main objectives of 2008 census were to: a) determine the status and distribution of greater one-horned rhinos in and around Bardia NP and Chitwan NP; b) assess the level of poaching threat on the rhino populations; c) use the census information to develop and implement an effective strategy for the security, monitoring and meta-population management of the remaining rhinos in Bardia NP, Chitwan NP and Shuklaphanta WR; and d) obtain valuable information on the distribution and abundance of the primary invasive alien plant species *M. micrantha*, a major threat to prime rhino habitat in Chitwan NP.

A standardised system has been introduced for future rhino counts. Further improvements have been made to the counting process. A properly designed block system has been established. Necessary training with evaluation of all census staff in survey techniques and rhino observation and accurate data recording was undertaken (3 day hands-on training workshop). Field tools and monitoring equipment have been put in place to ensure proper coordination of the sweeping operation and minimisation of under or over counting of rhinos. Data quality control was essential and procedures implemented included validation of data at the end of each census day, clear briefing sessions at the start of each census day and daily data analysis and debriefing sessions at the end of each census day. A well coordinated logistics team played a key role in the successful completion of the census.

In Bardia, 21 animals were recorded following intensive surveys; all in the Karnali floodplain inside the national park and in the corridor. No rhinos or their signs were found in the Babai valley. Alarmingly, the population is down by 30% over the last year based on the results from the May 2007 intensive survey. Eighty three rhinos were translocated into Bardia NP from Chitwan NP between 1986 and 2003 (13 in Karnali floodplain and 70 in Babai valley). Majority of the animals have been lost due to poaching; a few may have been washed away during the floods or moved across the border into India. This loss does not include the likely increase from breeding over the period and so it an underestimate, it is more likely that nearly one hundred rhino were poached. Protection of the remaining animals, both inside and in the surrounding areas of the park including the corridor to India, is critical as the population is close to being non-viable. Babai valley also needs to be secured to prevent poachers coming into the Karnali flood plain, for the protection of the remaining wildlife and for future releases of rhinos. On-going individual ID based monitoring of the rhinos on both sides of the border (joint monitoring system with common ID master files) is essential. This will not only help secure the population but also the on-going monitoring data will assist in the estimation of important population performance indicators (including population size) for management purposes. As seen with this census, there is chance that a small number of rhinos (under-counting) will not be detected. This is not a problem in a large population as the estimate is within +- a few percent. However in a small population this is an issue and ideally every animal should be regularly accounted for. Relatively expensive total counts using vast human and elephant resource was in part to blame for the slow reaction to the decline in rhino in Nepal between 2000 and 2005. More regular information officially reported would have stimulated management to take more action. The absence of sighting in one month should trigger more intensive monitoring in the home range of the individual animals concerned and information released to community and tourism operations that this individual is missing and to report its presence if seen.

The rhino population in Chitwan NP and its surrounding buffer zone community forests and Barandabhar corridor forest was found to be 408 animals (277 adults, 51 sub-adult and 80 calves). Despite the observed very low growth of the population, the population is reproductively performing well (approximately 61% of adult females recorded were with calves). The low growth is likely due to the on-going poaching or mortality from some other cause. Very high density of rhinos were recorded in the flood-plain grassland habitat created by Rapti and Reu rivers in their confluence. However, a large portion of the prime rhino grassland and riverine forest habitats are affected by *M. micrantha*; the primary invasive in the area. The invasive alien plant has immense potential to destroy prime rhino habitat. An effective management programme for *M. micrantha*, incorporated into the Chitwan NP protected area monitoring and management strategy, is urgently needed. Such a plan needs to include validated controls that can be used and monitored in the short term in priority conservation areas and biological control that is more cost effective and sustainable and which will take a longer time to develop. There are also other harmful alien plants such as *Lantana camara* and *Chromolaena odorata* which need to be tackled even if not yet as abundant, to nip them in the bud and save massive problems and expense in the future.

No rhino census was undertaken in Shuklaphanta WR as it is reported to have only five rhinos. This number is not regularly verified and cannot be ascertained with any certainty. Irrespective of this poor monitoring the existing population is non-viable (genetically and demographically - the IUCN stipulates a minimum of 20 founder animals for a viable population). Additional supplementation of the population is urgently needed following careful assessment of the field situation. Proper regular monitoring and security is a primary concern; a rhino was suspected poached in January 2008. The animals move large

distances including into India (into both agricultural and forest areas) making monitoring of these animals very difficult. Human wildlife conflict is an issue on both sides of the border. The park has insufficient resources to effectively monitor the animals and the army is not in a position to provide adequate security in all areas as they lack guard posts in critical locations. There is substantial pressure from livestock and illegal human encroachment and settlement, and illegal timber extraction is taking place in the south eastern part of the reserve. Ultimately, a sanctuary/intensive protection zone may be the only effective solution to secure and supplement the population with additional rhinos, and keep the animals within close breeding contact.

Key management recommendations to ensure long term survival of rhinoceros and their habitat include: i) setup of professionally trained, dedicated armed law-enforcement and anti-poaching units operating both inside and outside the protected areas; ii) establishment of standardised intensive block monitoring and integrated reporting system for routine law enforcement and biological management; iii) establishment of effective intelligence network systems; iv) development and implementation of effective public engagement programs including human-wildlife mitigation; and v) development and implementation of an effective invasive alien species control strategy.

1. Introduction

1.1. Background

Today only five species of rhinoceros remain: three occur in Asia, namely the Greater one-horned rhinoceros (*Rhinoceros unicornis*), Javan rhinoceros (*Rhinoceros sondaicus*) and Sumatran rhinoceros (*Dicerorhinus sumatrensis*), and two in Africa, namely the Black rhinoceros (*Diceros bicornis*) and White rhinoceros (*Ceratotherium simum*).

All three Asian rhinoceros are confined to isolated pockets of protected areas. Once believed widespread throughout the northern floodplains and nearby foothills of the Indian sub-continent between Indo-Myanmar border in the east and Sindh River basin, Pakistan in the west (Figure 1), the Greater one-horned rhinoceros (hereafter referred to as GOH rhino) are currently restricted in few protected areas in north-eastern India and lowland Nepal.

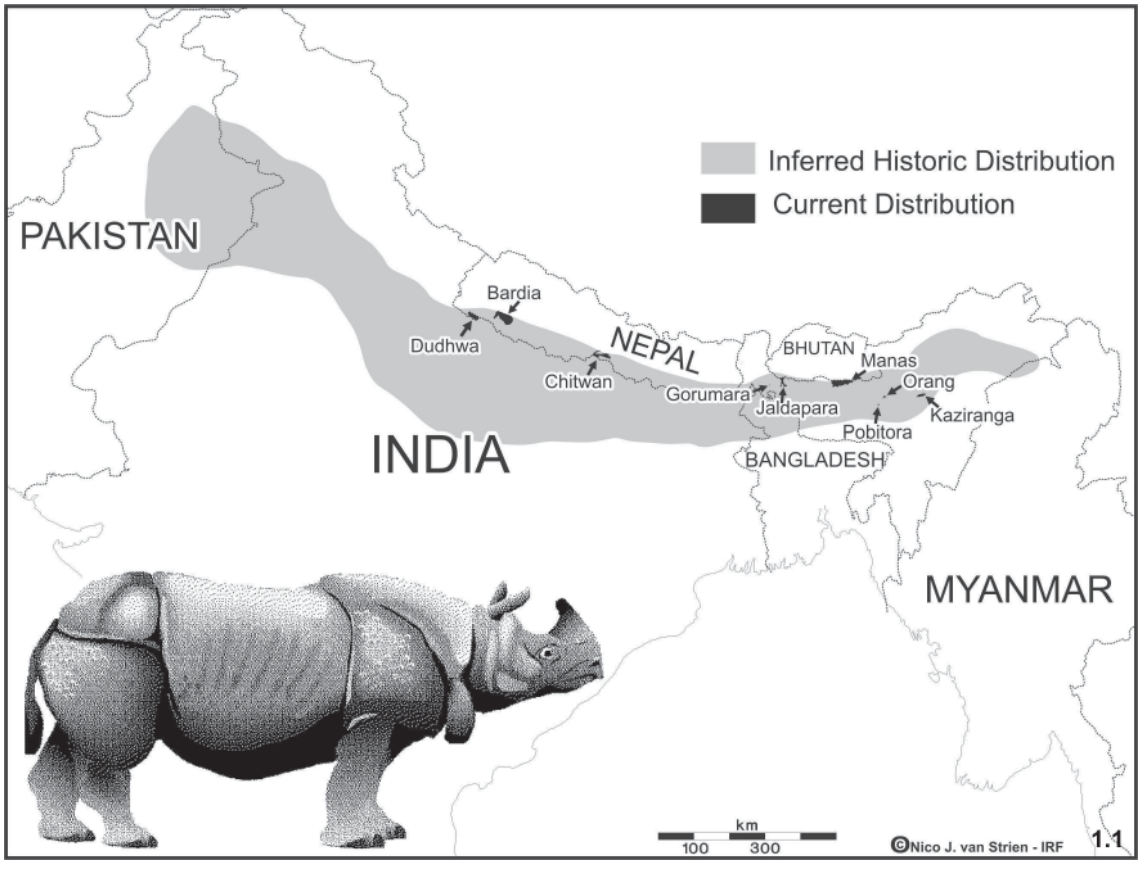


Figure 1: Greater one-horned rhino - historic and present distribution

In India, the majority of rhinos are found in Assam (Kaziranga National Park - NP, Pobitora Wildlife Sanctuary - WS and Orang NP) but also in West Bengal (Gorumara WS, Jaldapara WS) and a small reintroduced population survives in a large power fence enclosure in Dudhwa NP (Uttar Pradesh). The animals there were translocated from Chitwan NP and Kaziranga NP.

In Nepal, over 800 rhinos lived in Chitwan valley until 1950s. The valley and its rich biodiversity were protected by the then ruling Rana regime for hunting purpose. Only a few indigenous people (Tharus) were living in relative harmony with nature in the valley. Malaria prevalent in the lowland also prevented people moving into the valley from other parts of the country. Tharus were known to have some innate resistance to malaria lived relatively unaffected. After the end of the Rana regime in 1950 and eradication of malaria in mid 1950s opened up the valley where hundreds of thousands of people from mid-hills migrated to the valley, this sparked a period of clearance of prime wildlife habitats in the floodplains of Narayani, Rapti and Reu river systems and their tributaries. Wildlife including rhinos, tigers and their prey base were killed pushing them close to extinction. Rhino numbers dropped to less than 100 as early as mid 1960. Under increasing pressure to do something about the diminishing populations of wildlife, particularly rhino and their habitats, the then government established the Chitwan National Park in 1973. People living in the prime habitats were moved out and armed force was mobilized to control poaching. As a result, the rhino population grew and reached 544 animals in 2000. In order to spread the risk (due to poaching, flooding etc) and to maximize growth, the Nepal government between 1986 and 2003 reintroduced a total of 87 rhinos to Bardia NP (83) and Shuklaphanta Wildlife Reserve - WR (4). However, there has been a significant decline since then with only 372 animals found in Chitwan NP during the 2005 census. It was not possible to undertake a census in Bardia NP at the same time due to the insecurity in the region. However, following the end of conflict, a census was undertaken in Bardia NP in 2007 where only 31 animals were found entirely in the Karnali flood plain with the Babai valley rhino population apparently completely wiped out by poaching.

The GOH rhino is listed in Appendix I of the Convention on International Trade in Endangered Species and Wild Fauna and Flora (CITES)[1]. The species was categorised under IUCN criteria as Endangered for a long period until the relative recovery of a single population in India (Kaziranga NP) resulted in down-listing to Vulnerable category on the *IUCN Red List of Threatened Species* (IUCN 2008). Application of the same criteria to Nepal alone would result in an Endangered classification and there is some debate that this down-listing was not appropriate given the increasing pressures on this species from poaching and habitat encroachment. The Government of Nepal has included the GOH rhino in the list of protected animals and has been conducting various conservation programmes in collaboration with different conservation partners.

The current plight of the GOH rhino is further exacerbated by the recent and continuing range expansion of invasive alien plants in the *Terai* region. In general, it is now widely acknowledged across the globe that invasive species are a major threat, not just to agriculture, but also to natural habitats; for the latter, threatening biodiversity directly and also undermining conservation efforts because too little attention has been paid to date to address this particular issue. The threat of invasive alien

[1] CITES prohibits international commercial trade in endangered species.

species to biodiversity is categorised as second only to habitat destruction; in protected areas it is the most significant problem.

In the *Terai* several invasive plants now have established wide distributions and in consequence overrun key protected habitats such as Chitwan NP. The impacts are likely to be enormous e.g. loss of native flora and direct influence on herbivore population feeding patterns.

The Department of National Parks and Wildlife Conservation (DNPWC) initiated the national rhino census in collaboration with National Trust for Nature Conservation (NTNC), WWF and the Zoological Society of London (ZSL).

1.2. Objectives

The main objectives of the national rhino census were to:

- Determine the status and distribution of GOH rhinos in and around Bardia NP and Chitwan NP; with Suklaphanta WR reported to have only five rhinos.
- Assess the level of poaching threat to the rhino populations (in combination with intelligence data).
- Generate the information required to develop and implement a long term strategy for the security, monitoring and metapopulation management of the remaining rhinos in Bardia NP, Chitwan NP and Shuklaphanta WR.
- Obtain important information on the distribution and abundance of the primary invasive alien plant species *Mikania Micrantha* in order to develop urgently needed management components including streamlined planning of priority areas for controlling the invasive plant and integration of control activities with other park mangement components.

2. Rhino Protected Areas

2.1. Chitwan National Park

The park is situated in south central Nepal, covering 932 km^2 in the sub-tropical lowlands of the inner Terai (27°30'N 84°20'E). The area comprising the Tikauli forest-from Rapti river to the foothills of the Mahabharat - extending over an area of 175 km^2 was declared Mahendra Mriga Kunj (Mahendra Deer Park) by the late King Mahendra in 1959. In 1963, the area south of Rapti river was demarcated as a rhino sanctuary. The area was gazetted as the country's first national park in 1973 to conserve the rhino and other threatened species and their habitat. UNESCO declared Chitwan National Park a World Heritage Site in 1984 for its outstanding biodiversity of global significance.

In 1996, an area of 750 km^2 surrounding the park was declared a buffer zone to create a feeling of local ownership and to engage with the local communities in conservation including reducing their dependence on the park for natural resources. Government of Nepal has made provision of 30-50 percent of the park revenue for community development and natural resource management in the buffer zone.

The Park has a subtropical monsoonal climate with relatively high humidity and gets mean annual rainfall of 2100mm. More than 80% of the rainfall occurs within June to September.

The park encompasses a wide diversity of species and habitats within the elevation range from 110 to 850m asl. About seventy percent of the park is covered by sal (*Shorea robusta*) forest and its association and grasslands and floodplains cover approximately twenty percent of the area that provide excellent habitat for an array of species including the mega-herbivores (rhinoceros and elephants), big cats (tiger and leopard) and several ungulates. The park is home for 486 species of birds, over 40 species of mammals, 49 species of reptiles and amphibians and more than 120 species of fishes. The park is drained by Rapti, Reu and Narayani rivers.

2.2. Bardia National Park

Bardia National Park is the largest national park in the Terai zone, located in western lowland Nepal (28°30'N, 81°15'E) covering an area of 968 km^2. The protected area was established to protect and conserve tiger, its prey species and habitat. Initially, a small area was gazetted as the Karnali Wildlife Reserve in 1976. In 1982, it was renamed as Bardia Wildlife Reserve, and in 1984 it was extended to its current size. The reserve was given the status of a National Park in 1988.

In 1997, an area of 327 km^2 surrounding the park was declared as a buffer zone, which consists of forests and private lands. The park and local communities jointly manage the buffer zone and together they initiate community development activities and manage natural resources in the buffer zones.

The Park has a subtropical monsoonal climate with annual rains falling mainly between June and September. This is followed by a dry season between October and mid-February and a hot period from mid-February to June.

A total of six different habitat types make up the park: sal forest; khair sissoo forest, wooded grasslands, floodplain grasslands, riverine forest and small pockets of grasslands locally known as phantas. These intertwining habitats combined with the abundant water supply from the Karnali and Babai rivers provide near perfect conditions for a rich and diverse fauna, with grasslands capable of supporting a greater biomass of mammals, birds and insects than any other terrestrial habitat type.

A total of 53 mammal species (ten of which are protected), 400 avifauna, 25 species of reptiles and amphibians and 121 fish species have been recorded in Bardia National Park. The park is home to a number of endangered animals including the Royal Bengal tiger, wild elephant, Greater one-horned rhino, swamp deer, Gangetic dolphin, gharial, Bengal florican, lesser florican and sarus crane.

Bardia National Park is connected to Katarniaghat Wildlife Reserve in India through a narrow forest corridor allowing rhino and other species to move between the two protected areas. Eighty three Greater One-horned rhino were translocated to Bardia National Park from Chitwan National Park between 1986 - 2002.

2.3. Shuklaphanta Wildlife Reserve

Shuklaphanta Wildlife Reserve (28°45'16'' and 28°7'23'' North and 80°06'04'' and 80°21'40'' East) is located in Kanchanpur district in the far-western lowland *Terai* of Nepal. The reserve was managed as a hunting reserve from 1969, and was gazetted as a Wildlife Reserve in 1976, covering an area of 305 km^2. The reserve shares a common boundary with the Indian state of Uttar Pradesh in the south and west which is formed by the Mahakali (Sarda) river, a major tributary of the Ganges. The reserve extends up to the Syali River in the east and to the Siwaliks ridge in the north-east corner.

The area has a sub-tropical monsoonal type with three distinct seasons: winter, hot, monsoon. The mean monthly minimum temperature varies from 10 to 12°C in winter and rises gradually to 17°C in the spring and 26°C in the summer. The maximum temperature varies from 22° C to 36° C, reaching as high as 42° C in the pre-monsoon period. This part of the country receives less rain than eastern Nepal with average annual rainfall ranging from 1,300 mm to 2,300 mm, 80% of which falls during the monsoon (July to September).

Although the area of the reserve is small, it supports a wide range of biodiversity which is nationally and globally important. The main vegetation types are: sal forest; sal savanna, which is part of a continuum between climax forest and grassland that is maintained by fire or floods; mixed deciduous forest, which is patchily distributed among the more extensive grasslands in the south-west; grasslands, both dry (locally known as phantas) and wet in the case of areas inundated during the monsoon; lowland savanna, which occurs on the fringes of all main grasslands; khair-sissoo forest, dominated by *Acacia catechu* and *Dalbergia sissoo* and forming an early succession in riverine areas; and marsh, in which tall dense grasses are predominant (e.g. *Phragmites karka*, *Saccharum spontaneum* and *Sclerostachya fusca*).

Twenty four mammal species, three hundred and fifty species of birds and fourteen species of fish have been recorded in the reserve. The reserve supports the largest population of Bengal florican (*Houbaropsis bengalensis*) and swamp deer (*Cervus duvauceli*). The rhino population was started in 2003 with the translocation of 4 animals from Chitwan National Park to add to the one resident rhino which was first sighted and reported in 1995.

3. Methodology

The DNPWC coordinated the operation with technical and financial support from the NTNC, WWF-Nepal and ZSL (through the UK Darwin Initiative). In order to effectively conduct the two census operations, two coordination committees, one at the central level (DNPWC, ZSL, NTNC and WWF technical staff) and another at the field level (one for Bardia NP and one for Chitwan NP) were formed.

The census technique used to estimate the size and structure of the two rhino populations was based on the methodology developed by Laurie (1982) and Dinerstein and Price (1991). This method has already been proven to be reliable and practical for estimating the population size, age and sex structures, and distribution pattern of rhinoceros (used in 2007, 2005, 2000, 1994 census). Refinements were made to the approach in order to further reduce over and under counts and thus obtain a more accurate estimate. The aim was also to develop this census system as a standard method for future assessments in order to assess population performance over time. Rhino census requires properly skilled and motivated staff, well designed and coordinated census, system of control on data quality at observer and data recording level, and logistic support.

Technical staff from Chitwan NP, Bardia NP, NTNC's Biodiversity Conservation Centre (Chitwan), Bardia Conservation Program and Shuklaphanta Conservation Program, WWF Nepal Program and experienced staff from other local conservation organisations served as observers in the count.

3.1. Training

A 3-day training programme was conducted on-site prior to the counts. This was to ensure all observers participating in the census possessed high standards of observation and data collection skills. Standardised data collection was essential using the developed rhino data recording booklet. Training material was developed and observers trained in the following topics: 1) Ageing rhino; 2) Sexing rhino; 3) Use of the rhino data recording booklet; 4) Use of binoculars; 5) Use of GPS receiver; 6) Use of digital cameras; 7) Use of radio handsets. This material forms part of the IUCN Asian Rhino Specialist Group (AsRSG) course on Rhino Monitoring (IUCN AsRSG 2008). The training followed an outcomes-based approach and included formalised testing procedures to assess the degree of understanding/competence of trainees on each of the topics. During the first two days each topic was taught in detail by an instructor/expert (from ZSL, NTNC & DNPWC) followed by practical training sessions. On the final day, the trainees were tested (both written and practical tests) on each of the topics. Trainees were only passed if specific set standards of knowledge and competence were shown for each aspect of the training. Pass marks were set at 80% to ensure a high standard (Figures 2, 3, 4, 5).

The observers were practically trained to correctly assess the level of *M. Micrantha* infestation. The observers were also trained in correctly recording different habitats in which the invasive plant occured, namely : riverine/tropical mixed hardwood forests; Sal forest; tall grassland; short grassland; and wetland. A field practical training session was conducted and observers were formally tested. A data recording form for invasive species was designed and observers were shown how to complete this.

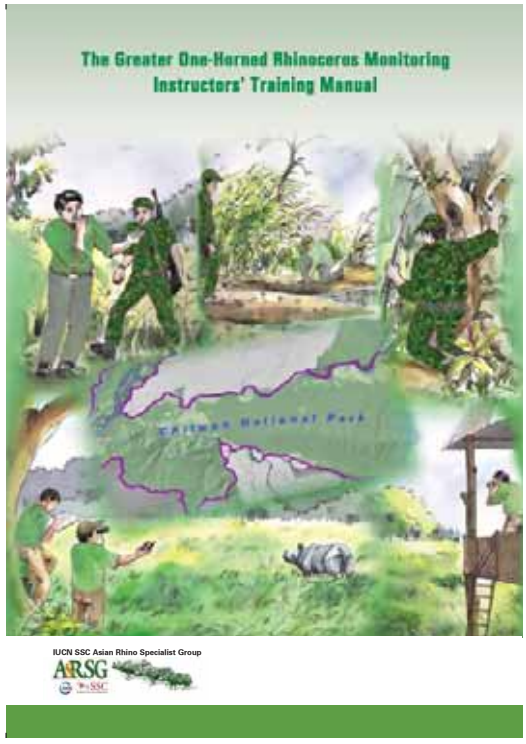


Figure 2: Rhino monitoring training manual - front cover

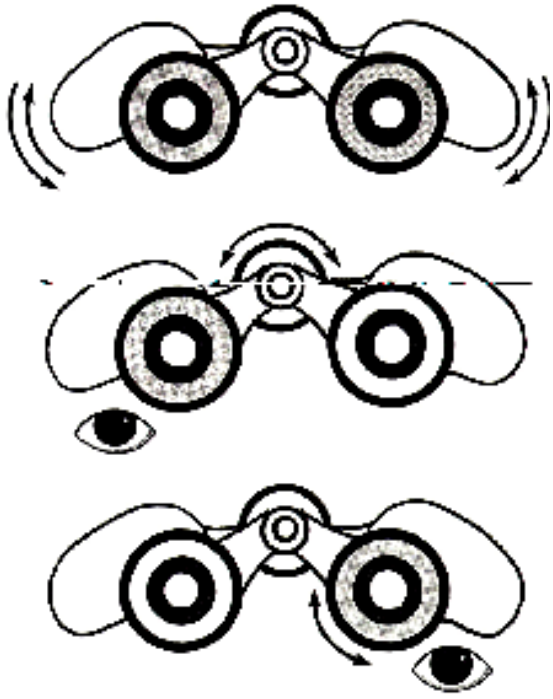


Figure 3: One of the training posters – calibrating binoculars

Figure 4: Observer training programme - Chitwan National Park

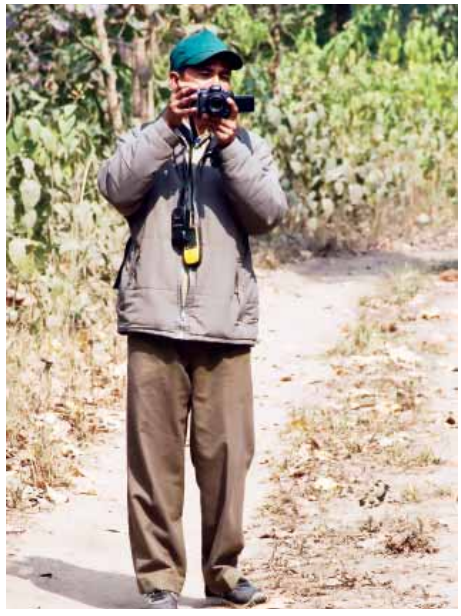


Figure 5: Practical observer training session – use of field monitoring equipment

3.2. Survey block design

All potential rhino habitats (both inside and outside the protected areas) were divided into blocks based on physical demarcation using a topographic map (scale 1:25,000) and field knowledge. Reconnaissance surveys were also conducted in the more difficult areas to refine the blocks and plan for the sweeping operation.

For Bardia NP, the area where rhino are known to exist, around the Karnali flood-plain and the corridor forest along the Geruwa river connecting Bardia NP with Katarniaghat Wildlife Sanctuary (WS), India was divided into 5 blocks (Figure 7). A 2-day rapid survey of the Babai valley was also planned to confirm the reported absence of rhino in the valley.

A 2-day rapid survey of the Babai valley was also planned to confirm the findings of the intensive status monitoring conducted in May 2007 that no rhinos occur in the valley.

Figure 6: Designing survey blocks – Chitwan National Park

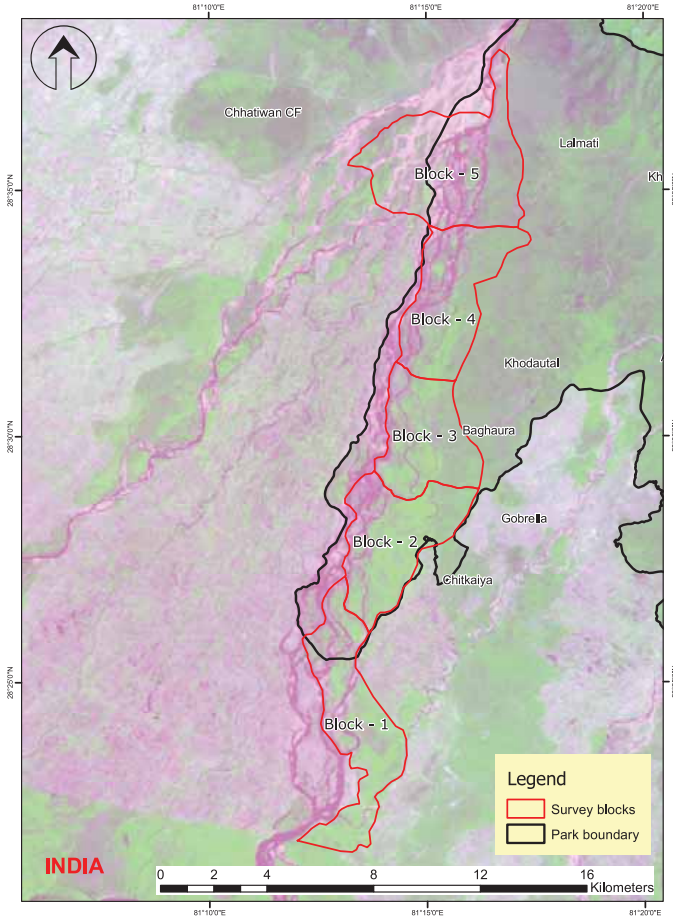


Figure 7: Survey blocks – Bardia National Park (Block 1: – Katarniaghat Forest Corridor (outside NP); Block 2: Hatisar – Lamkighagar; Block 3: Lamkighagar - Gainda Machan; Block 4: Gainda Machan – Laguna Machan; Block 5: Laguna Machan – Lalmati including Chhatiwan CF)

All potential rhino habitats in Chitwan NP and the buffer zones were divided into a total of 16 blocks (Figure 8).

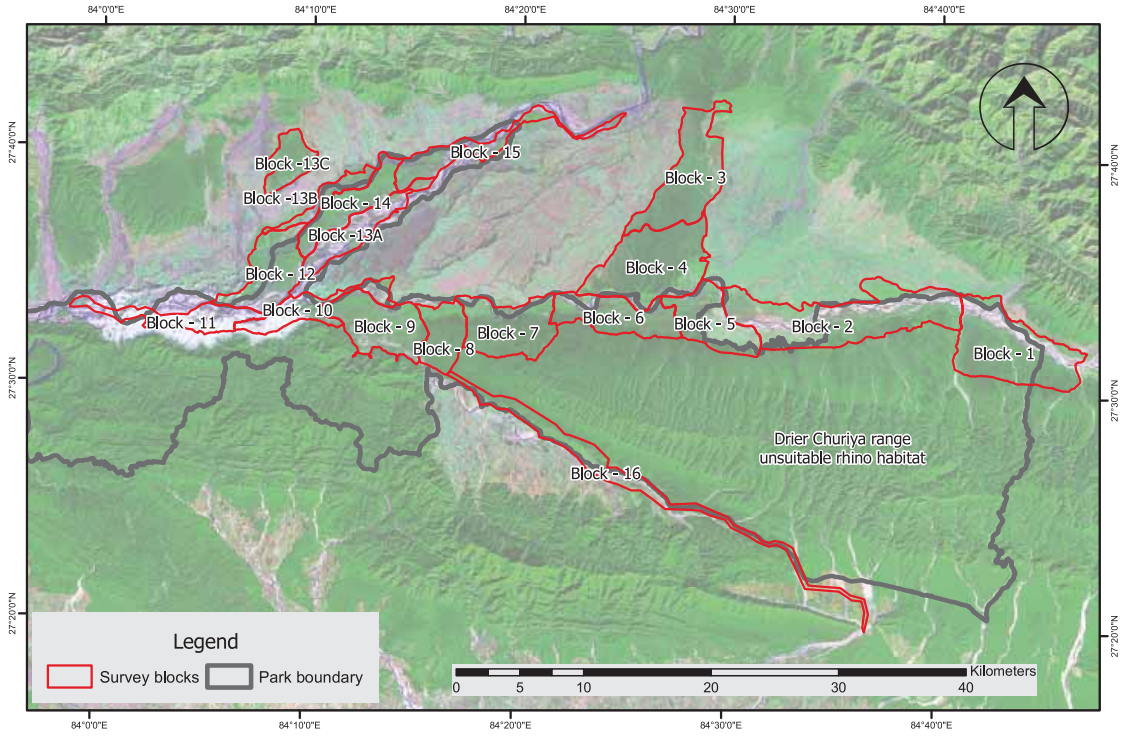


Figure 8: Survey blocks – Chitwan National Park

3.3. Count operation

Where necessary, tall grasses were cut and burnt to improve visibility to observe animals. A maximum of 45 elephants were used in Chitwan NP and 15 elephants in Bardia NP (Figure 9). Elephants were lined up and moved parallel along transects marked on the map to sweep individual blocks. The elephant line at places was over 5 km long in one continuous sweep (Figure 10). Experienced staff were assigned to manage sections of the sweep to coordinate the operation. Radio communication was essential for this and to maintain distances between two elephants at approximately 50m in dense forests and 100 - 200m in open grasslands (Figure 11). Maps of area to be covered on each census day were produced and provided to each observer for navigation purposes (Figure 12). The maps in conjunction with the GPS receivers were extremely useful to ensure groups of elephants didn't break from the census line particularly in thick forests. Each elephant carried 1 – 2 well trained observers; over 80% of the observers from DNPWC, NTNC, WWF-Nepal and other local conservation organisations had experience from previous counts (Figure 13).

Figure 9: A large part of the census elephant team – Chitwan National Park

Figure 10: Elephant alignment at start of day's census

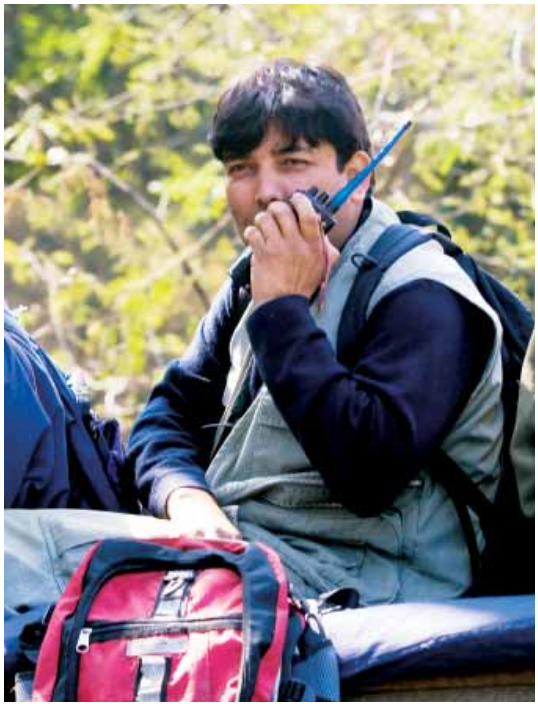


Figure 11: Coordinating survey operation using hand-held radio system

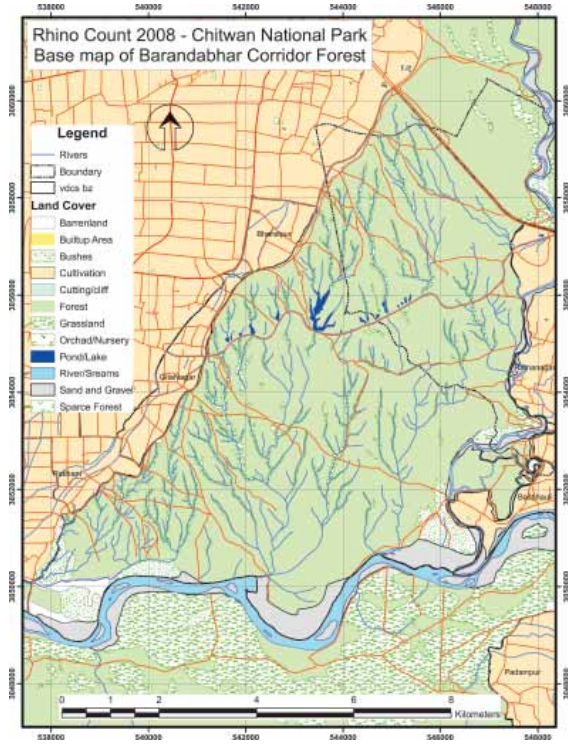


Figure 12: A base map for a day's survey

Figure 13: Observer team on elephant back

3.3.1. Track logging

Each elephant team carried a Garmin eTrex-H (High Antenna) GPS receiver to avoid under counts. The GPS receivers were all set at the start of each day to automatically record the census tracks. The Garmin eTrex-H continuously worked in all the terrain including thick forest. The data were downloaded at the end of each day on to a computer using DNRGarmin software. Each track data was then transformed into the same coordinate system as the underlying park satellite image (Landsat ETM+ image of 2006 for Bardia NP and Landsat ETM+ mosaic created from images of multiple dates from 1999-2002 for Chitwan NP) and associated coverage maps (including park boundary and survey blocks derived from Nepal Government topographic maps of 1:25,000 scale) in ESRI ArcGIS software (Figure 14).

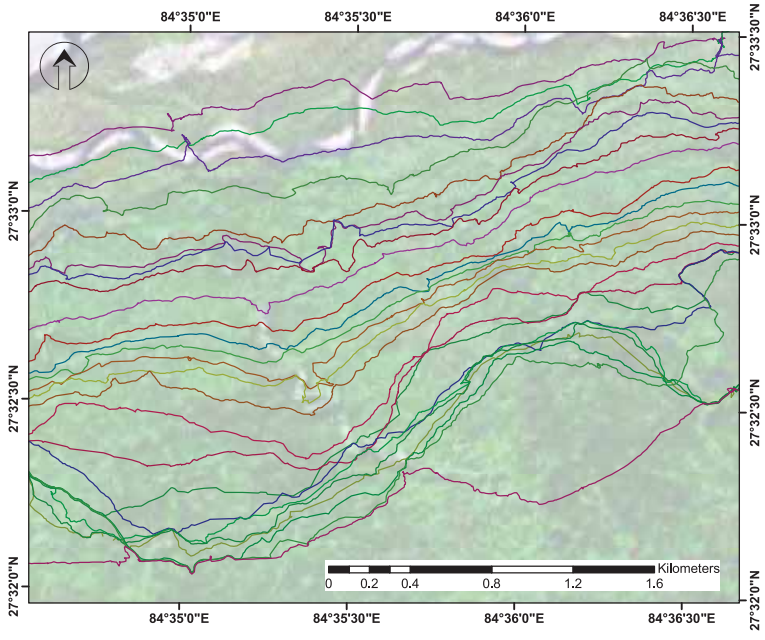
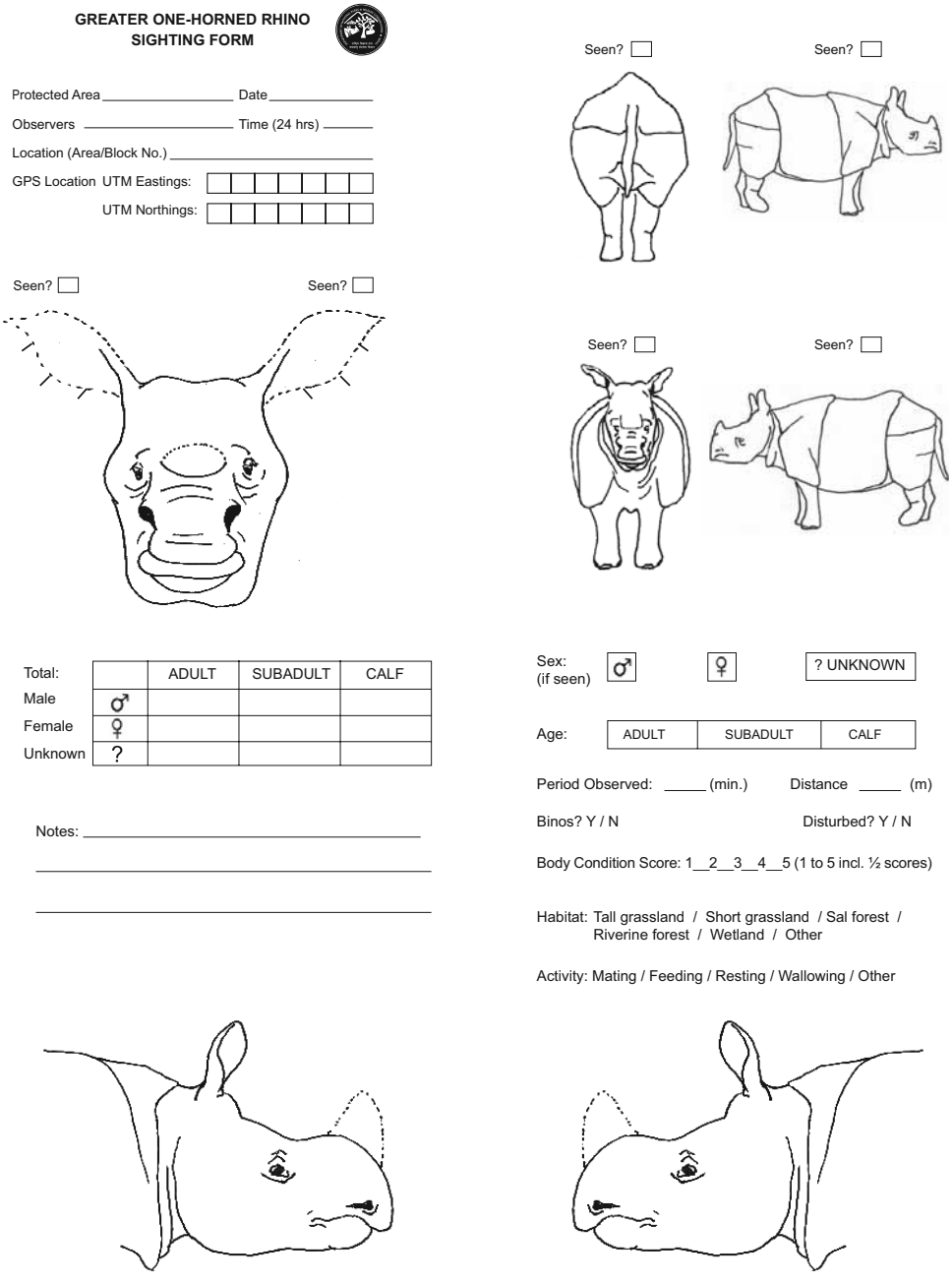


Figure 14: Sample GPS tracks map showing a day's coverage - Chitwan National Park

3.3.2. Rhino identification features and demography data recording

A rhino data recording booklet was designed to standardise the accurate recording of rhino identification features and demographic data (Figure 15).



GREATER ONE-HORNED RHINO
SIGHTING FORM

Protected Area _____ Date _____

Observers _____ Time (24 hrs) _____

Location (Area/Block No.) _____

GPS Location UTM Eastings: | | | | | | | |

UTM Northings: | | | | | | | |

Seen? ☐ Seen? ☐

Seen? ☐ Seen? ☐

Seen? ☐ Seen? ☐

Total:		ADULT	SUBADULT	CALF
Male	♂			
Female	♀			
Unknown	?			

Notes: _____

Sex: (if seen) ♂ ♀ ? UNKNOWN

Age: ADULT | SUBADULT | CALF

Period Observed: _____ (min.) Distance _____ (m)

Binos? Y / N Disturbed? Y / N

Body Condition Score: 1__2__3__4__5 (1 to 5 incl. ½ scores)

Habitat: Tall grassland / Short grassland / Sal forest / Riverine forest / Wetland / Other

Activity: Mating / Feeding / Resting / Wallowing / Other

Figure 15: Standardised rhino sighting data recording form

The booklet was put together to form a convenient way of recording all of the details about a GOH rhino. It was also small enough to conveniently fit into a shirt pocket.

The observers were trained to look for and draw/note any features such as horn shape, ear tears, skin folds, deformities, epidermal knobs, body scars or tail shape that would make a rhino distinguishable. They were trained to correctly fill in the following information:

- Date and time
- GPS location
- Standardised age class (adult, sub-adult or calf)
- Sex (male, female or unidentified sex)
- Habitat type (tall grassland, short grassland, Sal forest, riverine forest, wetland, other)
- Distinct rhino identification features (ears and horn, body and tail features)
- Body condition (good, average, poor)
- Group composition
- Activity

Trainees were trained to record the information fully and accurately. The emphasis was on accuracy and they were taught to put a "?" if they were unsure. The observers filled in the forms from the centre of the booklet and the completed form was then removed and stored in a water-proof plastic folder.

3.3.3. Invasive alien plant species data recording

Mikania micrantha is a fast growing perennial creeper belonging to the family Asteraceae. It is commonly called "mile-a-minute weed" because of its exceptionally fast growth rate and spreading nature. The native range of *M. micrantha* lies in the tropical and sub-tropical zones of Central and South America. Although it is only of minor importance as a weed in its native habitats, once it is transported outside, *M. micrantha* is capable of rapidly producing a huge amount of biomass and even smothering large trees, causing significant losses in natural forests, grasslands, plantations and agricultural systems. *M. micrantha* is now a major weed in many countries within the moist tropical zones of South and South-east Asia and the Pacific, and is expanding its range. In Nepal, it is aggressively spreading from east to west and has reached Chitwan NP and beyond in less than half a decade probably from northern India where it was reported to be introduced during WW II (1940's) for use as a camouflage creeper for securing military installations (Poudel *et al.* 2005). It is the principal invasive plant in Chitwan NP and is now fairly widespread in areas closer to the river and in places very abundant. This is a major concern as rhino and other herbivores are known not to eat *M. micrantha*. It has the potential to destroy prime habitats of threatened species including rhino (Figure 16).

Figure 16: *Mikania micrantha* infestation - Chitwan National Park

The initiation of an effective management programme for *M. micrantha* will need the following components.

1. Understanding the distribution and abundance of the principal plant invasive species. The major invasive species needs to be mapped and this can be done using a GIS system. Such a system will allow streamlined planning of priority areas for controlling the invasive and also integration of activities with other park management components.

2. Understanding the impacts/dynamics of the weed in relation to major plant and animal communities. The extent of invasion by this plant in different plant communities seems to differ between communities with some grassland types very badly affected. This aspect requires further study along with understanding of the temporal patterns of invasion, especially in relation to flooding and fire regimes and impacts on native fauna. Overall this information is necessary to justify major interventions such as biological control and to set priorities.

3. Understanding more about why *M. micrantha* is invasive. This will provide crucial baseline information on potential factors (especially human ones) exacerbating the spread and impacts, to build intervention programmes. Major factors could be use of fire for grassland management and the use of the park for resources by locals. This will require appropriate community surveys.

4. Developing suitable interventions, including an awareness campaign aimed both at local communities and policy makers: Overall, development of short, medium and long term

measures will be needed all based on conservation priorities and available resources. The initial focus in the short term would possibly include improved cultural/mechanical control based on the experience from previous trials. Long term will be about developing biological control where the experience available in India and elsewhere will be very useful.

The first important step was therefore to assess distribution and abundance of *M. micrantha.* This provides the foundation data on which to build the other components. The rhino census provided an excellent opportunity to obtain this information in addition to saving time and resources. The basic method included assessment of invasive cover from an elephant for a defined sized grid using a simple ranking of cover by invasive as measure of abundance; 0: absence; 1: <50%; 2: >50% cover within an approximate semi circular area of 50 m in front of and left and right of the elephant observer team (Figure 17,18,19). This was done periodically (approximately every 30 minutes) during the census. The type of habitat and position of each assessment using a GPS receiver were also recorded.

Figure 17: *Mikania micrantha* assessment method from elephant back

Figure 18: *Mikania micrantha:* 1% - 50% cover

Figure 19: *Mikania micrantha:* >50% cover

3.3.4. Data quality checking and debriefing

Procedures were put in place for data validation at the end of each census day. The Rhino ID master files created and updated through regular block monitoring in Bardia NP were also used for this purpose. A Rhino ID master file contains details of potential identification features such as horn shape, ear tears, skin folds, deformities, body scars or tail shape. These features are recorded both as up-to-date photos and drawings (Figure 20).

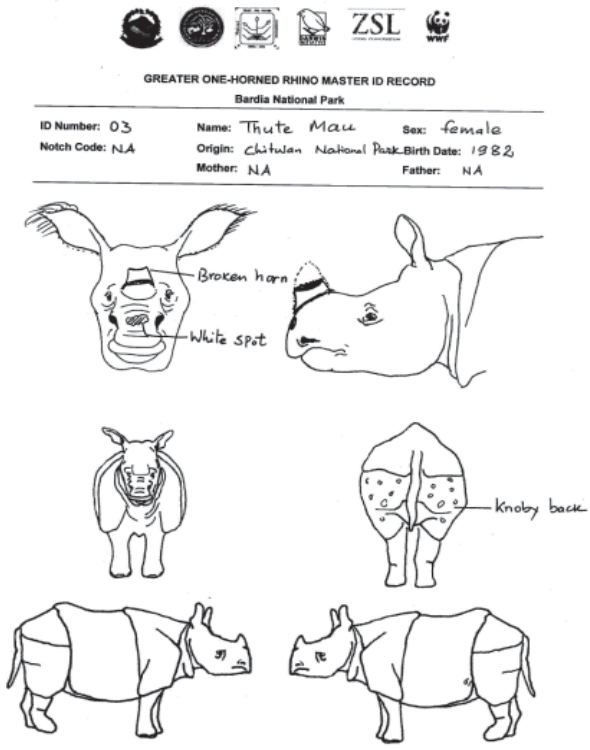


Figure 20 : A completed record in Rhino master ID file

In addition, digital cameras were employed both for validating data and to further build up the ID master files. Experienced observers checked all rhino sighting information to ensure double counts did not take place. Uncertainties were resolved by carefully checking with the observer teams. Communication in the field was essential between the elephant observation teams to ensure rhinos were recorded accurately by the best placed team. Motorola handheld radio sets were used and found to be very reliable.

The observers used binoculars (Opticron - 10 x 50 etc.) where possible for observing identification features of rhino without getting too close and disturbing the animals. After recording, rhinos were carefully pushed behind the census line to prevent being counted again. Individual rhinos were identified using a range of features such as horn shape, ear tears, skin folds, knobs, deformities, body scars and tail shape. Where necessary, at the end of each day, observers also cross checked their sighting data with observers sitting on elephant of either side to avoid double counting (Figure 21).

Figure 21: Elephant backed observer team recording rhino information

The validated data were then entered into an excel spread sheet and final list tabulated for each day. The *M. Micrantha* recorded sheets were also checked and entered into an excel spread sheet at the end of each census day.

Daily de-briefing sessions were conducted with the whole census team. This included a detailed review of the day's tracks to ensure all potential rhino areas were covered well and a final review of the following day's survey operation (Figure 22).

Figure 22: A day's coverage being reviewed at a debriefing session

3.3.5. Field logistics

All GPS receivers, cameras, binoculars and radio handsets were numbered and placed in the corresponding numbered rucksack. Each rucksack also contained two rhino data recording booklets, an invasive alien plant species recording sheet, plastic folder, pencil, eraser and spare set of batteries for the GPS receiver (Figures 23 and 24). Each observer was assigned a number along the census line during briefing sessions before the start of the day's survey. Two members of the team were specifically given the task of looking after and distributing the equipment (Figure 25). All equipments were carefully checked at the end of each day and used batteries charged using a portable generator.

Figure 23: Survey data recording items

Figure 25: Equipment being distributed at the start of a day's census

A tractor was rented locally to move camping gear (tents, mattresses, petromax, generator for power supply), food items for census crew, fuel-wood, iron chains for tying up the elephants during night, elephant food ration (rice, raw sugar and salt) and drinking water in areas where clean water was not accessible.

The logistics team also contained a food supply and transportation team. Each member of the census team was provided with breakfast, packed food whilst on the count and dinner in the evening. Up to six vehicles (NTNC and DNPWC) were used to transport observers from the camp to the start-up point each day, and for procurement of food items (Figure 26).

Figure 24: A numbered rucksack for carrying monitoring and data recording equipment

Figure 26: Tents and food being supplied to survey camp - Chitwan National Park

Figure 27: Setting up camp - Bardia National Park

4. Results

4.1. Bardia National Park

4.1.1. Coverage and search effort

A total of 85.85 square kms of potential rhino habitats were surveyed in the Karnali floodplain (Figure 28). Over the period of five days, a total of 293 elephant hours were spent (Table 1) searching for rhinos (3.41 elephant hours per square km). In Babai valley, a rapid search/assessment was undertaken over two days spending a total of 52 elephant hours. In May 2007, an intensive status monitoring conducted by DNPWC, NTNC and ZSL in the Babai valley reported the absence of rhinos in the area.

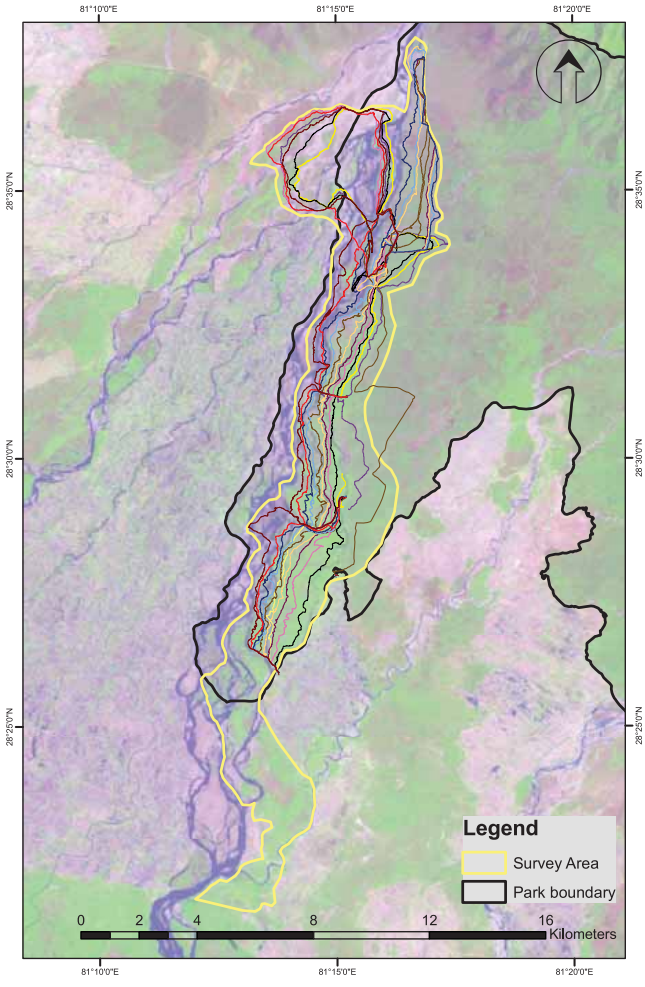


Figure 28: Survey tracks - Bardia National Park

All possible rhino habitats were searched (Table 1). In addition to blocks 1-5, the dry Sal forests stretching between Karnali floodplain and Babai River (including Chitkaiya, Gobrella, Baghaura, Khodautal, Lamkauli - up to the highway, Lalmati, Khairbhatti, Amreni, Karmala and Sainawar areas) were surveyed for rhino and their signs (foot-print and dung). No rhino or their signs were found in the dry Sal forests. All water holes (Khodautal, Lamkaulital, Hattiktal, Jarayotal, Dhaneshtal) were also visited and checked for fresh rhino signs. Based on field information, the Chhatiwan community forest in the Kailali District and buffer zone community forests in Gola and Patabhar were also searched. The Chhatiwan community forest (45 square kms) stretches along the western branch of Karnali River and is connected with Geruwa floodplain.

Table 1: Search effort - Bardia National Park

Month/ Day/Year	Day	Block surveyed	Start time	End time	Number of elephants used	Survey time (hours)	Total effort (elephant hours)	Area surveyed (sq. km.)
Karnali flood-plain								
3/1/2008	1	Block – 1	09:00	15:30	10	6.5	65	17.75
3/1/2008			10:30	15:30	1	5	5	
3/2/2008	2	Block – 2	07:30	12:30	6	5	30	15.72
3/2/2008			07:30	13:30	3	6	18	
3/3/2008	3	Block – 3	07:00	11:30	11	4.5	49.5	13.34
3/4/2008	4	Block – 4	06:50	11:50	11	5	55	15.75
3/5/2008	5	Block - 5	07:00	12:30	5	5.5	27.5	23.29
3/5/2008			07:00	13:30	2	6.5	13	
3/5/2008			07:00	14:00	2	7	14	
3/5/2008			07:00	14:50	2	8	16	
Total							293	85.85
Babai valley rapid assessment								
3/6/2008	6		07:00	14:00	4	7	28	
3/7/2008	7		07:00	13:00	4	6	24	
Total							52	

4.1.2. Rhino status and distribution

The census operation revealed 18 rhinos. Seventeen animals were sighted during the census; two of which were sighted by DNPWC game scouts having moved into India the day before the census started from Block 1 and subsequently returned to this block after it was swept. The remaining animal was an indirect sighting (fresh spoor) in Block 4; there were signs of an animal moving out of this block into Block 3 duriing the start of Block 4 census (sweeping operation from Block 1 to Block 5.)

The 13 up-to-date records in the Rhino ID master files were used to carefully check and validate the completed sighting forms and digital photos taken by the observers. These files were created following the May 2007 status monitoring exercise. Table 2 shows the recorded ID animals (in the rhino master ID files) that were confirmed during the census.

Table 2: ID rhino sightings - Bardia National Park

ID	Name	Sex	Age class	Last seen	Area	Comment
1	Terrible Thito	Male	Adult	June 2007	-	-
2	Terrible Male	Male	Adult	2nd March 2008	Block 2	Confirmed from sighting form (03.02.01)*
3	Thute Mau	Female	Adult	27th March 2008	Block 2	Confirmed during intensive search operation (after census)
4	Thute's Mau's Bacha	Unknown	Calf	27th March 2008	Block 2	Confirmed during intensive search operation (after census)
5	Khag Chiruwa Tikhe	Female	Adult	2nd March 2008	Block 2	Confirmed from sighting form (03.02.03)*
6	Khag Chiruwa Tikhe's Calf	Unknown	Calf	2nd March 2008	Block 2	Confirmed from sighting form (03.02.03)*
7	V Kane Bhale	Male	Adult	28th March 2008	Block 3	Confirmed during intensive search operation (after census)
8	Tikhe Pothi	Female	Adult	1st March 2008	Block 1	Confirmed from sighting form (07.01.05)*
9	Tikhe Pothi' Calf	Unknown	Calf	1st March 2008	Block 1	Confirmed from sighting form (07.01.05)*
10	Suntali Pothi	Female	Adult	2nd March 2008	Block 2	Confirmed from sighting form (05.02.02)*
13	Suntali's Calf	Unknown	Calf	2nd March 2008	Block 2	Confirmed from sighting form (05.02.02)* Born after May 2007
11	Ghaite Gainda	Unknown	Adult	24th Nov 07	-	-
12	Golaghat Male	Male	Adult	5th March 2008	Block 5	Confirmed from sighting forms (09.05.01, 11.05.01)*

* census sighting form reference number

The sightings of animals not registered in the rhino master ID file or confirmed are provided in Table 3.

Table 3: Non-ID rhino sightings - Bardia National Park

ID	Name	Sex	Age class	Last seen	Area	Comment
-	-	Unknown	Adult	1st March 2008	Block 1	Incomplete sighting (09.01.02)*, could be ID 1 or 11
-	-	Unknown	Adult	2nd March 2008	Block 1	Sighted during census – not during the sweeping operation
-	-	Unknown	Adult	2nd March 2008	Block 1	Sighted during census – not during the sweeping operation
-	-	Female	Adult	3rd March 2008	Block 3	Sighted during census (02.03.02)*

ID	Name	Sex	Age class	Last seen	Area	Comment
-	-	Unknown	Calf	3rd March 2008	Block 3	Sighted during census (02.03.02)*
-	-	Unknown	Adult	3rd March 2008	Block 3	Incomplete sighting (04.03.01)*, could be ID 1 or 11
-	Budhune Female	Female	Adult	3rd March 2008	Block 3	Sighted during census (05.03.04)*
-	Budhune Female's Calf	Unknown	Calf	3rd March 2008	Block 3	Sighted during census (05.03.04)*
-	-	Unknown	Adult	6th March 2008	Block 5	Incomplete sighting (03.06.01)* (sighted near day 6 camp from car whilst moving to the start point), could be ID 1 or 11

* sighting form reference number

The information on the indirect sighting recorded individual rhino is provided in Table 4 below.

Table 4: Indirect sightings of unique rhino - Bardia National Park

ID	Name	Sex	Age class	Seen	Area	Comment
-	-	Unknown	Adult	4th March 2008	Block 4	Fresh spoor seen, checked at the boundaries of block 3-5 for crossing of rhino (04.04.01)*

* sighting form reference number

An intensive search operation was undertaken to locate the remaining known animals. Three animals were found and photographs were taken to confirm their sightings. This information is also provided in Table 2.

A total of 22 rhinos were confirmed in Bardia NP (including the one sub-adult orphan kept at park headquarters - Table 5). The population constituted 15 adults, 1 sub-adult and 6 calves. Adult sex ratio (proportion of sexed adult females to males) was found to be 2 (n=9), whereas adult female to calf ratio was 1.67 (n=10 - assuming the sex of "unsexed" adult individuals to be in the same ratio of "sexed" adult individuals).

Table 5 : Rhino population status - Bardia National Park

Sex	Adult	Sub-adult	Calf	Total
Male	3	1	0	4
Female	6	0	0	6
Unknown	6	0	6	12
Total	15	1	6	22

Distribution of rhino population by group composition and block is summarized in Table 6 and Figure 29. The results show that the majority (77%) of the population in Bardia NP were located in the southern and central areas of the Karnali floodplain (Blocks 1, 2 and 3). Adult females with dependent calves were also only present in these blocks; no mother-calf pairs were found in the more disturbed habitats of Bardia-Katarniaghat forest corridor.

Table 6: Rhino population group composition - Bardia National Park

Group composition	Blocks					Babai valley & other areas	Park HQ	Total
	1	2	3	4	5			
Adult female with dependent calf	1	3	2					6
Dependent calf	1	3	2					6
Adult un-sexed	3		1	1	1			6
Adult male		1	1		1			3
Sub-adult male							1*	1
Total	**5**	**7**	**6**	**1**	**2**		**1**	**22**

* orphan male brought from Chitwan NP now at Park HQ - Thakurdwara

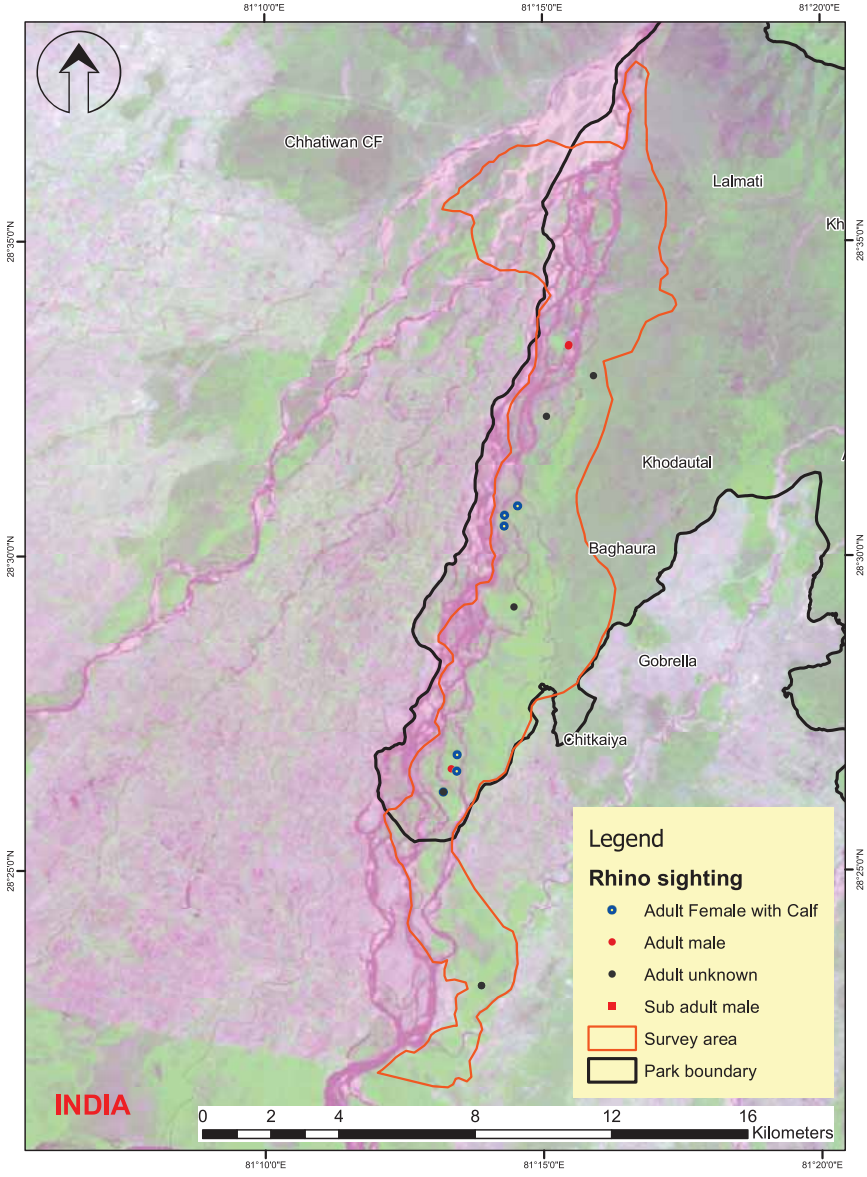


Figure 29: Rhino distribution - Bardia National Park

A large proportion of the rhinos (66%) were recorded in the riverine forests (Table 7).

Table 7: Rhino distribution by habitat type - Bardia National Park

Habitat Type	Blocks					Total
	1	2	3	4	5	
Riverine forest	3	5	5	1		14
Sal forest						
Tall grassland					2	2
Wetland		2	1			3
Riverbed	*2*					*2*
Total	**5**	**7**	**6**	**1**	**2**	**21**

4.2. Chitwan National Park

4.2.1. Coverage and search effort

A total area of 470.2 square km of potential rhino habitats both inside the national park and in the surrounding buffer zone were surveyed (Figure 30). It took 3107.5 elephant hours (Table 8) to complete the census (6.6 elephant hours per square km). Movement of elephants in the central part of the southern stretch of Barandabhar forest was difficult due to ground condition, mainly in Bish Hajari Lake and its surrounding area. However, a thorough search of trails leading to the swampy areas and used by rhinos and other animals was made. No fresh spoors of rhinos going into the area or coming out were evident indicating absence of rhinos in that area during the count.

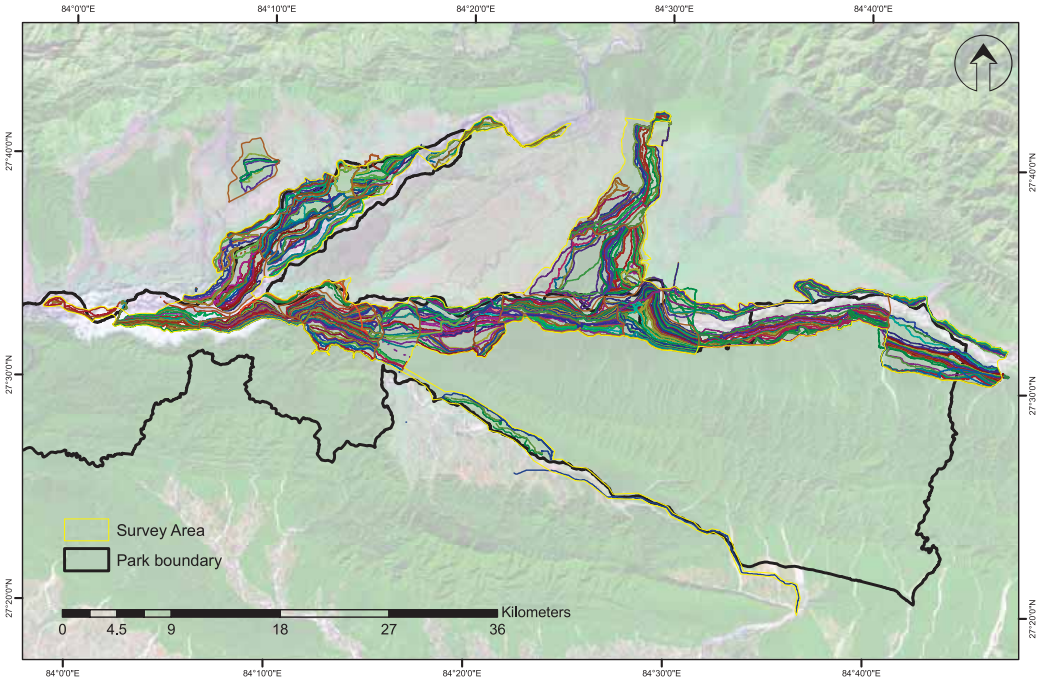


Figure 30 : Survey tracks - Chitwan National Park

Table 8: Search effort - Chitwan National Park

Date	Day	Block surveyed	Start time	End time	Number of elephants used	Survey time (hours)	Total effort (elephant hours)	Area surveyed (sq. km.)
8/3/2008	1	1	9.00	15.30	34	6.5	221	46.36
9/3/2008	2	2	7.30	17.30	41	10	410	59.95
10/3/2008	3	Rest day						
11/3/2008	4	3	8.00	12.30	40	4.5	180	36.17
12/3/2008	5	4	8.30	13.30	40	5	200	44.88
13/3/2008	6	5	8.30	14.30	37	6	222	23.40
14/3/2008	7	6	8.00	15.30	37	7.5	277.5	24.49
15/3/2008	8	7	8.00	13.00	34	5	170	29.22
16/3/2008	9	8	8.00	9.00	27	1	27	15.98
17/3/2008	10	9	9.00	18.00	28	9	252	27.73
18/3/2008	11	10	7.30	13.30	28	6	168	16.13
19/3/2008	12	11	7.30	13.00	24	5.5	132	17.27
20/3/2008	13	12	7.30	14.00	24	6.5	156	25.11
21/3/2008	14	13	8.00	13.30	24	5.5	132	36.34
22/3/2008	15	14	7.00	17.30	24	10.5	252	20.83
23/3/2008	16	15	6.00	13.00	32	7	224	18.41
19/3/2008 20/3/2008	12-13	16 (Madi)	7.00	13.00	7	12	84	27.92
Total							**3,107.5**	**470.20**

4.2.2. Rhino status and distribution

The size of the rhino population in Chitwan NP was found to be 408 animals (Table 9, Figure 31). Adult female-male sex ratio of sexed rhinos in Chitwan NP was 1.34 (n=199) whereas adult female to calf ratio was 1.98 (n=159 - assuming the sex of "unsexed" adult individuals to be in the same ratio of "sexed" adult individuals).

Table 9 : Rhino population status - Chitwan National Park

Sex	Adult	Sub-adult	Calf	Total
Male	85	8	7	100
Female	114	9	8	131
Unknown	78	34	65	177
Total	277	51	80	408

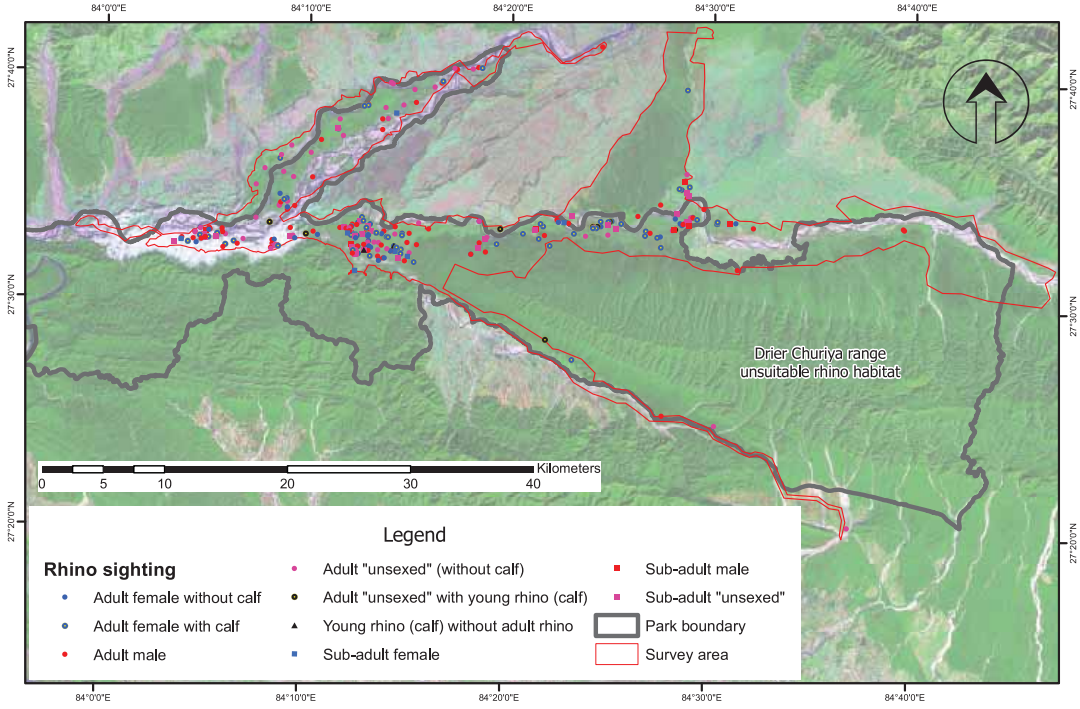


Figure 31: Rhino distribution - Chitwan National Park

Approximately 61% of total 'sexed adult females' (114) were with calves (Table 10). Block 9 had the highest number of rhinos (32.8%) as a result of the prime rhino flood-plain grassland habitat created by Rapti and Reu rivers in their confluence.

Table 10: Rhino population group composition - Chitwan National Park

Group composition	Blocks																Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Adult female with calf		4	1	2	3	14	4		26	2	6	2	2	1	2	1	70
Adult "unsexed" with young rhino (calf)					1	3	1			1		1				1	8
Adult female without calf		1		1	4	4	2		21	3	5	3					44
Adult male		5	2	2	5	4	5	1	26	6	12	4	4	4	4	1	85
Adult "unsexed" (without calf)		1		1	4	5	5		13	6	6	11	2	5	9	2	70
Sub-adult female		1				1			5		1		1				9
Sub-adult male		1		1	2		1		2		1						8
Sub-adult "unsexed"				2	5	3	4		13	2	4			1			34
Calf with adult female		4	1	2	3	14	4		26	2	6	2	2	1	2	1	70
Young rhino (calf) with unsexed adult rhino					1	3	1			1		1				1	8
Young rhino (calf) without adult rhino									2								2
Total	**0**	**17**	**4**	**11**	**28**	**51**	**27**	**1**	**134**	**23**	**41**	**24**	**11**	**12**	**17**	**7**	**408**

Tall grassland was the most preferred habitat in Chitwan followed by riverine forest (Table 11). Nearly 73% of total rhinos were recorded in tall grasslands and riverine forests.

Table 11: Rhino distribution by habitat type - Chitwan National Park

Habitat Type	Blocks																Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Tall grassland		7		1	14	31			65	20	20	2					160
Riverine forest		9		10	7	16	11	1	20	1	14	16	4	11	15	2	137
Wetland						3	2		19	1	3	2	3	1			34
Short grassland		1			5		1		17		3	2	1				30
Sal forest			2				12		4								18
Shrubland					2												2
Not specified			*2*			*1*	*1*		*9*	*1*	*1*	*2*	*3*		*2*	*5*	*27*
Grand Total	**0**	**17**	**4**	**11**	**28**	**51**	**27**	**1**	**134**	**23**	**41**	**24**	**11**	**12**	**17**	**7**	**408**

4.2.3. *Mikania Micrantha* abundance and distribution

Mikania micrantha data was collected from 3009 locations (Figure 32). Approximately 44% of the assessed areas (plots) were infested with *M. micrantha*. Heavy infestation was recorded in 15% of the plots (Figure 33).

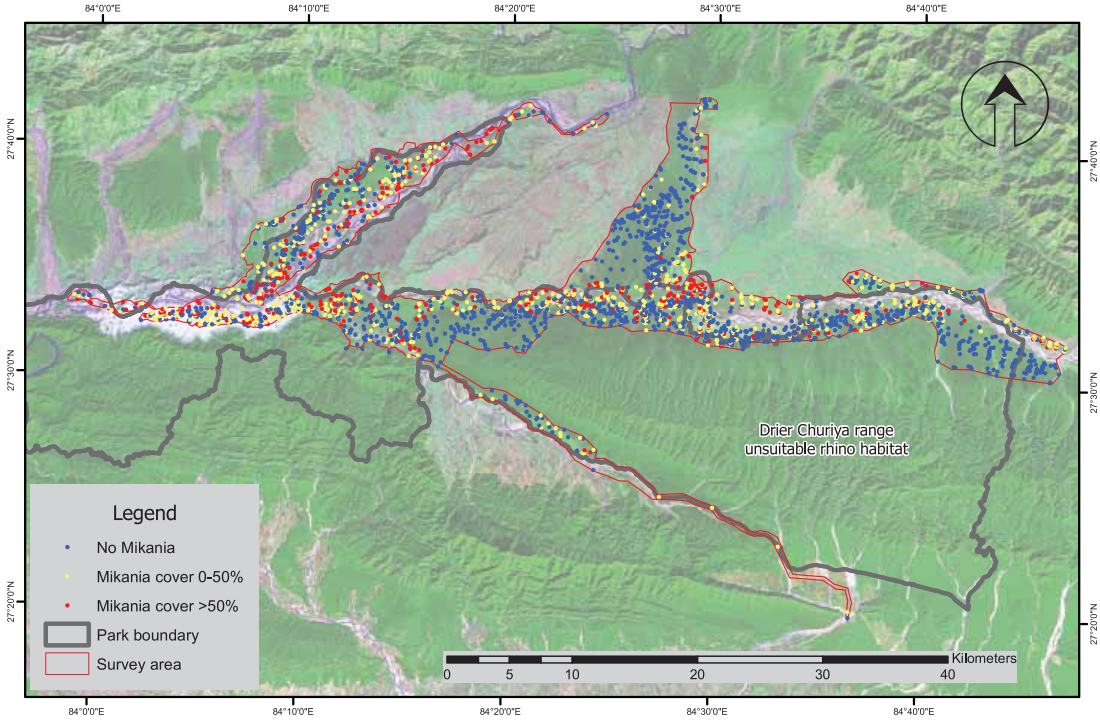


Figure 32: *Mikania micrantha* distribution and abundance - Chitwan National Park

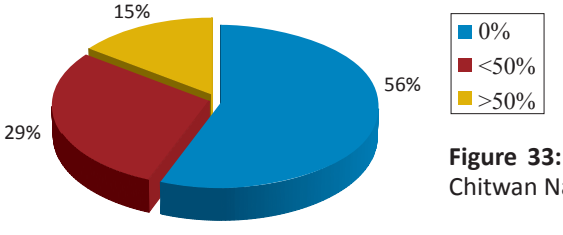


Figure 33: *Mikania Micrantha* abundance in rhino habitats - Chitwan National Park

Riverine and sub-tropical mixed hardwood forests were found to be most invaded by *M. micrantha* (63.1% of plots invaded, 24.2% of the plots highly invaded). Other habitat types in descending order of invasion magnitude were: wetland, tall grassland, short grassland and Sal forest (Table 12). Approximately 73% of the total rhinos recorded were sighted in tall grasslands and riverine forests (Table 11). These prime rhino areas also have the most *M. micrantha* infestation (38% and 63.1% of the plots invaded).

Table 12: *Mikania micrantha* infestation by habitat type - Chitwan National Park

Habitat Types	*Mikania Micrantha* cover			% Invaded
	0 %	<50 %	>50 %	
Riverine forest/sub-tropical mixed hardwood	36.9	38.9	24.2	63.1
Wetland	58.3	33.4	8.3	41.7
Tall grassland	62.0	28.1	9.9	38.0
Short grassland	64.9	29.9	5.2	35.1
Sal forest	87.6	10.4	2.0	12.4

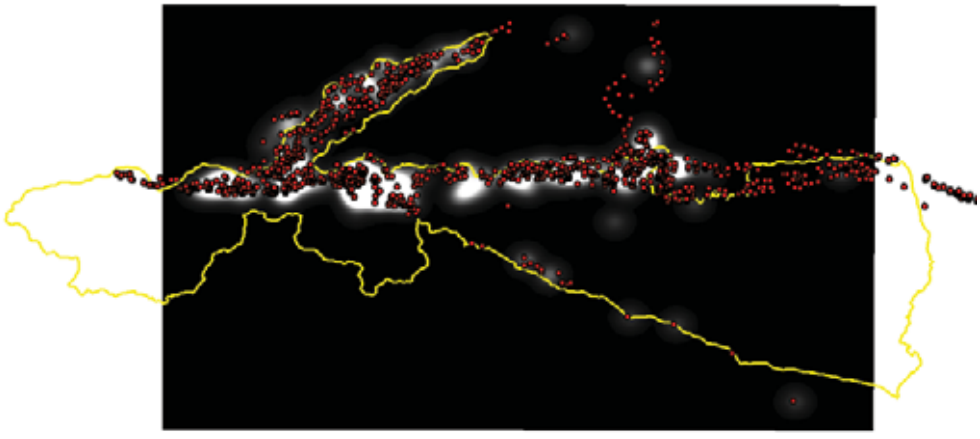


Figure 34: *Mikania micrantha* infestation superimposed on rhino density map - Chitwan National Park (increasing brightness = higher rhino densities)

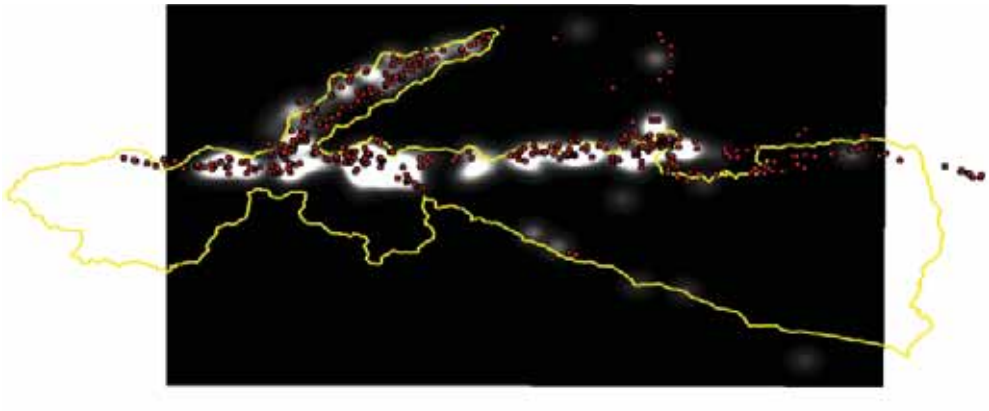


Figure 35: High *Mikania micrantha* infestation superimposed on rhino density map - Chitwan National Park (increasing brightness = higher rhino densities)

5. Discussion and Recommendations

The 2008 national census estimated a rhino population (*in situ* and *ex situ*) of 437 in Nepal (Chitwan NP – 408, Bardia NP – 22 including one captive orphan rhino, Shuklaphanta WR – 5 and Central Zoo – 2) with an *in situ* population of 434 animals. This was based on an improved standardised block survey system which will allow direct comparison of future census data. Key elements of the system include:

- well trained census team (staff trained in survey techniques and rhino observation and accurate data recording);
- appropriate field tools and equipment (GPS receiver for each elephant observer team, radio handsets, well designed field data recording forms, GIS and GPS-to-computer data downloading software, topographical and land-cover paper and digital maps, paper "laminated" hand maps, digital cameras and binoculars);
- validation of data at the end of each census day;
- clear briefing sessions at the start of each census day;
- daily data analysis and debriefing sessions at the end of each census day;
- properly designed blocks with sufficient elephants to maintain the determined inter elephant distances in the different habitats;
- well coordinated survey & logistics teams.

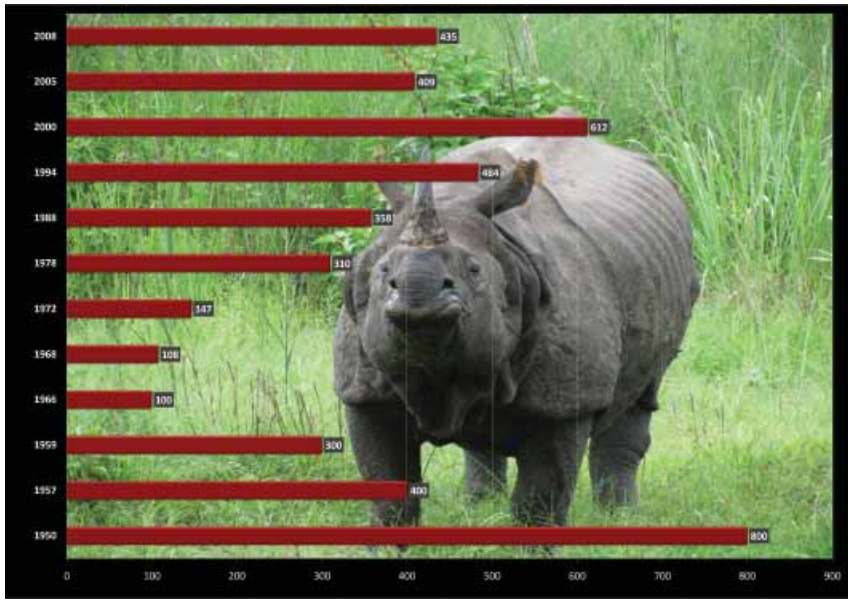


Figure 36 : National rhino population status

The equipment procured, maps produced, survey blocks designed and GPS track data generated during this census will serve as valuable items and reference materials for planning future census/monitoring operations.

The trend in rhino numbers is shown in Figure 36. Specific conclusions and recommendations are provided below for each of the three rhino populations.

5.1 Bardia National Park

Rhinos were reintroduced into Bardia NP between 1986 and 2003 with 13 rhinos released in the Karnali floodplain and 70 rhinos in Babai valley. An intensive monitoring survey in May 2007 found only 30 rhinos in Karnali floodplain with no rhinos found in the Babai valley. The 2008 census revealed only 21 individuals in the Karnali floodplain. The two day rapid survey of Babai valley resulted in no direct or indirect rhino sightings. This confirmed the report drawn by the status monitoring exercise in May 2007 that there were no rhinos remaining in the Babai valley.

Authorities in Katarniaghat WS, India reported the presence of rhinos in the floodplain of the sanctuary at the time the census was launched in Bardia NP. Ideally this area should have been surveyed at the same time as a narrow strip of forest corridor (about 13 km) along the Geruwa River connects Bardia NP with Katarniaghat WS and allows movement of a range of wildlife species, particularly rhinos, elephants and tigers between these two protected areas.

There have been four recorded deaths of rhinos since May 2007; 3 adults (clean animals) and an approximately one month old calf. The details are provided in Table 13.

Table 13: Rhino mortality recorded - post May 2007

Rhino ID	Carcass sighting date	Approximate age of carcass	Age	Sex	Cause of death	Comment
-	05-11-07	3 weeks	Adult	Unknown	Poaching	
-	22-11-07	3 weeks	Adult	Unknown	Unknown	
-	19-12-07	2 days	Calf	Female	Poaching	
-	25-02-08	4 hours	Adult	Female	Injury	Got stuck in Karnali river, broke a fore leg and died two days after being freed

This indicates that 7 rhinos from the May 2007 population of 31 rhinos are currently unaccounted. Possible reasons for this are:

1) Poaching/natural deaths – however no carcasses were detected both during the sweep and also during regular block monitoring (operational since August 2007) but carcasses can be scavenged and removed in a relatively short period of time.

2) Severe monsoon flooding of the Karnali river in July/August 2007 may have washed away some of the animals. Four rhinos were reported to have been washed away during the monsoon floods of 2006 (NTNC pers. com.).

3) Some of the animals have moved across the border into India. It is known that there is a regular movement of certain rhinos between India and Nepal; during this census animals were recorded in the corridor forest. The Indian authorities have also verbally indicated the presence of rhinos on their side. This suggests that several animals may have moved into the Indian Territory during the census thus resulting in the lower number sighted in the Nepal side.

The absence of rhinos in Babai valley is due to poaching during the armed conflict. Security in the Babai valley collapsed from 2002 after the withdrawal of Guthi, Parewaodar, Kalinara, Danavtal and Asneri security (Nepal army) posts. Similarly, park posts were also closed down. The resulting security vacuum in the valley allowed poachers to overtly carry out poaching of rhino and other wildlife species. Carcasses of dead rhinos of all age groups were observed during the 2007 sweeping operation. Since the 2000 census, a total of 16 rhinos were reported poached in Babai valley and 5 in Karnali floodplain. No effective patrolling was possible between 2004 and 2006.

In the year 2007-2008 alone, the Bardia NP population has declined by over 30 percent from 31 to 21 animals and at this rate will be lost or become non-viable very soon. Fortunately since improved monitoring and the capture of a gang of poachers in May 2008 no further cases have been reported. The sex ratio of the remaining known adults is favourable to growth (close to two females to an adult male) but six out the 15 adult animals remain unsexed so the ratio could be significantly different. The known adult female to calf ratio also indicates good recruitment. There is an urgent need to identify the rest of the animals, update ID master files and monitor the remaining animals intensively on both sides of the border. This will not only help secure the population but also the on-going monitoring data will assist in the estimation of important population performance indicators (including population size) for management purposes. The setup of dedicated well trained and armed anti-poaching unit operating both inside and outside the park will be essential.

5.2 Chitwan National Park

Rhino numbers in Chitwan NP increased from 100 animals in the 1960s to 544 in 2000 allowing establishment of founder groups in Bardia NP and Shuklaphanta WR (83 and 4 rhinos were translocated between 1986 and 2003 to Bardia NP and Shuklaphanta WR respectively). However, there has been a significant decline since then to around 400 by 2005. This number is more or less static suggesting any growth is being depressed by ongoing poaching pressure. There is very good potential for growth of this population. The known adult male-female sex ratio is biased towards

females. There is also good recruitment with adult female to calf ratio close to 2. As in the case of Bardia NP, the implementation of a regular block monitoring and reporting system with a newly constituted, integrated (Park, Army and scientific staff), professionally trained dedicated and armed APU is necessary to effectively control poaching.

In addition to poaching the biggest and an increasing threat facing the population is *M. micrantha* which is now extensively spread across potential rhino habitats in the park and the buffer zone. About 50 percent of potential rhino areas are now affected by the principal invasive species with primary rhino habitats (riverine forests and tall grasslands - where approximately 73% or 297 of the rhinos were sighted) found to be most affected. The potential for the invasive alien plant to destroy prime rhino habitat is very significant. Visual interpretation indicates a correlation between rhino density and distribution and abundance of *M. micrantha* infestation. The Sukhibhar area has one of the highest density of Greater One-Horned rhino (about a third of the Chitwan's rhino population) and weed infestation is observed to be increasing in this prime rhino habitat. Failure to control this invasive species is likely to significantly reduce the rhino and other herbivore carrying capacity of this prime area in the next few years. Data from regular monitoring in the Baghmara buffer zone community forest is indicating the negative impact where over 30 rhinos used to regularly be seen ten years ago but now less than 15 animals are known to utilise the area. The most immediate impact of this invasion on rhino is pressure for the animals to leave the park in search of available food, in the adjacent buffer zones and farming land. Analysis of poaching incidence by location shows that a higher proportion of animals were poached outside the protected area by a factor of nearly 10 times compared to those killed within (Bradley-Martin 2009). The weed is also affecting ungulate populations.

5.3 Shuklaphanta Wildlife Reserve

Shuklaphanta WR rhino population was started in 2003 with the translocation of 4 animals from Chitwan NP to add to the one resident rhino which was first sighted and reported in 1995 (Upadhyaya, pers. com.). No further translocations have taken place and the existing population is non-viable (genetically and demographically - the IUCN suggests a minimum of 20 founder animals for a viable population). The existing adult male is now considered to be non-breeding due to its advanced age. Additional supplementation of the population is urgently needed but only after careful assessment of the field situation. The Shuklaphanta WR population is under constant threat; a rhino was suspected poached in January 2008 with 4 poachers subsequently caught with rhino body parts and prosecuted. The animals move large distances including into India (into both agricultural and forest areas) making monitoring of these animals very difficult. Human wildlife conflict is an issue on both sides of the border; one Indian citizen was killed in March 2008. The park has insufficient resources to effectively monitor the animals. The army is not in a position to provide adequate security in all areas as they lack guard posts in critical locations. Most of the guard posts were destroyed during the armed conflict that ended recently. There is substantial pressure from livestock and illegal human encroachment and settlement, and illegal timber extraction is taking place in the south eastern part of the reserve. Ultimately, a sanctuary/intensive protection zone may be the only effective solution

to secure and supplement the population with additional rhinos, and keep the animals within close breeding contact (this is in fact gradually happening in Bardia NP with the on-going fencing projects for HWC mitigation in the Karnali flood-plain).

5.4 Recommendations

1) Establishment of regular intensive block monitoring

Reliance on sporadic and relatively expensive total counts using vast human and elephant resource was in part to blame for the slow reaction to the decline in rhino in Nepal between 2000 and 2005. More regular information officially reported would have stimulated timely action. In small populations of Bardia NP and Shuklaphanta WR and small sub-populations in Chitwan NP it is essential to setup a standardized programme of routine patrols based on individual rhino based monitoring. This will serve as a security and rhino audit function with a check that none of the rhinos are missing because of illegal off-takes or other demographic impacts. The rhino monitoring staff should regularly identify each and every rhino in such populations. The presence of monitoring staff on patrol on a daily basis plus the knowledge that the population is being kept under close demographic surveillance, so that any poaching will be detected, serves to deter would-be poachers including corrupt elements within that area's protection/management force. The regular audit will also mean that a total census operation is not required. With any large census and as seen in this census, there is chance that a small number of rhinos will not be detected. This is not a problem in a large population as the estimate is within +- a few percent. However in a small population this can be a problem and ideally every animal should be accounted for.

Another major reason for routine rhino monitoring is because the adaptive management that is required to maximize metapopulation growth rates for rhinos is not possible without reasonably accurate annual population estimates, measures of demographic performance, and information on mortality patterns, behaviour and translocations. Rhino sighting and law enforcement data can guide patrol deployment and increase protection as well as provide measures to assess performance either through providing a complete record of the population on an ongoing basis, or by allowing accurate estimates of population size, performance and structure by incorporating mark-recapture procedures.

2) Establishment of an integrated standardized monitoring and reporting system

An integrated standardised monitoring and reporting system will provide the necessary information for effective protection and management of the rhino and their habitat. Such a system will require properly skilled and motivated staff, a system of control on data quality at observer and data recording level, and the support of the country's conservation management structures.

Rhino monitoring training

A formalized training programme for personnel can greatly accelerate the process of acquiring high standards of observational and data-collection skills. Under the DNPWC-NTNC-ZSL Darwin Initiative project, an initial group of 12 park staff from the 3 rhino areas were trained as accredited

rhino monitoring instructors (based on the AsRSG accredited course, R Amin 2008). A significant advantage of this approach is that monitoring staff can be trained where they are located by the trained instructors, thus saving time and money and minimizing daily operational impact on the field teams. In addition, with continuous teaching of the modules it is possible to maintain consistency as well as deal with the inevitable staff turnover. It is the responsibility of these instructors to ensure that all the rhino monitoring field staff in the 3 areas are properly trained and tested. The training needs to be undertaken on a regular basis to ensure that the monitoring standards are maintained at a high level and that, new staff is also adequately trained quickly. Regular auditing in the field and providing support will ensure that staff are being adequately trained and evaluated. It is important to recognise and retain trained staff (including informally-acquired tracking skills).

Population master files

The monitoring of Bardia and Shuklaphanta rhino populations has allowed the development of accurate and up-to-date master files for these populations, containing details of potential identifying features such as horn shape, ear tears, skin folds, deformities, body scars, tail shape etc. The ID files are used to quality control rhino sighting data recorded in field sighting forms and correctly classify the sightings into a) first class ID sighting with ID number assigned; b) first class clean sighting and c) incomplete sighting. The files will also help to capture and transfer the knowledge/skills of the highly experienced key observers which otherwise would be lost during transfers or retirements. The photographic sequences kept in the files will enable changes in the animals to be tracked over time and allow development of guidelines on horn and body size appearance with rhino age thus improving the accuracy of ageing of animals in future. The aim in small populations (or sub-populations) is for every individual rhino to be given a unique identifier (ID) for life to enable population performance data to be derived (e.g. inter-calving intervals for each cow). Rhinos that do not have known features by which they are identifiable are known as “clean” animals.

Filling field sighting forms and data quality control process

The process of completing and validating field data recording forms should be implemented in all rhino areas (this process has been initiated in Bardia NP and Shuklaphanta WR) to ensure that the data are collected on an on-going basis and are of the best possible quality for it to be useful. Trained rhino monitoring instructors should ensure that the monitoring staff are adequately trained to approach and observe rhinos, and accurately complete the standardized sighting forms. The use of high resolution (8-10x optical zoom) digital cameras will make it much easier for rhino monitors and other staff to reliably record sightings of rhinos. This information should then be checked on a regular basis by experienced accredited observers and the sightings classified in accordance with the ID master files, which are continually updated by the field officers.

It is important that field monitoring staff also give equal importance in collecting information on clean animals – not just ID individuals. The validation of rhino sightings is an important part of this process to ensure all staff are correctly identifying animals with subtle ID features and not basing their decisions on unreliable features such as territory and behaviour. This can be amplified with high staff turn over and the loss of vital knowledge of experienced observers. This can be problematic as

there is a risk of inflating reserve totals with duplicate "clean" rhinos which have been given different names. On-going training, accurate filling of sighting forms and the use of up-to-date ID master files for validation is very important. Having clearly identifiable rhinos (e.g. through ear notching) particularly in small population (or sub-populations) will make monitoring easier, more transparent, and in the long run will allow quality information to be maintained for decision making. This will also boost interest and motivate rhino monitoring staff.

Computerised GIS databases

Once rhinos are individually identifiable, their details should be maintained in population databases which assist greatly in ensuring that information can be derived to meet the needs both at park and national (metapopulation management) level. This is particularly the case for Bardia NP and Chitwan NP (populations of 20 or more rhinos). The DNPWC-NTNC-ZSL project has developed a customised GIS based wildlife monitoring database which should be implemented fully. This database will contain key information and dates for individual rhinos (dates of births, calving records, details of ID features, mortalities, translocations) as well as all their sightings records plus information on patrol movements and sightings of illegal activities. The database program is then be able to interrogate the data and produce reports and answers to frequently asked questions.

Monitoring rhinos through radio-tracking

Modern radio-tracking technology provides good potential to facilitate rhino monitoring. VHF radio transmitter neck collars have been used to monitor translocated rhinos. GPS UHF downloadable and satellite collars are now available enabling position data to be collected at programmed interval. However, these are considerably more expensive.

The transmitters can also include mortality sensors that change the frequency of the signal after a predetermined period of immobility.

The radio-tracking technology can be cost effective in certain situations such as:

- where there is active poaching activity;
- where post-release monitoring of translocated rhinos is required, particularly where it is difficult to monitor the rhinos through other means until they settle down;
- where there is insufficient monitoring capacity to ensure regular sightings through recognition of identity features (however, if radio-tracking is relied upon in such situations, care must be taken not to develop over-reliance and complacency on the part of the monitors who may tend towards cursory confirmation of signals rather than visual checks).

Transponders are often confused with radio transmitters but are a different technology, being based on the activation of an implanted microchip by an external device (equivalent to a bar-code reader). These microchips are very useful for very short range confirmation of the identities of rhinos or horns, and should be routinely embedded when rhinos are immobilized for whatever reason. Hopefully, this technology will improve to the point that it does assist with longer-range monitoring.

Mark-recapture population estimation

The use of mark-recapture methods could provide population estimates (with confidence intervals) in Chitwan NP (where not all animals are individually identifiable i.e. where a significant number of rhinos are "clean" and where known rhinos are not all seen within a year). The Bayesian Mark-Recapture population estimation software, RHINO (Emslie and Amin 2001) can be used for this purpose provided:

- rhino sightings have been collected throughout a population (or sub-population) over a period of time, and
- equal attention has been paid to monitoring both identifiable and "clean" rhinos, and
- there are enough sightings of adults and independent sub-adult rhinos (ideally with the number of sightings being at least double the estimated total number of rhinos in these age classes).

RHINO is designed for use in populations where not all animals are individually identifiable and where monitoring data are collected primarily by anti-poaching patrols and other staff on an ongoing ad-hoc basis, rather than by specialised teams of rhino monitors (i.e. periodic census). Additional knowledge that might be derived (about known deaths, introductions and removals in a population and where known calves have become independent of their mothers) is incorporated into the estimation process, which deals with some violations of classical mark-recapture assumptions. Population estimates with confidence levels can be produced at both a whole park and sub-park area level.

If Chitwan NP population is to be monitored less intensively then sightings data will not be accumulated on the regular basis that is required to run the RHINO program. In these situations, provided a significant proportion of the population has recordable distinguishing features, then periodic discrete surveys ("audits") of a rhino sub-population can be used to generate population estimates, using other (and sometimes more basic) methods of mark-recapture population estimation. Such estimates may have a lower degree of accuracy and precision than those that would be derived through the more continuous monitoring but will nonetheless be useful. This use of periodic ground surveys may be relevant where there are insufficient trained staff (in rhino identification) available to accumulate sufficient, reliable sightings data and specialist rhino monitors have to be brought in from other areas to conduct the surveys.

Standardised reporting and demographic analyses

Monthly park progress reports on rhino security, monitoring and community engagement will be very useful. A template has been developed which includes a monthly rhino sighting chart and patrol, illegal activity and animal sighting intensity maps. This is proving to be very valuable for planning monitoring patrols and anti-poaching activities. Most of the elements of the standard report should be generated automatically from the GIS wildlife database system.

Annual reporting on the status of individual rhino populations using a standardised format, and evaluation of the results obtained collectively from one or more country, are fundamental means of meeting the requirements for monitoring and adaptive management. Park and National status reporting is a key component of implementing the conservation strategy. To promote optimal metapopulation performance it is necessary to look at the age and sex composition, calving rates of females, and causes and rates of mortality within each population. Reasons for suboptimal performance can then be determined and solutions put in place.

A formal park and national-status reporting programme should be implemented. Park managers and scientists should be trained to analyse population performance data, preparation of parks status reports and synthesis of the national status reports. The park-level status reports should supply information on population size, age and sex structure, translocations and mortalities (including causes), as well as a number of standardized biological performance indicators (age at first calving, percentage females calving, proportion of adult females with calves, intervals between calving, mortality rates and net population growth rates). The individual park reports should then be synthesised and analysed at a national level. The resultant national report interprets and contrasts the status, performance and population dynamics of all greater one-horned rhino populations in Nepal (and perhaps regionally). The feedback from the national-status summary report is vital to programme managers and staff because it places the results of individual-reserve reports into a metapopulation context. Without regular park-level status reporting and the production of interpreted national status report summaries, a problem may also remain undetected far longer.

The individual park status reports could include the following sections.

- Population size and structure (Sex and age);
- Female breeding performance;
- Mortalities;
- Introductions;
- Translocations (removals);
- Territories/home-ranges and behavioural observations;
- Security;
- Habitat, ecological and social carrying capacity;
- Community programmes;
- Research;
- Reports and publications;

A number of key indicators are used to determine population performance and to understand the underlying factors involved in populations performing below or above the national target or internationally-accepted minimum annual underlying growth rate. Due to variable calving rates from year to year (in part a function of birth lags) population estimates are normally analysed over longer periods of three or preferably five years when estimating overall growth rates. The following demographic indicators could be used (following a review) both at national and regional (AsRSG) level.

Park and National status reporting is a key component of implementing the conservation strategy. To promote optimal metapopulation performance it is necessary to look at the age and sex composition, calving rates of females, and causes and rates of mortality within each population. Reasons for suboptimal performance can then be determined and solutions put in place.

i) **Overall annual population growth rates :** The calculation of growth rates must exclude translocations in or out. Managers of any populations performing at or below the minimum target level will need to look closely at the various performance indicators (as given below) for their populations to try to understand the reasons for their poor performance. In small populations, percentage growth rates are less meaningful as a change in population size of just one rhino may have a big influence on the estimated growth rate. Underlying growth rates are not independent of sex ratio and for populations with a greater proportion of females growth rates should be higher. There are methods for correcting growth rate estimates for differences in sex ratio, and it is often important to do so in order to achieve a more objective assessment of underlying performance in response to habitat and other environmental and population density factors. Being equivalent to compound interest rather than simple interest, the annual population growth rate that is calculated for a population over a period of several years needs to be based on the correct formula, which it often is not (leading to inflated estimates).

ii) **Adult sex ratio :** This has been noted to have considerable influence on the rates of increase of rhino populations. Populations with close to two females to an adult male, in "good habitat" should have a good population growth rate, indicative of social constraints placed upon the population with sex ratios close to parity.

iii) **Observed inter-calving intervals (ICIs) :** The average period between giving birth provides one of the best indicators of population performance. This measure is also largely independent of sex ratio. The measure is determined by observing the calving frequency of known females and averaging these values. In some cases the actual inter-calving interval may be overestimated if a calf has been born and died and this was not detected; the indicator must be based on surviving calves.

iv) **Average percentage of adult females calving per year :** This is a similar measure of performance to ICI. The main difference between average observed ICI and the percentage of females with calves under one year is that the latter measure includes those females that have not calved. A value of 50 % is approximately equivalent to an inter-calving interval of 2 years, 33 % to 3 years and 25 % to 4 years. The average percentage of females calving per year should exceed 33%. A similar measure is to add up the number of calves born over a period and express this as a ratio compared to the number of adult female years for the same period. This value can then be converted to give an estimate of the percentage of adult females with calves born per year.

v) **Average age at first calving :** This is another useful indicator of breeding performance which can be used where the rhinos are individually known and frequently sighted. Females in rapidly growing populations may have their first calves as young as 6.5 years but in populations with poor performance age at first calving may lengthen to over 7.5 years.

vi) **Proportion of calves in the population :** This indicator is useful in single population samples and could be used in large, infrequently monitored populations. It helps to track recruitment and is a true reflection of population structure to help interpret other parameters. However, it could require lumping of data that would obscure sub-population variability. It is difficult to use in small or sex-biased populations.

vii) **Annual mortality rates :** Very intensive monitoring is required to detect mortalities; in reality it is often very difficult to detect all calf mortalities, especially in large populations. However, the average annual mortality rate measured over a number of years is a good indicator. Early carcass detection and detailed post-mortem examination is essential if the cause of death is to be determined. Ideally based on a long-term data set, these records can provide very valuable insight into the causes of under-performance. The extent of mortalities due to poaching, inter-specific aggression and poor condition related to habitat conditions are particularly important to establish.

3) Establishment of dedicated armed and well trained law-enforcement & anti-poaching unit

The protection of rhino populations from poaching is critical to successful conservation of rhinos in Nepal. To date, despite international rhino horn trade bans under CITES for nearly thirty years, only those populations that have been effectively protected have maintained or increased their population size. Field protection, and especially measures that increase the probability of detecting poachers before they kill, are critical.

There is therefore an urgent need to strengthen law-enforcement and security in the 3 protected areas through the deployment of a permanent complement of well-led, adequately supplied and strongly motivated armed anti-poaching unit based at the park in order to conduct active patrolling both inside and around the protected areas. Under this approach, the rhino areas would be treated as Intensive Rhino Protection Zones where law enforcement staff is deployed at a moderate to high density (ideally two field staff team at approximately 5-10 km^2) specifically to protect rhino. The key principle behind the IPZ is the concentration of anti-poaching effort in specific areas rather than spreading available resources inadequately over huge areas.

The APU should conduct daily patrols and also undertake special operations such as night surveillance at the most sensitive rhino areas. River patrols should be undertaken using the recently provided outboard engine boats for rapid reaction. Trained staff by professional boat handlers in the operation and maintenance of the boats will be essential.

Law enforcement staff will always perform best when well trained and well motivated. Motivation and commitment can be enhanced by keeping staff informed about recent developments and successes in law enforcement, and explaining how their job fits into the wider international picture of combating poachers and traffickers. The training should cover weapons handling and maintenance; anti-poaching, tracking and monitoring procedures; use of equipment such as GPS, binoculars, cameras and communication equipment; use of field data recording booklet with additional training on basic rhino biology, ageing, sexing and identification features. The development of a comprehensive anti-poaching training manual, relevant to the conditions and situations APU staff

are likely to encounter, should be developed; the rhino monitoring instructors manual has already been produced. The training material should be modular and a team of on-site instructors (minimum of 5 instructors) should be trained who can then train their staff on-site on a regular basis. Training in scene-of-the-crime-investigation should also be undertaken. If emergency reaction plans are well rehearsed (e.g. on discovering an animal has been poached or finding poachers in the area), there is a good chance that poachers will be apprehended and successfully convicted.

Law enforcement staff must be provided with adequate equipment, transport and base accommodation. They form the vital last line of defense and would often risk their lives protecting rhino and other wildlife. It is imperative that they should receive due recognition for the role they perform. Any decline in security patrolling through lack of funds or low morale can provide the opportunity poachers are looking for, and has the potential to undermine further rhino protection efforts.

4) Monitoring law enforcement

It is important to be able to assess the effectiveness of law enforcement programmes. By recording information on:

(i) the number of hours spent on patrols,

(ii) the areas covered,

(iii) the carcasses found,

(iv) the animal sightings,

(v) the illegal activities,

It is possible to identify strengths and weaknesses in the enforcement effort through mapping and modify strategies accordingly. Field monitoring and anti-poaching staff on patrols should regularly log their position and sightings of animals and illegal activities using a GPS receiver. These should then be entered in to the wildlife database monitoring system and plotted on the park GIS map. Indices of patrol effort, illegal activities and animal abundances can also be calculated.

Such a well-planned and supervised patrolling system is already being developed and is in the final stages of completion and will be critical for the most effective deployment of staff and resources.

5) Developing and operating intelligence networks

Experience has shown that intelligence networks are an economical way of preventing poaching and apprehending rhino offenders. Useful information enables the park authorities to be proactive. People intent on illegally obtaining rhino horn often try to extract information from park staff about security, numbers and whereabouts of rhino. Staff should be warned of this, and rewarded for informing park authorities of such attempts. The existing intelligence system should be reviewed and enhanced where needed.

6) Equipment and support

All field patrol staff should be equipped with the necessary monitoring equipment. This includes communication equipment, GPS receiver, binoculars, digital cameras, data recording forms, maps and

accessories such as spare batteries, pens etc. Patrol teams should also be provided with necessary transport (e.g. rubber boats) and camping equipment to conduct effective patrol and surveillance.

7) Effective control of *Mikania micrantha* and other invasive alien plant species

An effective management programme for *M. micrantha*, incorporated into the Chitwan NP protected area management strategy, is urgently required. The extent of invasion is now so great that total eradication is not feasible. There are also other harmful alien plants such as *Lantana camara* and *Chromolaena odorata* which need to be tackled even if not yet as abundant, to nip them in the bud and save future massive problems and expense. To address the issues, a management plan needs to developed that will address immediate and longer term conservation priorities and thus an understanding of these priorities is crucial for a sound plan. In this context the management plan needs to be built on a good understanding of which habitats are being invaded, what the impacts are and an understanding of the key factors driving the invasions. On this basis, suitable and locally appropriate interventions can be developed and validated with inputs from expert agencies. Where needed, research should be carried out on control methods. Local community could benefit from clearing these invasive species in selected areas.

There are several approaches for invasive alien plant species control that could be exploited in a management plan: monitoring and mapping, awareness raising, cultural control, mechanical/ manual control, chemical control and biological control. Monitoring is crucial as is awareness raising; many local communities and resource managers are unaware of invasive species issues. Invasive species are frequently exacerbated by human mediated factors and thus spread can be partly addressed by an understanding of these factors and by the development of cultural controls. It is very difficult to mechanically or manually control *M. micrantha* on a wide area basis as each node on a stem can produce a new plant when in contact with soil. More general slash and burn attempts in India found these to actually escalate the problem as pieces of the plant fell in new areas or it was dumped in new areas and spread. But nonetheless, more locally focus efforts using mechanical control against invasive plants can produce good results. For chemical control, the use of herbicides such as glycophosate is complicated by the risk of contamination of the host plants and impact on biodiversity. Detailed trials on the use of herbicides will need to be carried out to quantify the impact on the weed and effects on biodiversity in natural systems. Large scale use of herbicides will not be possible in natural protected area systems. The most viable and sustained solution appears to be biological control (natural enemy of the weed). There are 43 fungal pathogens recorded from *M. micrantha*, the most promising biological control agents are 3 rust species from the neo sub-tropical native range of the weed (Ellison 2001). These rusts kill the leaf and the stem, affecting the whole plant. The highly selective rust fungus *Puccinia spegazinni* (which can only survive on this weed) is being implemented in India and China and lessons drawn from these countries will be valuable (Ellison and Murphy 2001, Sankaran *et al.* 2001). But biological control does take time to develop and implement.

In summary a management plan needs to be developed that will incorporate several types of control; these need researching to validate approaches. The plan needs to include controls that can be used in the short term in priority conservation areas and biological control that is more cost effective and sustainable but will take a longer time to develop.

8) Effective public engagement

A practical and effective mechanism for active involvement of buffer zone communities, politicians, hoteliers, nature guides, and community based organisations, such as Buffer Zone Management Committee (BZMC), Users Committees and youth groups etc. should be developed and implemented as soon as possible. Since BZMC is the apex body responsible to manage the buffer zone, plans and programs targeted to address local conservation issues, such as poaching, habitat encroachment, overgrazing and overexploitation of forest resources should be incorporated in Buffer Zone Management Plan and implemented effectively. Regular group discussion and interaction programs should be undertaken among members representing the various stakeholders. A close coordination should be maintained with Village Development Committee (VDC) to avoid duplication of the work, as VDCs even in the buffer zones work independently. Recently, legal provision to mobilise national army (deputed in Protected Areas) in the buffer zone area has been made and its command needs to be further expanded into areas beyond the Buffer Zone boundary to specifically counter poaching incidents jointly with park staffs.

Importantly, efforts should immediately be made to resolve wildlife-human conflict (crop damage, livestock depredation, property damage and injuries) with communities inhabiting areas adjacent to the Protected Areas. Recently, for example in BNP, power fences along border of cultivated fields, particularly rhino and elephant damage prone areas have been constructed. Solar backed power fences established across the majority of the VDCs in the Karnali flood plain have been effective in preventing rhinos, elephants and medium sized ungulates (Chital) from entering into the crop fields.

In addition, buffer zone communities have taken initiatives to introduce unpalatable cash crop species, such as Mentha. Mentha plants are processed to produce methanol used widely in allopathic medicines (Figure 37).

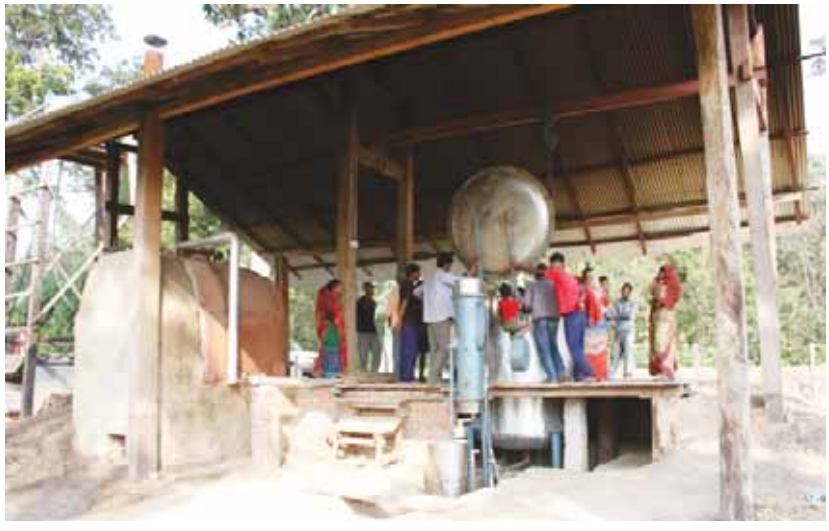


Figure 37: Mentha processing plant recently established at Bidrapuri, Bardia National Park Buffer Zone

Efforts should also be made to compensate the injury and loss of human life, and property/agriculture damage by wild animals, particularly rhinos and elephants. Provision (financial) should be made for immediate relief and long term support.

Conservation Education (CE) is one of the most effective tools to generate public support in wildlife conservation. CE programs among school children, farmers, women groups, should be launched/ continued to raise awareness on current rhino conservation issues (poaching, habitat degradation – invasive alien plant species, encroachment, livestock grazing within protected areas) and necessary actions among high level government officials, political parties and law makers. DNPWC in collaboration with conservation partners and community based organisations is launching CE programs in the buffer zones of Chitwan NP, Bardia NP and Shuklaphanta WR (Figure 38).

Figure 38: A conservation education field trip - Bardia National Park

Finally, novel methods of communicating through media; theatre and radio can have widespread and long-lasting impacts. Theatre was applied in the buffer zones, attracting large audiences and it is not perhaps surprising that after these intensive publicity efforts that community became actively engaged in anti-poaching (Figure 39). This led to the arrest of a large poaching gang in Bardia NP in May 2008. No poaching has been recorded since.

Figure 39: Community "Silence of Bardia" theatre play in Bardia National Park Buffer Zone

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Appendices

Appendix I : Bardia National Park - Detailed Sighting Events

Sighting No	Date	Time	Elephant No	GPS Easting	GPS Northing	Block / Area	Age	Sex	Body Condition	Habitat Type
07.01.05	3/1/2008	15:10	7	521542	3146374	Block 1 - Naya Belli	Adult	Female	Good	Riverine Forest
07.01.06	3/1/2008	15:10	7	521542	3146374	Block 1 - Naya Belli	Calf	Unknown	Good	Riverine Forest
03.01.01	3/1/2008	11:45	3	522668	3140684	Block 1 - Patthar Bhuji	Adult	Unknown	Not Assessed	Not Assessed
09.01.01	3/1/2008	10:50	9	522668	3140684	Block 1 - Patthar Bhuji	Adult	Unknown	Not Assessed	Not Assessed
09.01.02	3/1/2008	15:15	9	521542	3146374	Block 1 - Naya Belli	Adult	Unknown	Not Assessed	Riverine Forest
03.02.01	3/2/2008	8:05	3	521778	3147051	Patkanuwa	Adult	Male	Not Assessed	Riverine Forest
03.02.02	3/2/2008	8:40	3	521951	3147460	Patkanuwa	Adult	Female	Not Assessed	Riverine Forest
03.02.02	3/2/2008	8:40	3	521951	3147460	Patkanuwa	Calf	Unknown	Not Assessed	Riverine Forest
05.02.01	3/2/2008	8:38	5	521945	3146988	Hathi Machan	Adult	Female	Good	Riverine Forest
05.02.02	3/2/2008	8:38	5	521945	3146988	Hathi Machan	Calf	Unknown	Good	Riverine Forest
02.03.02	3/3/2008	9:43	2	523346	3154489	Gola Ghat	Adult	Female	Good	Wetland
02.03.03	3/3/2008	9:43	2	523346	3154489	Gola Ghat***	Calf	Unknown	Good	Wetland
04.03.01	3/3/2008	8:14	4	523618	3151798	Terrible Island	Adult	Unknown	Not Assessed	Riverine Forest
05.03.04	3/3/2008	10:25	5	523727	3154762	Gola Bandh, Block-3	Adult	Female	Not Assessed	Riverine Forest
05.03.03	3/3/2008	10:25	5	523727	3154762	Gola Bandh, Block-3	Calf	Unknown	Not Assessed	Riverine Forest
05.04.02	3/4/2008	8:58	5	524571	3157397	Bagh Tappu, Block 4	Adult	Unknown	Not Assessed	Riverine Forest
09.05.01	3/5/2008	14:10	9	525212	3159464	Laguna Machan west	Adult	Male	Not Assessed	Tall grassland
11.05.01	3/5/2008	14:15	11	525223	3159501	West of Laguna Machan	Adult	Male	Not Assessed	Tall grassland
03.06.01	3/6/2008	7:35	3	525945	3158587	East of Bagh tappu	Adult	Unknown	Not Assessed	Sal forest
10.06.01	3/6/2008	9:57	10	523331	3154172	Kaloban	Adult	Female	Not Assessed	Riverine Forest
10.06.01	3/6/2008	9:57	10	523331	3154172	Kaloban	Calf	Male	Not Assessed	Riverine Forest
						Orphan rhino at Park HQ	Sub-adult	Male	Not Assessed	Not Assessed

Appendix II : Chitwan National Park - Detailed Sighting Events

Sighting No	Date	Time	Elephant No	GPS Easting	GPS Northing	Block / Area	Age	Sex	Body Condition	Habitat Type
21.02.01	3/9/2008	9.15	21	564908	3049086	Khagendramalli/Back of CJL	Adult	Male	Good	Short grassland
15.02.01	3/9/2008	9.58	15	564830	3049170	Khagendramalli/ CJL	Adult	Male	Good	Riverine forest
30.02.01	3/9/2008	17.05	30	552615	3048981	Icharni island	Adult	Male	Good	Tall grassland
30.02.02	3/9/2008	17.15	30	549629	3049305	Icharni island	Adult	Female	Good	Riverine forest
30.02.02	3/9/2008	17.15	30	549629	3049305	Icharni island	Calf	Male	Good	Riverine forest
30.02.03	3/9/2008	17.19	30	549672	3049329	Icharni island	Adult	Female	Good	Riverine forest
30.02.03	3/9/2008	17.19	30	549672	3049329	Icharni island	Calf	Male	Good	Riverine forest
30.02.03	3/9/2008	17.19	30	549672	3049329	Icharni island	Subadult	Female	Good	Riverine forest
31.02.01	3/9/2008	15.27	31	549672	3049445	Icharni island	Adult	Unknown	Good	Tall grassland
31.02.03	3/9/2008	17.10	31	549672	3049445	Icharni island	Adult	Female	Good	Tall grassland
31.02.03	3/9/2008	17.10	31	549672	3049445	Icharni island	Calf	Unknown	Good	Tall grassland
31.02.04	3/9/2008	17.15	31	549672	3049445	Icharni island	Adult	Male	Good	Tall grassland
31.02.05	3/9/2008	17.15	31	549672	3049445	Icharni island	Adult	Female	Good	Tall grassland
31.02.05	3/9/2008	17.15	31	549672	3049445	Icharni island	Calf	Unknown	Good	Tall grassland
32.02.01	3/9/2008	16.40	32	550711	3049339	Icharni island	Subadult	Male	Medium	Riverine forest
33.02.01	3/9/2008	16.14	33	551184	3049352	Icharni island	Adult	Female	Good	Riverine forest
34.02.01	3/9/2008	16.20	34	-	-	Icharni island jungle	Adult	Male	Good	Riverine forest
15.04.01	3/11/2008	9.25	15	547011	3060101	Barandabar/north of highway	Adult	Female	Good	Sal forest
15.04.01	3/11/2008	9.25	15	547011	3060101	Barandabar/north of highway	Calf	Male	Good	Sal forest
DFO Record	-	-	-	-	-	Barandabar/north of highway	Adult	Male	Not Assessed	Not Assessed
DFO Record	-	-	-	-	-	Barandabar/north of highway	Adult	Male	Not Assessed	Not Assessed
21.05.01	3/12/2008	13.00	21	545013	3050735	Dabikhola (Khorshor)	Adult	Male	Avg - Good	Tall grassland
30.05.01	3/12/2008	11.00	30	546721	3052007	Baghmara bufferzone CF	Adult	Male	Avg - Good	Riverine forest
30.05.02	3/12/2008	11.00	30	546721	3052007	Baghmara bufferzone CF	Adult	Female	Avg - Good	Riverine forest
31.05.01	3/12/2008	10.55	31	546948	3052616	Baghmara bufferzone CF	Subadult	Male	Avg-Good	Riverine forest
33.05.01	3/12/2008	10.43	33	547349	3052242	Baghmara bufferzone CF	Adult	Female	Good	Riverine forest

Sighting No	Date	Time	Elephant No	GPS Easting	GPS Northing	Block / Area	Age	Sex	Body Condition	Habitat Type
33.05.01	3/12/2008	10.43	33	547349	3052242	Baghmara bufferzone CF	Calf	Female	Good	Riverine forest
33.05.02	3/12/2008	11.10	33	547110	3051745	Baghmara bufferzone CF	Subadult	Unknown	Avg	Riverine forest
36.05.01	3/12/2008	N/C	36	547106	3053266	Baghmara bufferzone CF	Adult	Unknown	Good	Riverine forest
36.05.02	3/12/2008	N/C	36	547284	3051528	Baghmara bufferzone CF	Subadult	Unknown	Good	Riverine forest
37.05.01	3/12/2008	11.45	37	546510	3052071	Baghmara bufferzone CF	Adult	Female	Avg-Good	Riverine forest
37.05.01	3/12/2008	11.45	37	546510	3052071	Baghmara bufferzone CF	Calf	Female	Avg-Good	Riverine forest
01.06.01	3/13/2008	14.15	1	546381	3050057	Near to Rapti Khola	Subadult	Unknown	Good	Short grassland
01.06.02	3/13/2008	14.15	1	546381	3050057	Near to Rapti Khola	Subadult	Unknown	Good	Short grassland
03.06.01	3/13/2008	14.00	3	546244	3049614	Jaymangala grassland	Adult	Female	Good	Riverine forest
07.06.01	3/13/2008	N/C	7	547635	3049764	Near to Sauraha Kasara fireline	Adult	Female	Not Assessed	Shrub land
07.06.01	3/13/2008	N/C	7	547635	3049764	Near to Sauraha Kasara fireline	Calf	Unknown	Not Assessed	Shrub land
08.06.01	3/13/2008	N/C	8	547192	3049419	Near to Jaymangala ghol	Subadult	Unknown	Good	Tall grassland
08.06.02	3/13/2008	N/C	8	547494	3049750	Sauraha road	Adult	Unknown	Medium	Tall grassland
08.06.03	3/13/2008	N/C	8	548570	3050448	Sauraha road	Adult	Male	Good	Riverine forest
08.06.04	3/13/2008	N/C	8	546656	3049238	2 No. Bridge	Adult	Female	Good	Riverine forest
10.06.01	3/13/2008	13.25	10	547308	3049452	Jaymangala ghol	Adult	Female	Good	Tall grassland
10.06.01	3/13/2008	13.25	10	547308	3049452	Jaymangala ghol	Subadult	Unknown	Good	Tall grassland
13.06.01	3/13/2008	13.20	13	547393	3049433	Jaymangala ghol	Adult	Unknown	Good	Riverine forest
13.06.02	3/13/2008	13.20	13	547393	3049433	Jaymangala ghol	Adult	Unknown	Good	Riverine forest
13.06.03	3/13/2008	13.31	13	547080	3049219	Jaymangala grassland	Subadult	Unknown	Good	Tall grassland
13.06.04	3/13/2008	13.42	13	546812	3049106	Simreni	Adult	Female	Good	Riverine forest
14.06.01	3/13/2008	13.00	14	547674	3049754	South of No. 1 bridge	Adult	Male	Medium	Riverine forest
15.06.01	3/13/2008	8.29	15	551393	5045534	Dadarpul	Adult	Male	Good	Short grassland
15.06.02	3/13/2008	11.20	15	548015	3049611	Jaymangala Chaur	Adult	Female	Medium	Short grassland
15.06.02	3/13/2008	11.20	15	548015	3049611	Jaymangala Chaur	Calf	Unknown	Medium	Short grassland
15.06.03	3/13/2008	11.35	15	543214	3049761	Jaymangala	Adult	Male	Good	Tall grassland

Sighting No	Date	Time	Elephant No	GPS Easting	GPS Northing	Block / Area	Age	Sex	Body Condition	Habitat Type
22.06.01	3/13/2008	14.00	22	546236	3048751	Dadhran simal ghari	Adult	Unknown	Good	Tall grassland
22.06.01	3/13/2008	14.00	22	546236	3048751	Dadhran simal ghari	Calf	Unknown	Good	Tall grassland
24.06.01	3/13/2008	11.25	24	547330	3049107	Jaymangala ghol	Subadult	Male	Good	Tall grassland
25.06.01	3/13/2008	13.00	25	546881	3049206	Jaymangala ghol	Adult	Male	Poor	Tall grassland
25.06.02	3/13/2008	15.15	25	546035	3048664	TT route	Adult	Unknown	Not Assessed	Tall grassland
28.06.01	3/13/2008	12.00	28	546109	3048681	-	Subadult	Male	Medium	Tall grassland
29.06.01	3/13/2008	13.15	29	544780	3048070	South of Kachwani	Adult	Female	Good	Tall grassland
29.06.01	3/13/2008	13.15	29	544780	3048070	South of Kachwani	Calf	Unknown	Good	Tall grassland
01.07.01	3/14/2008	11.50	1	541833	3049126	Dumariya	Adult	Female	Good	Tall grassland
01.07.02	3/14/2008	11.50	1	541833	3049126	Dumariya	Calf	Unknown	Medium	Tall grassland
04.07.01	3/14/2008	12.38	4	541052	3049309	West of old Dumariya fireline	Adult	Female	Medium	Riverine forest
04.07.01	3/14/2008	12.38	4	541052	3049309	West of old Dumariya fireline	Calf	Female	Medium	Riverine forest
04.07.02	3/14/2008	14.15	4	537864	3049630	Sitamai ghat	Adult	Female	Medium	Riverine forest
04.07.02	3/14/2008	14.15	4	537864	3049630	Sitamai ghat	Subadult	Unknown	Medium	Riverine forest
04.07.03	3/14/2008	15.00	4	536632	3049336	Ghatgai	Adult	Male	Medium	Riverine forest
06.07.01	3/14/2008	9.15	6	543866	3048577	East of Charhara phanta	Adult	Female	Good	Tall grassland
06.07.01	3/14/2008	9.15	6	543866	3048577	East of Charhara phanta	Calf	Unknown	Good	Tall grassland
06.07.02	3/14/2008	12.30	6	540911	3049296	Dumariya	Adult	Unknown	Good	Riverine forest
06.07.02	3/14/2008	12.30	6	540911	3049296	Dumariya	Calf	Unknown	Good	Riverine forest
07.07.01	3/14/2008	12.40	7	540789	3049247	West of Dumariya post	Adult	Female	Not Assessed	Tall grassland
07.07.01	3/14/2008	12.40	7	540789	3049247	West of Dumariya post	Calf	Unknown	Not Assessed	Tall grassland
08.07.01	3/14/2008	9.25	8	544031	3043625	Charhra khola	Adult	Female	Good	Tall grassland
08.07.01	3/14/2008	9.25	8	544031	3043625	Charhra khola	Calf	Unknown	Good	Tall grassland
08.07.02	3/14/2008	12.15	8	540182	3049253	Dumariya area	Adult	Female	Good	Tall grassland
08.07.02	3/14/2008	12.15	8	540182	3049253	Dumariya area	Calf	Unknown	Good	Tall grassland
08.07.03	3/14/2008	15.45	8	536746	3049123	Ghatgai	Adult	Unknown	Good	Riverine forest
08.07.03	3/14/2008	15.45	8	536746	3049123	Ghatgai	Adult	Female	Good	Riverine forest
10.07.01	3/14/2008	12.20	10	540776	3048999	Dumariya ghat	Subadult	Unknown	Good	Wetland

Sighting No	Date	Time	Elephant No	GPS Easting	GPS Northing	Block / Area	Age	Sex	Body Condition	Habitat Type
11.07.01	3/14/2008	9.22	11	544204	3048417	-	Adult	Male	Good	Tall grassland
11.07.02	3/14/2008	11.55	11	541450	3048708	-	Adult	Unknown	Good	Tall grassland
12.07.01	3/14/2008	12.00	12	541409	3048666	Dumariya	Subadult	Unknown	Good	Tall grassland
13.07.01	3/14/2008	12.45	13	540222	3048859	Bahapur khola	Adult	Female	Good	Wetland
13.07.02	3/14/2008	12.58	13	539926	3048854	In between bahapur khola and jarneli post	Adult	Unknown	Medium	Riverine forest
13.07.02	3/14/2008	12.58	13	539926	3048854	In between bahapur khola and jarneli post	Calf	Unknown	Medium	Riverine forest
13.07.03	3/14/2008	13.16	13	539541	3048829	Jarneli ghol	Adult	Unknown	Good	Tall grassland
13.07.03	3/14/2008	13.16	13	539541	3048829	Jarneli ghol	Calf	Unknown	Good	Tall grassland
13.07.04	3/14/2008	14.31	13	537580	3049065	Ghatgai	Adult	Male	Good	Wetland
13.07.05	3/14/2008	14.48	13	537201	3049105	Ghatgai	Subadult	Female	Good	Riverine forest
14.07.01	3/14/2008	8.46	14	543801	3048183	Short Machan first	Adult	Female	Good	Tall grassland
14.07.01	3/14/2008	8.46	14	543801	3048183	Short Machan first	Calf	Unknown	Good	Tall grassland
14.07.02	3/14/2008	13.35	14	535502	3048768	Way to Jarneli	Adult	Female	Medium	Tall grassland
14.07.02	3/14/2008	13.35	14	535502	3048768	Way to Jarneli	Calf	Unknown	Medium	Tall grassland
15.07.01	3/14/2008	12.58	15	539633	3048786	Jarneli ghol	Adult	Female	Not Assessed	Tall grassland
15.07.01	3/14/2008	12.58	15	539633	3048786	Jarneli ghol	Calf	Unknown	Not Assessed	Tall grassland
15.07.02	3/14/2008	13.15	15	539639	3048786	Jarneli	Adult	Male	Not Assessed	Tall grassland
15.07.03	3/14/2008	13.35	15	539639	3048786	Jarneli	Adult	Unknown	Not Assessed	Not Assessed
17.07.01	3/14/2008	13.05	17	539836	3048709	Jarneli	Adult	Female	Good	Riverine forest
17.07.01	3/14/2008	13.05	17	539836	3048709	Jarneli	Calf	Unknown	Good	Riverine forest
23.07.01	3/14/2008	8.50	23	545050	3048131	-	Adult	Female	Good	Tall grassland
23.07.02	3/14/2008	12.25	23	540786	3048178	-	Adult	Unknown	Good	Tall grassland
26.07.01	3/14/2008	13.24	26	539557	3048710	-	Adult	Female	Good	Riverine forest
26.07.01	3/14/2008	13.24	26	539557	3048710	-	Calf	Unknown	Good	Riverine forest
26.07.02	3/14/2008	14.08	26	538018	3048244	-	Adult	Female	Good	Tall grassland
26.07.02	3/14/2008	14.08	26	538018	3048244	-	Calf	Female	Good	Tall grassland

Sighting No	Date	Time	Elephant No	GPS Easting	GPS Northing	Block / Area	Age	Sex	Body Condition	Habitat Type
27.07.01	3/14/2008	14.15	27	538966	3048058	Jarneli	Adult	Unknown	Not Assessed	Tall grassland
28.07.01	3/14/2008	14.12	28	533880	3048133	-	Adult	Female	Good	Tall grassland
28.07.01	3/14/2008	14.12	28	533880	3048133	-	Calf	Unknown	Good	Tall grassland
30.07.01	3/14/2008	9.00	30	545115	3047259	Gauri Machan area	Adult	Female	Good	Tall grassland
30.07.02	3/14/2008	9.00	30	545115	3047259	Gauri Machan area	Calf	Unknown	Not Assessed	Tall grassland
06.08.01	3/15/2008	8.13	6	535282	3048966	-	Adult	Unknown	Good	Riverine forest
06.08.01	3/15/2008	8.13	6	535282	3048966	-	Calf	Unknown	Good	Riverine forest
07.08.01	3/15/2008	11.50	7	530963	3047756	-	Adult	Unknown	Medium	Short grassland
10.08.01	3/15/2008	8.30	10	534922	3048534	Lamital area	Subadult	Male	Good	Riverine forest
10.08.02	3/15/2008	8.45	10	534832	3048493	West of Kasara	Adult	Male	Not Assessed	Riverine forest
10.08.02	3/15/2008	8.45	10	534832	3048493	West of Kasara	Subadult	Unknown	Not Assessed	Riverine forest
10.08.02	3/15/2008	8.45	10	534832	3048493	West of Kasara	Subadult	Unknown	Not Assessed	Riverine forest
10.08.03	3/15/2008	11.30	10	531745	3047236	West of Kasara	Adult	Female	Good	Wetland
10.08.03	3/15/2008	11.30	10	531745	3047236	West of Kasara	Calf	Unknown	Good	Wetland
10.08.04	3/15/2008	11.50	10	530820	3047645	Kasara - Bamkatta	Subadult	Unknown	Good	Sal forest
14.08.01	3/15/2008	11.59	14	530345	3047310	Kasara area	Adult	Male	Avg - Good	Sal forest
16.08.01	3/15/2008	12.10	16	530880	3046551	End of Lame Ral	Adult	Male	Good	Not Assessed
17.08.01	3/15/2008	8.23	17	535168	3047732	-	Adult	Female	Good	Sal forest
17.08.01	3/15/2008	8.23	17	535168	3047732	-	Calf	Unknown	Good	Sal forest
17.08.02	3/15/2008	12.08	17	530239	3046842	-	Adult	Unknown	Good	Sal forest
17.08.02	3/15/2008	12.08	17	530239	3046842	-	Subadult	Unknown	Good	Sal forest
18.08.01	3/15/2008	7.40	18	535633	3048010	Ghatgai Post	Adult	Male	Good	Sal forest
20.08.01	3/15/2008	8.32	20	536077	3047212	Kasara	Adult	Female	Good	Sal forest
20.08.01	3/15/2008	8.32	20	536077	3047212	Kasara	Calf	Unknown	Good	Sal forest
20.08.03	3/15/2008	12.20	20	529692	3046344	Kasara	Adult	Female	Good	Sal forest
20.08.02	3/15/2008	12.20	20	529692	3046344	Kasara	Adult	Male	Good	Sal forest
26.08.01	3/15/2008	12.45	26	WP 08	-	Kasara	Adult	Unknown	Good	Sal forest

Sighting No	Date	Time	Elephant No	GPS Easting	GPS Northing	Block / Area	Age	Sex	Body Condition	Habitat Type
29.08.01	3/15/2008	10.20	29	530306	3049045	Ghaila Ghari BZCF	Adult	Unknown	Good	Riverine forest
29.08.02	3/15/2008	10.20	29	530306	3049045	Ghaila Ghari BZCF	Adult	Female	Good	Riverine forest
29.08.02	3/15/2008	10.20	29	530306	3049045	Ghaila Ghari BZCF	Adult	Unknown	Good	Riverine forest
31.08.01	3/15/2008	11.00	31	532006	3048486	Ghaila Ghari BZCF	Adult	Unknown	Good	Riverine forest
31.08.01	3/15/2008	11.00	31	532006	3048486	Ghaila Ghari BZCF	Calf	Unknown	Good	Riverine forest
03.09.01	3/16/2008	8.50	3	526205	3048346	North of Dhurba Post	Adult	Male	Good	Riverine forest
01.10.01	3/17/2008	10.15	1	521512	3048001	Sukhibhar - Bhimle	Subadult	Unknown	Medium	Tall grassland
01.10.02	3/17/2008	11.45	1	519900	3047870	Bhimle - Riu	Subadult	Male	Good	Riverine forest
01.10.03	3/17/2008	16.45	1	520460	3046779	Sukhibhar	Adult	Female	Medium	Tall grassland
01.10.03	3/17/2008	16.45	1	520460	3046779	Sukhibhar	Calf	Unknown	Good	Tall grassland
01.10.04	3/17/2008	16.45	1	520460	3046779	Sukhibhar	Adult	Female	Medium	Tall grassland
01.10.04	3/17/2008	16.45	1	520460	3046779	Sukhibhar	Calf	Male	Medium	Tall grassland
01.10.05	3/17/2008	16.45	1	520460	3046779	Sukhibhar	Adult	Male	Good	Tall grassland
02.10.01	3/17/2008	11.15	2	521169	3048059	Sukhibhar	Adult	Female	Good	Tall grassland
02.10.02	3/17/2008	11.15	2	521169	3048059	Sukhibhar	Adult	Male	Good	Tall grassland
02.10.03	3/17/2008	11.45	2	519891	3047916	Bhimle	Adult	Female	Good	Sal forest
02.10.03	3/17/2008	11.45	2	519891	3047916	Bhimle	Calf	Male	Good	Sal forest
02.10.04	3/17/2008	13.00	2	518048	3068218	Rapti and Riu Dobhan	Adult	Male	Good	Tall grassland
04.10.01	3/17/2008	9.25	4	524672	3046343	-	Adult	Unknown	Good	Tall grassland
04.10.02	3/17/2008	10.10	4	523401	3046887	-	Adult	Female	Good	Tall grassland
04.10.02	3/17/2008	10.10	4	523401	3046887	-	Calf	Female	Good	Tall grassland
04.10.03	3/17/2008	10.10	4	523401	3046887	-	Calf	Female	Good	Tall grassland
04.10.04	3/17/2008	11.10	4	521233	3047792	-	Adult	Female	Good	Tall grassland
04.10.04	3/17/2008	11.10	4	521233	3047792	-	Calf	Unknown	Good	Tall grassland
04.10.05	3/17/2008	16.12	4	523485	3048445	-	Adult	Male	Good	Wetland
05.10.01	3/17/2008	11.09	5	521299	3047747	Sukhibhar	Adult	Female	Medium	Riverine forest
05.10.01	3/17/2008	11.09	5	521299	3047747	Sukhibhar	Calf	Unknown	Medium	Riverine forest

Sighting No	Date	Time	Elephant No	GPS Easting	GPS Northing	Block / Area	Age	Sex	Body Condition	Habitat Type
05.10.02	3/17/2008	12.05	5	519870	3047822	-	Subadult	Unknown	Medium	Riverine forest
05.10.03	3/17/2008	15.48	5	522551	3048074	Sukhibhar near Rapti	Adult	Male	Poor	Riverine forest
06.10.01	3/17/2008	9.46	6	523980	3046636	Sukhibar upper Phanta	Adult	Female	Medium	Tall grassland
06.10.01	3/17/2008	9.46	6	523980	3046636	Sukhibar upper Phanta	Calf	Unknown	Medium	Tall grassland
06.10.02	3/17/2008	11.42	6	520103	3047734	Bhimle Phanta	Adult	Female	Medium	Riverine forest
06.10.02	3/17/2008	11.42	6	520103	3047734	Bhimle Phanta	Calf	Unknown	Medium	Riverine forest
07.10.01	3/17/2008	10.10	7	523601	3046768	-	Adult	Female	Good	Short grassland
07.10.01	3/17/2008	10.10	7	523601	3046768	-	Calf	Unknown	Good	Short grassland
07.10.02	3/17/2008	11.15	7	521252	3047632	Sukhibhar Phanta	Adult	Female	Good	Tall grassland
08.10.01	3/17/2008	11.23	8	520785	3047766	Sukhibhar	Subadult	Unknown	Medium	Tall grassland
09.10.01	3/17/2008	10.37	9	522140	3047123	Sukhibhar	Adult	Unknown	Medium	Tall grassland
09.10.02	3/17/2008	11.43	9	520178	3047773	Bhimle	Subadult	Female	Medium	Tall grassland
09.10.03	3/17/2008	11.53	9	519879	3047689	Bhimle	Adult	Female	Good	Riverine forest
09.10.03	3/17/2008	11.53	9	519879	3047689	Bhimle	Calf	Unknown	Good	Riverine forest
10.10.01	3/17/2008	10.20	10	522558	3045894	Bhimle - North	Adult	Male	Good	Tall grassland
10.10.02	3/17/2008	10.38	10	522653	3045894	Bhimle - North	Adult	Female	Medium	Tall grassland
10.10.03	3/17/2008	11.35	10	520359	3047690	Bhimle	Adult	Female	Good	Short grassland
10.10.03	3/17/2008	11.35	10	520359	3047690	Bhimle	Calf	Unknown	Good	Short grassland
10.10.04	3/17/2008	14.30	10	520757	3049195	North of Bhimle	Adult	Female	Not Assessed	Riverine forest
10.10.04	3/17/2008	14.30	10	520757	3049195	North of Bhimle	Calf	Unknown	Not Assessed	Riverine forest
10.10.05	3/17/2008	15.15	10	521419	3048641	North-west of Bhimle	Adult	Female	Good	Riverine forest
10.10.05	3/17/2008	15.15	10	521419	3048641	North-west of Bhimle	Calf	Unknown	Good	Riverine forest
11.10.01	3/17/2008	9.22	11	524533	3046067	-	Adult	Unknown	Good	Short grassland
11.10.02	3/17/2008	9.22	11	524533	3046067	-	Subadult	Female	Good	Short grassland
11.10.03	3/17/2008	9.39	11	523953	3046279	-	Adult	Female	Good	Short grassland
11.10.04	3/17/2008	9.39	11	523953	3046279	-	Adult	Female	Good	Short grassland
11.10.04	3/17/2008	9.39	11	523953	3046279	-	Calf	Unknown	Good	Short grassland

Sighting No	Date	Time	Elephant No	GPS Easting	GPS Northing	Block / Area	Age	Sex	Body Condition	Habitat Type
11.10.05	3/17/2008	9.56	11	523511	3046454	-	Adult	Female	Good	Short grassland
11.10.05	3/17/2008	9.56	11	523511	3046454	-	Subadult	Female	Good	Short grassland
11.10.06	3/17/2008	10.30	11	522389	3046934	-	Adult	Male	Good	Tall grassland
12.10.01	3/17/2008	13.30	12	518987	3048289	Bhimle	Adult	Male	Not Assessed	Not Assessed
13.10.01	3/17/2008	10.00	13	523132	3046477	Sukhibhar	Adult	Male	Good	Tall grassland
13.10.02	3/17/2008	10.00	13	523132	3046477	Sukhibhar	Adult	Female	Good	Tall grassland
13.10.03	3/17/2008	11.00	13	521344	3047245	Sukhibhar	Adult	Male	Good	Wetland
13.10.04	3/17/2008	11.00	13	521344	3047245	Sukhibhar	Adult	Female	Good	Wetland
13.10.05	3/17/2008	13.38	13	519352	3048339	West of Bhimle	Adult	Male	Good	Wetland
13.10.06	3/17/2008	13.38	13	519352	3048339	West of Bhimle	Subadult	Unknown	Good	Wetland
13.10.07	3/17/2008	13.38	13	519352	3048339	West of Bhimle	Subadult	Unknown	Medium	Wetland
13.10.08	3/17/2008	14.00	13	519998	3048565	West of Bhimle	Adult	Male	Good	Wetland
14.10.01	3/17/2008	10.12	14	521150	3046694	-	Adult	Female	Good	Tall grassland
14.10.02	3/17/2008	11.00	14	521276	3047146	-	Adult	Unknown	Good	Short grassland
14.10.03	3/17/2008	11.00	14	521776	3047146	-	Adult	Unknown	Good	Tall grassland
14.10.04	3/17/2008	16.30	14	525377	3048785	-	Adult	Unknown	Good	Wetland
15.10.01	3/17/2008	11.40	15	520265	3047596	Bhimle - Tentend Camp	Subadult	Unknown	Good	Tall grassland
15.10.02	3/17/2008	14.00	15	519899	3048425	West of Bhimle	Adult	Female	Good	Riverine forest
15.10.02	3/17/2008	14.00	15	519899	3048425	West of Bhimle	Calf	Unknown	Good	Riverine forest
15.10.03	3/17/2008	16.10	15	523471	3047844	West of Sukhibhar	Adult	Unknown	Medium	Tall grassland
16.10.01	3/17/2008	10.19	16	522851	3046632	-	Adult	Unknown	Not Assessed	Not Assessed
16.10.03	3/17/2008	10.53	16	521379	3046822	-	Adult	Female	Good	Short grassland
16.10.04	3/17/2008	11.01	16	521379	3046822	-	Adult	Female	Good	Short grassland
16.10.05	3/17/2008	11.35	16	520297	3047462	-	Adult	Female	Good	Wetland
16.10.06	3/17/2008	13.55	16	519873	3048344	-	Adult	Male	Good	Short grassland
16.10.07	3/17/2008	16.22	16	524070	3047922	-	Adult	Male	Good	Tall grassland
16.10.08	3/17/2008	16.22	16	524070	3047922	-	Adult	Female	Good	Tall grassland

Sighting No	Date	Time	Elephant No	GPS Easting	GPS Northing	Block / Area	Age	Sex	Body Condition	Habitat Type
17.10.01	3/17/2008	N/C	17	521510	3046717	-	Adult	Female	Medium	Tall grassland
17.10.02	3/17/2008	N/C	17	520964	3046967	-	Adult	Male	Good	Short grassland
17.10.03	3/17/2008	N/C	17	519470	3048276	-	Adult	Unknown	Good	Tall grassland
17.10.04	3/17/2008	N/C	17	524624	3047931	-	Adult	Male	Good	Tall grassland
18.10.01	3/17/2008	9.00	18	525032	3045605	-	Adult	Female	Good	Sal forest
18.10.01	3/17/2008	9.00	18	525032	3045605	-	Calf	Unknown	Good	Sal forest
18.10.02	3/17/2008	9.20	18	524296	3045690	-	Adult	Male	Good	Tall grassland
18.10.03	3/17/2008	13.37	18	519479	3048242	-	Adult	Male	Good	Riverine forest
18.10.04	3/17/2008	14.13	18	520439	3048724	Bhimle	Adult	Female	Good	Not Assessed
18.10.05	3/17/2008	16.15	18	524038	3047775	-	Adult	Female	Not Assessed	Not Assessed
18.10.05	3/17/2008	16.15	18	524038	3047775	-	Calf	Female	Not Assessed	Not Assessed
19.10.01	3/17/2008	9.30	19	523759	3045875	Sukhibhar	Adult	Female	Not Assessed	Tall grassland
19.10.01	3/17/2008	9.30	19	523759	3045875	Sukhibhar	Subadult	Unknown	Not Assessed	Tall grassland
19.10.02	3/17/2008	10.55	19	521318	3046468	Sukhibhar	Adult	Male	Good	Wetland
19.10.03	3/17/2008	12.10	19	519936	3046940	Sukhibhar - Riu	Subadult	Male	Good	Tall grassland
19.10.04	3/17/2008	13.50	19	519717	3048252	Tiger tops	Adult	Unknown	Good	Riverine forest
19.10.05	3/17/2008	14.20	19	520600	3048841	Nanda Bhauju Tal	Adult	Female	Good	Wetland
19.10.05	3/17/2008	14.20	19	520600	3048841	Nanda Bhauju Tal	Subadult	Unknown	Good	Wetland
19.10.06	3/17/2008	15.10	19	521309	3048480	Sukhibhar	Subadult	Unknown	Good	Tall grassland
19.10.07	3/17/2008	15.45	19	522396	3047844	Sukhibhar	Adult	Female	Poor	Tall grassland
19.10.08	3/17/2008	15.50	19	522872	3047664	Sukhibhar	Adult	Unknown	Good	Tall grassland
20.10.01	3/17/2008	9.30	20	521466	3046046	-	Adult	Female	Good	Not Assessed
20.10.01	3/17/2008	9.30	20	521466	3046046	-	Calf	Unknown	Good	Not Assessed
20.10.02	3/17/2008	11.25	20	520948	3046512	-	Adult	Female	Good	Tall grassland
20.10.02	3/17/2008	11.25	20	520948	3046512	-	Subadult	Unknown	Good	Tall grassland
20.10.02	3/17/2008	11.25	20	520948	3046512	-	Calf	Unknown	Good	Tall grassland

Sighting No	Date	Time	Elephant No	GPS Easting	GPS Northing	Block / Area	Age	Sex	Body Condition	Habitat Type
20.10.03	3/17/2008	11.55	20	520320	3046520	-	Adult	Unknown	Good	Tall grassland
20.10.04	3/17/2008	14.30	20	520881	3048882	-	Adult	Female	Good	Wetland
20.10.04	3/17/2008	14.30	20	520881	3048882	-	Calf	Unknown	Good	Wetland
20.10.05	3/17/2008	15.00	20	522771	3047608	-	Adult	Female	Good	Not Assessed
20.10.05	3/17/2008	15.00	20	522771	3047608	-	Calf	Unknown	Good	Not Assessed
20.10.06	3/17/2008	16.30	20	522896	3047601	-	Adult	Female	Good	Tall grassland
20.10.06	3/17/2008	16.30	20	522896	3047601	-	Calf	Unknown	Good	Tall grassland
21.10.01	3/17/2008	10.27	21	522108	3046024	In front of tiger tops tented camp	Adult	Male	Good	Tall grassland
21.10.02	3/17/2008	11.45	21	520000	3046692	In front of tiger tops tented camp	Subadult	Unknown	Not Assessed	Tall grassland
21.10.03	3/17/2008	13.48	21	519761	3048020	Chhatiwan Tal	Adult	Male	Good	Riverine forest
22.10.01	3/17/2008	16.35	22	525258	3047037	Sukhibhar	Adult	Male	Poor	Wetland
23.10.01	3/17/2008	10.20	23	522223	3045790	Tented camp area	Adult	Female	Good	Wetland
23.10.02	3/17/2008	10.20	23	522223	3045790	Tented camp area	Adult	Male	Good	Wetland
23.10.03	3/17/2008	11.20	23	520489	3046211	Surung Khola	Adult	Female	Good	Tall grassland
23.10.03	3/17/2008	11.20	23	520489	3046211	Surung Khola	Calf	Unknown	Good	Tall grassland
23.10.04	3/17/2008	11.45	23	520060	3046584	Between Surung Khola and Tiger Tops	Adult	Unknown	Good	Tall grassland
23.10.05	3/17/2008	13.44	23	519626	3047851	Bhimle	Subadult	Female	Good	Riverine forest
24.10.01	3/17/2008	11.30	24	520367	3046260	Tiger tops tented camp	Adult	Female	Good	Wetland
24.10.02	3/17/2008	11.30	24	520367	3046260	Tiger tops tented camp	Subadult	Unknown	Good	Wetland
24.10.03	3/17/2008	11.50	24	520070	3046482	Surung Khola	Adult	Female	Good	Tall grassland
24.10.03	3/17/2008	11.50	24	520070	3046482	Surung Khola	Calf	Unknown	Good	Tall grassland
24.10.04	3/17/2008	14.14	24	520342	3048538	-	Adult	Male	Good	Short grassland
24.10.05	3/17/2008	16.32	24	524463	3047182	Sukhibhar	Adult	Male	Good	Tall grassland
25.10.01	3/17/2008	10.20	25	522191	3045662	-	Adult	Female	Good	Tall grassland

Sighting No	Date	Time	Elephant No	GPS Easting	GPS Northing	Block / Area	Age	Sex	Body Condition	Habitat Type
25.10.02	3/17/2008	11.20	25	520218	3046171	-	Subadult	Unknown	Medium	Tall grassland
25.10.03	3/17/2008	15.05	25	521135	3048324	Bhimle	Adult	Female	Good	Tall grassland
25.10.03	3/17/2008	15.05	25	521135	3048324	Bhimle	Calf	Unknown	Good	Tall grassland
25.10.04	3/17/2008	15.30	25	521933	3047944	Rapti	Adult	Female	Good	Tall grassland
25.10.04	3/17/2008	15.30	25	521933	3047944	Rapti	Calf	Unknown	Good	Tall grassland
25.10.05	3/17/2008	15.30	25	521933	3047944	Rapti	Adult	Female	Medium	Tall grassland
25.10.05	3/17/2008	15.30	25	521933	3047944	Rapti	Calf	Unknown	Medium	Tall grassland
27.10.01	3/17/2008	14.25	27	520246	3044810	North of Bhimle Post	Subadult	Female	Poor	Riverine forest
27.10.02	3/17/2008	14.35	27	520033	3046210	Near to Bhimle Post	Adult	Male	Medium	Tall grassland
MD1.10.01	3/17/2008	9.30	MD1	538064	3037974	Ghanghar	Adult	Female	Good	Riverine forest
MD1.10.02	3/17/2008	9.30	MD1	538064	3037974	Ghanghar	Calf	Unknown	Medium	Riverine forest
05.11.02	3/18/2008	10.20	5	515234	3043305	-	Adult	Male	Good	Tall grassland
05.11.03	3/18/2008	10.30	5	514967	3048171	Baghmara Phanta	Adult	Male	Good	Tall grassland
07.11.01	3/18/2008	11.45	5	513496	3047145	-	Adult	Male	Good	Tall grassland
08.11.01	3/18/2008	11.25	8	513664	3047189	West of Devi Tal	Adult	Female	Good	Tall grassland
11.11.01	3/18/2008	11.40	11	513486	3046854	Devi Tal - Khoriya Muhan	Adult	Male	Good	Tall grassland
16.11.01	3/18/2008	9.17	16	516821	3047934	Baghmara	Adult	Male	Good	Riverine forest
16.11.02	3/18/2008	11.40	16	513525	3046641	Devi Tal	Adult	Unknown	Good	Wetland
17.11.01	3/18/2008	10.50	17	514954	3047486	-	Adult	Female	Good	Tall grassland
17.11.01	3/18/2008	10.50	17	514954	3047486	-	Calf	Unknown	Good	Tall grassland
17.11.02	3/18/2008	10.50	17	514954	3047486	East of Devi Tal	Subadult	Unknown	Good	Tall grassland
17.11.03	3/18/2008	11.30	17	513812	3046793	Devi Tal	Adult	Unknown	Medium	Tall grassland
18.11.01	3/18/2008	10.40	18	515185	3047546	-	Adult	Unknown	Good	Tall grassland
19.11.01	3/18/2008	11.32	19	513843	3046739	Devi Tal	Subadult	Unknown	Not Assessed	Tall grassland
19.11.02	3/18/2008	11.49	19	513389	3046519	Devi Tal	Adult	Male	Good	Tall grassland
20.11.01	3/18/2008	9.00	20	517178	3047673	-	Adult	Female	Good	Not Assessed
20.11.02	3/18/2008	10.30	20	516213	3047728	-	Adult	Unknown	Good	Tall grassland

Sighting No	Date	Time	Elephant No	GPS Easting	GPS Northing	Block / Area	Age	Sex	Body Condition	Habitat Type
20.11.02	3/18/2008	10.30	20	516213	3047728	-	Calf	Unknown	Good	Tall grassland
20.11.03	3/18/2008	11.45	20	513743	3046649	-	Adult	Unknown	Good	Tall grassland
21.11.01	3/18/2008	12.00	21	513977	3046705	-	Adult	Female	Medium	Tall grassland
21.11.01	3/18/2008	12.00	21	513977	3046705	-	Calf	Unknown	Medium	Tall grassland
22.11.01	3/18/2008	10.45	22	515335	3047339	-	Adult	Female	Poor	Tall grassland
22.11.02	3/18/2008	11.45	22	513428	3046432	-	Adult	Unknown	Poor	Tall grassland
22.11.03	3/18/2008	12.45	22	522101	3046519	West of Devi Tal	Adult	Unknown		Tall grassland
01.12.01	3/19/2008	7.35	1	511142	3047206	-	Adult	Unknown	Medium	Wetland
01.12.02	3/19/2008	10.10	1	507613	3048044	-	Adult	Female	Medium	Riverine forest
01.12.03	3/19/2008	10.30	1	507185	3047723	-	Adult	Male	Medium	Riverine forest
02.12.01	3/19/2008	9.02	2	509412	3048011	Temple Bote Chhapro	Adult	Male	Medium	Riverine forest
02.12.02	3/19/2008	9.58	2	507643	3048005	Temple Tiger Area (Narayani River side)	Adult	Unknown	Medium	Riverine forest
02.12.03	3/19/2008	10.17	2	507248	3047684	-	Adult	Unknown	Medium	Riverine forest
03.12.01	3/19/2008	9.45	3	508374	3048064	Temple Tiger area	Adult	Male	Good	Riverine forest
03.12.02	3/19/2008	10.45	3	507199	3047620	Temple Tiger area	Adult	Unknown	Good	Riverine forest
04.12.01	3/19/2008	9.20	4	508430	3047917	Temple Tiger area	Adult	Male	Good	Tall grassland
05.12.01	3/19/2008	8.40	5	509676	3047539	-	Adult	Unknown		Riverine forest
05.12.02	3/19/2008	8.53	5	509458	3047705	Temple Tiger Boat Ghat	Adult	Male	Good	Tall grassland
05.12.03	3/19/2008	8.53	5	509458	3047705	Temple Tiger Boat Ghat	Adult	Male	Good	Tall grassland
05.12.04	3/19/2008	9.50	5	508065	3047789	Temple tiger area	Subadult	Male	Good	Wetland
07.12.01	3/19/2008	8.13	7	510350	3047025	Temple tiger area	Adult	Female	Good	Tall grassland
07.12.01	3/19/2008	8.13	7	510350	3047025	Temple tiger area	Calf	Unknown		Tall grassland
07.12.02	3/19/2008	9.06	7	509015	3047614	Temple tiger area	Adult	Female	Medium	Tall grassland
07.12.02	3/19/2008	9.06	7	509015	3047614	Temple tiger area	Calf	Male	Medium	Tall grassland
07.12.03	3/19/2008	9.59	7	507971	3047514	Temple tiger area	Subadult	Unknown	Medium	Tall grassland
08.12.01	3/19/2008	9.08	8	508881	3047380	Temple tiger area	Adult	Unknown	Poor	Tall grassland

Sighting No	Date	Time	Elephant No	GPS Easting	GPS Northing	Block / Area	Age	Sex	Body Condition	Habitat Type
08.12.02	3/19/2008	9.08	8	508881	3047380	Temple tiger area	Subadult	Unknown	Medium	Tall grassland
08.12.03	3/19/2008	10.11	8	507602	3047422	Temple tiger area	Adult	Female	Medium	Tall grassland
08.12.03	3/19/2008	10.11	8	507602	3047422	Temple tiger area	Calf	Unknown	Medium	Tall grassland
09.12.01	3/19/2008	8.05	9	510676	3046801	Singe Tal	Adult	Male	Good	Tall grassland
09.12.02	3/19/2008	9.40	9	508296	3047302	Temple tiger area	Adult	Female	Good	Tall grassland
09.12.02	3/19/2008	9.40	9	508296	3047302	Temple tiger area	Calf	Unknown	Good	Tall grassland
09.12.03	3/19/2008	9.45	9	508344	3047868	Temple tiger area	Adult	Female	Medium	Not Assessed
09.12.04	3/19/2008	10.00	9	508064	3047267	North of Temple Tiger	Subadult	Unknown	Not Assessed	Riverine forest
09.12.05	3/19/2008	10.05	9	508064	3047267	North of Temple Tiger	Adult	Female	Good	Tall grassland
09.12.06	3/19/2008	10.15	9	508064	3047267	North of Temple Tiger	Adult	Male	Good	Tall grassland
09.12.07	3/19/2008	10.55	9	506138	3047222	Gaidakhasa	Adult	Male	Good	Tall grassland
12.12.01	3/19/2008	10.10	12	507723	3047137	-	Adult	Male	Good	Riverine forest
12.12.02	3/19/2008	10.22	12	507078	3047159	-	Adult	Male	Good	Wetland
15.12.01	3/19/2008	8.30	15	509689	3046729	-	Adult	Female	Good	Short grassland
15.12.02	3/19/2008	8.30	15	509689	3046729	-	Calf	Female	Medium	Short grassland
16.12.01	3/19/2008	11.00	16	506087	3047062	-	Adult	Female	Not Assessed	Riverine forest
16.12.02	3/19/2008	11.00	16	506087	3047062	-	Subadult	Female	Not Assessed	Riverine forest
17.12.01	3/19/2008		17	507322	3046820	North of Temple Tiger	Adult	Female	Good	Riverine forest
19.12.01	3/19/2008	10.40	19	506643	3046901	-	Adult	Female	Good	Tall grassland
19.12.01	3/19/2008	10.40	19	506643	3046901	-	Calf	Unknown	Good	Tall grassland
19.12.02	3/19/2008	11.15	19	505542	3046879	-	Subadult	Unknown	Good	Short grassland
20.12.01	3/19/2008	8.45	20	509522	3046492	-	Adult	Male	Poor	Riverine forest
01.13.01	3/20/2008	9.30	1	514693	3049666	North of Narayani River	Adult	Male	Medium	Short grassland
01.13.02	3/20/2008	10.01	1	515279	3049975	North of Narayani River	Adult	Male	Medium	Short grassland
03.13.01	3/20/2008	9.30	3	514690	3049855	Island jungle	Adult	Unknown	Good	Tall grassland
03.13.02	3/20/2008	9.30	3	514690	3049855	Island jungle	Adult	Female	Good	Tall grassland
05.13.01	3/20/2008	8.25	5	513242	3048622	South of Gohi Ghat	Adult	Unknown	Medium	Riverine forest

Sighting No	Date	Time	Elephant No	GPS Easting	GPS Northing	Block / Area	Age	Sex	Body Condition	Habitat Type
05.13.01	3/20/2008	8.25	5	513242	3048622	South of Gohi Ghat	Calf	Unknown	Medium	Riverine forest
07.13.01	3/20/2008	11.09	7	514645	3050320	Island area	Adult	Unknown	Medium	Riverine forest
07.13.02	3/20/2008	11.14	7	514684	3050354	Island area	Adult	Unknown		Riverine forest
10.13.01	3/20/2008	10.05	10	514021	3049983	-	Adult	Unknown	Good	Riverine forest
10.13.02	3/20/2008	10.05	10	514021	3049983	-	Adult	Unknown	Good	Riverine forest
11.13.01	3/20/2008	9.35	11	514083	3050118	Island area	Adult	Unknown	Not Assessed	Riverine forest
11.13.02	3/20/2008	9.50	11	514629	3050602	Island area	Adult	Female	Medium	Riverine forest
12.13.01	3/20/2008	9.42	12	514142	3050236	-	Adult	Male	Good	Riverine forest
12.13.02	3/20/2008	10.04	12	514407	3050497	-	Adult	Female	Good	Riverine forest
12.13.02	3/20/2008	10.04	12	514407	3050497	-	Calf	Unknown	Good	Riverine forest
15.13.01	3/20/2008	9.50	15	514041	3050926	-	Adult	Female	Good	Riverine forest
17.13.01	3/20/2008	8.03	17	512137	3048937	Bandar jhula	Adult	Unknown	Not Assessed	Not Assessed
17.13.02	3/20/2008	11.30	17	515109	3052331	-	Adult	Unknown	Not Assessed	Not Assessed
18.13.01	3/20/2008	14.45	18	513971	3053819	Gaida Ghole	Adult	Female	Medium	Riverine forest
18.13.01	3/20/2008	14.45	18	513971	3053819	Gaida Ghole	Calf	Unknown	Not Assessed	Riverine forest
18.13.02	3/20/2008	14.50	18	-	-	Gaida Ghole	Adult	Male	Good	Wetland
20.13.01	3/20/2008	12.40	20	512776	3052998	Ratula Gholl?	Adult	Unknown	Not Assessed	Wetland
22.13.01	3/20/2008	14.40	22	514088	3054086	Krishna CF	Adult	Unknown	Good	Riverine forest
24.13.01	3/20/2008	14.15	24	512111	3051656	Back of Lamachaur post	Adult	Unknown	Not Assessed	Riverine forest
04.14.01	3/21/2008	11.45	4	522696	3057215	-	Adult	Unknown	Good	Wetland
04.14.02	3/21/2008	12.15	4	523367	3057687	-	Subadult	Female	Good	Wetland
08.14.01	3/21/2008	8.15	8	516674	3052335	Island area	Adult	Male	Good	Riverine forest
12.14.01	3/21/2008	12.10	12	522263	3056319	-	Adult	Male	Good	Short grassland
17.14.01	3/21/2008	13.05	17	521092	3058347	-	Adult	Male	Poor	Riverine forest
17.14.02	3/21/2008	13.15	17	521057	3058296	-	Adult	Female	Good	Riverine forest
17.14.02	3/21/2008	13.15	17	521057	3058296	-	Calf	Unknown	Not Assessed	Riverine forest

Sighting No	Date	Time	Elephant No	GPS Easting	GPS Northing	Block / Area	Age	Sex	Body Condition	Habitat Type
18.14.01	3/21/2008	9.15	18	514907	3054881	-	Adult	Unknown	Good	Wetland
18.14.02	3/21/2008	13.10	18	520736	3058209	-	Adult	Male	Good	Not Assessed
18.14.03	3/21/2008	13.10	18	520736	3058209	-	Adult	Female	Good	Not Assessed
18.14.03	3/21/2008	13.10	18	520736	3058209	-	Calf	Unknown	Not Assessed	Not Assessed
01.15.01	3/22/2008	10.10	1	-	-	Mardi ghol	Adult	Unknown	Good	Wetland
08.15.01	3/22/2008	12.00	8	519106	3055753	-	Adult	Unknown	Good	Riverine forest
09.15.01	3/22/2008	17.15	9	524964	3058609	Gajapur Tappu	Adult	Male	Good	Riverine forest
10.15.01	3/22/2008	15.35	10	522241	3057178	Island area	Adult	Male	Good	Riverine forest
13.15.01	3/22/2008	7.55	13	526187	3053151	Bandarjhula	Adult	Male	Good	Riverine forest
13.15.02	3/22/2008	8.50	13	516492	3054343	Bandarjhula	Adult	Unknown	Good	Riverine forest
14.15.01	3/22/2008	13.20	14	518672	3056333	Island forest	Adult	Female	Not Assessed	Riverine forest
14.15.01	3/22/2008	13.20	14	518672	3056333	Island forest	Calf	Unknown	Not Assessed	Riverine forest
14.15.02	3/22/2008	13.45	14	518672	3056333	Island forest	Subadult	Unknown	Not Assessed	Riverine forest
18.15.01	3/22/2008	12.48	18	518790	3057097	-	Adult	Unknown	Not Assessed	Riverine forest
21.15.01	3/22/2008	10.05	21	517323	3055396	Island forest	Adult	Male	Not Assessed	Riverine forest
24.15.01	3/22/2008	N/C	24	514313	3052730	East of Lamichaur - island	Adult	Unknown	Not Assessed	Riverine forest
01.16.01	3/23/2008	11.35	1	528228	3061369	Sikarauli	Adult	Male	Good	Riverine forest
04.16.01	3/23/2008	10.36	4	526463	3059883	Gajapur area	Adult	Unknown	Good	Riverine forest
04.16.02	3/23/2008	11.50	4	527000	3060237	Gajapur area	Adult	Male	Good	Riverine forest
05.16.01	3/23/2008	9.46	5	523960	3058369	-	Adult	Unknown	Good	Riverine forest
05.16.02	3/23/2008	11.28	5	527091	3060381	-	Adult	Female	Good	Riverine forest
05.16.02	3/23/2008	11.28	5	527091	3060381	-	Calf	Unknown	Good	Riverine forest
05.16.03	3/23/2008	11.35	5	528031	3061447	-	Adult	Unknown	Good	Riverine forest
20.16.01	3/23/2008	9.10	20	524818	3059639	Kujauli area	Adult	Unknown	Medium	Riverine forest
23.16.01	3/23/2008	7.25	23	523055	3060085	-	Adult	Unknown	Not Assessed	Riverine forest
23.16.02	3/23/2008	7.40	23	522890	3060167	-	Adult	Unknown	Not Assessed	Riverine forest
23.16.03	3/23/2008	7.40	23	522890	3060167	-	Adult	Unknown	Not Assessed	Riverine forest

Sighting No	Date	Time	Elephant No	GPS Easting	GPS Northing	Block / Area	Age	Sex	Body Condition	Habitat Type
23.16.04	3/23/2008	9.18	23	522487	3058109		Adult	Unknown	Not Assessed	Riverine forest
06.16.01	3/23/2008	6.45	6	539997	3063481	Seti Devi	Adult	Male	Good	Riverine forest
07.16.01	3/23/2008	12.04	7	529975	3061554	Sirkauli Tappu	Adult	Male	Not Assessed	Not Assessed
07.16.02	3/23/2008	12.20	7	529531	3061419	Sirkauli Tappu	Adult	Unknown	Not Assessed	Not Assessed
05.16.01	3/23/2008	12.05	5	530252	3061520	Jhanjhane Sissoo plantation	Adult	Female	Medium	Riverine forest
05.16.01	3/23/2008	12.05	5	530252	3061520	Jhanjhane Sissoo plantation	Calf	Male	Medium	Riverine forest
MD.US.01	3/15/2008	N/C	N/C	535874	3039550	Botesimara	Adult	Unknown	Not Assessed	Not Assessed
MD.US.01	3/15/2008	N/C	N/C	535874	3039550	Botesimara	Calf	Unknown	Not Assessed	Not Assessed
MD.US.02	3/19/2008	N/C	N/C	549753	3032806	Dabuwa	Adult	Unknown	Not Assessed	Not Assessed
MD.US.03	3/13/2008	N/C	N/C	560749	3024753	Thori	Adult	Unknown	Not Assessed	Not Assessed
MD.US.04	3/19/2008	N/C	N/C	545475	3033560	Bagai	Adult	Male	Not Assessed	Not Assessed

* N/C : Not Completed


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