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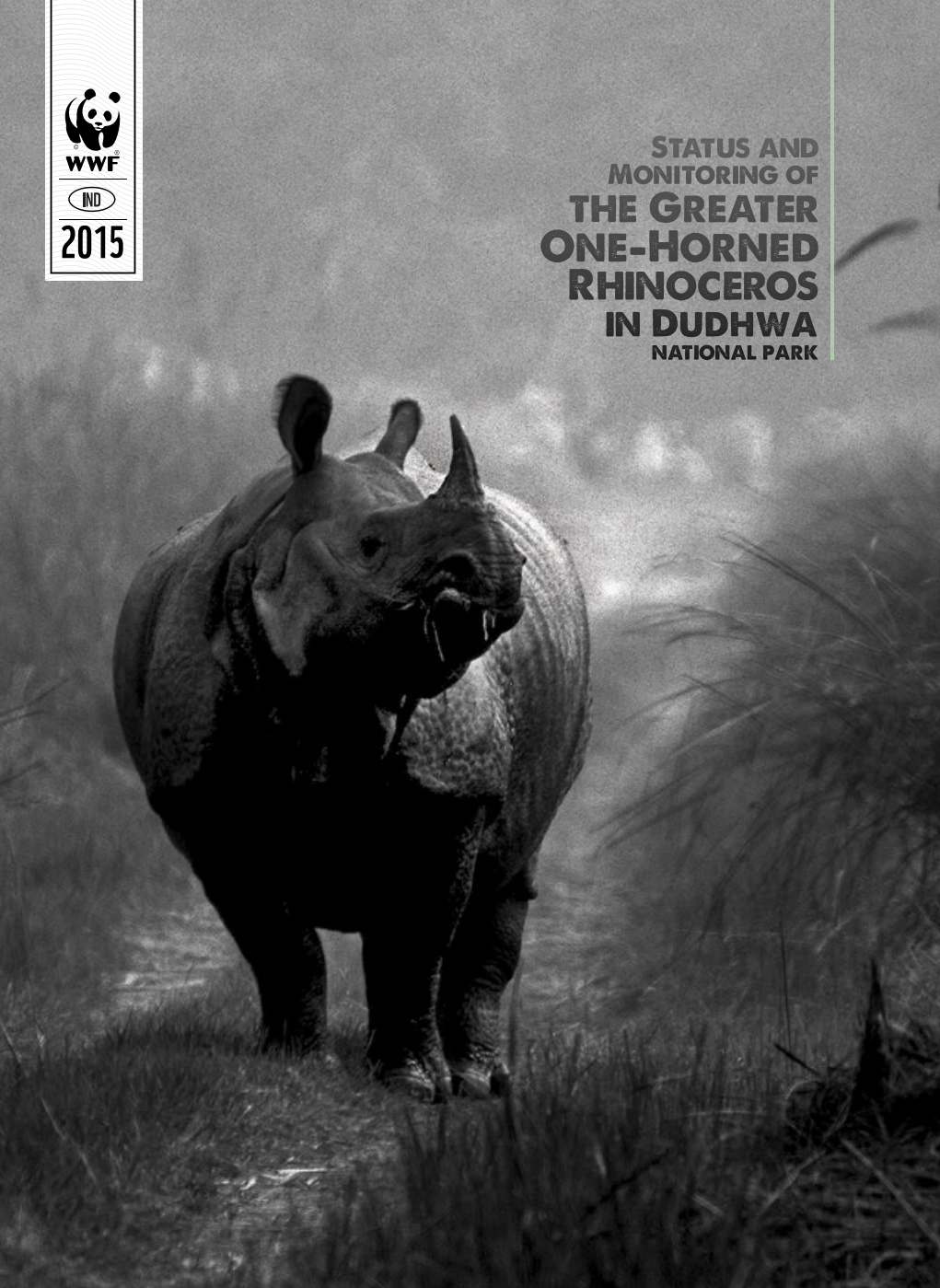
2015

STATUS AND MONITORING OF THE GREATER ONE-HORNED RHINOCEROS IN DUDHWA NATIONAL PARK



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STATUS AND MONITORING OF THE GREATER ONE-HORNED RHINOCEROS IN DUDHWA NATIONAL PARK

© IRSHAD ALI, MAHAVAT / DUDHWA TIGER RESERVE

A male tiger stalks rhinoceros Rajshree and her one month old calf

FOREWORD

Dr. Rupak De

IFS
Principal Chief Conservator of Forests (Wildlife) & Chief Wildlife Warden
Uttar Pradesh Forest Department

The population of the Greater One-Horned rhinoceros is under severe threat in India. An animal that once roamed nearly all across north and east India is now confined to a few forest pockets in Assam and West Bengal, and as a reintroduced population in Uttar Pradesh. A part of the Terai in Uttar Pradesh is fortunate enough to have recovered a population once lost to hunting and deforestation. While the reintroduced population has seen a rise in number, it has been imperative to establish a newer, more advanced method to monitor these individuals to ensure their safety.

Dudhwa Tiger Reserve is the oldest protected area and tiger reserve in Uttar Pradesh. It is home to several endangered and threatened flora and fauna such as the tiger, leopard, elephant, sloth bear and swamp deer. With the rhino population once again thriving in Dudhwa, this is an ideal example of a conservation success story.

The rhino ID program is an interesting, positive and welcome effort towards the effective conservation and monitoring of the rhinos in Dudhwa. This compilation is the first of its kind and provides comprehensive and consolidated information about individual rhinos including photographs and identification marks. This publication marks a significant achievement for front line staff and managers for formulating effective monitoring and conservation strategies. This report is the culmination of collaborative effort between World Wide Fund for Nature - India (WWF-India) for training and establishing such an innovative program and the management and field staff of Dudhwa Tiger Reserve for applying this in the rhino area.

Let this be a precursor to all the other parks and states to adopt a technologically advanced, yet easily implemented protocol.

(Rupak De, Dr.)

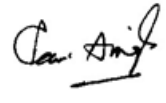
Ravi Singh

Secretary General & Chief Executive Officer
World Wide Fund for Nature - India

Although rhino populations are shrinking worldwide, the Indian or greater one-horned rhino populations in India have recovered as a result of on-ground conservation actions. Rhinos are found in four Indian states with the largest population in Assam, followed by West Bengal, Uttar Pradesh and a small population in Bihar. The population in Dudhwa at Uttar Pradesh was re-established three decades back with rhinos being sourced from Assam and Nepal. The rhino reintroduction program at Dudhwa is a testament to the fact that it is possible to conserve wild populations with active management measures.

Even though the population has increased over the last thirty years, scientific and systematic monitoring of rhinos has been wanting. With the commitment to conserve threatened species in Dudhwa and the entire Terai Arc Landscape, the Uttar Pradesh state Forest Department together with WWF-India initiated scientific monitoring of rhinos at this Park. This program, utilizing new techniques in India, has come to set a new standard in the monitoring of rhinos. We sincerely hope that this does not remain a standalone initiative and that other monitoring programs learn from this and further improve on it to bring a more personalized and importantly, an intensive and scientifically sound method to monitor rhino populations in other landscapes and countries.

I would like to thank all concerned for taking up this work, especially the Chief Wildlife Warden – Uttar Pradesh, Field Director, Deputy Director, ACFs, Range Officers, Foresters, Forest Guards and the Mahouts of Dudhwa Tiger Reserve; WWF-AREAS Programme Coordinator; NTNC – Nepal and the field team of WWF-India Terai Arc Landscape programme working in Dudhwa.



(Ravi Singh)

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ACKNOWLEDGEMENTS

The ID based rhino monitoring program in Dudhwa has now become the standard method for monitoring in the Kakraha rhino reintroduction area. For the successful implementation of this program, it took the will and hard work of several people from both the Uttar Pradesh Forest Department and the World Wide Fund for Nature - India (WWF-India). We are grateful to Dr. Rupak De, Principal Chief Conservator of forests -cum-Chief Wildlife Warden for his support and keen interest in this program; at WWF-India, we are grateful to Mr. Ravi Singh, Secretary General & Chief Executive Officer, Dr. Sejal Worah, Programme Director and Dr. Dipankar Ghose, Director-Species & Landscapes, for pulling together the funding and supporting this program all through.

Many thanks to Mr. Shailesh Prasad, Field Director, Dudhwa Tiger Reserve; Ganesh S. Bhat, Former Deputy Director, Dudhwa Tiger Reserve and Vinod Krishan Singh, Deputy Director, Dudhwa Tiger Reserve, for their constant support in making sure that the program faced no obstacles. A special thanks to Mr. Ganesh S. Bhat for all the hours spent discussing and consolidating the ID based rhino monitoring, and to Mr. Vinod Krishan Singh and Mrs. Abha Singh for providing a very homely atmosphere. We also wish to thank Anand Kumar Srivastav, Wildlife Warden- Belraien, C.K.P. Choudhary, Former Range Officer, South Sonaripur, D.K. Lal Srivastava, Range Officer, South Sonaripur, without whose interest and constant presence in the field this program would not have been implemented effectively. Again a special thanks to Mr. C.K.P. Choudhary for the time spent in the rhino area working closely for the betterment of the rhinos.

This monitoring program would not have started so smoothly if it were not due to the hours of training carried out by Babu Ram Lamichhane of NTNC, Nepal, who was very helpful throughout. A lot of the work would not have been possible without the able advice of Pranav Chanchani, Research Associate, WWF-India; and Dabeer Hasan, Project Officer who helped in the coordination of the program. The WWF tiger monitoring team comprised of Ashish Bista, Rekha Warrier, Shwetha Nair, Macson D'Almeida and Rohit Ravi, and Wildlife Trust of India veterinarian Dr. Saurabh Singhai, are all thanked for their contribution towards the project and for being the best companions possible. And I would like to thank my field assistants Udan Lal and Devendra Kumar, who painstakingly carried out my field work; and Sher Singh, who taught me almost everything I know about working and living in the wild. I am grateful to Chhavi Jain and Anil Cherukupalli for the long hours spent designing and for the publication of this report. I would also like to extend my gratitude to Dr. Satya Priya Sinha, who gave me access to all his work and without whose help the rhino family trees would never have been complete.

And finally, a great thanks and hand of applause is owed to the staff of the Kakraha rhino area : Ghanshyam Shukla, Deputy Range Officer, South Sonaripur, for pushing the staff to do their duties, thoroughly. I am proud to know the elephant-backed staff who beat the odds and difficulties, even of illiteracy, to collect data of photographic and remote-sensed value; the mahavats - Chote Lal, Jagroop Prasad, Idrish Khan, Irshad Ali, Lallan Baksh, Manoj Kumar, Mohd. Umar, Rameshwar Yadav, Sushil Kumar and chara-cutters - Aijaj Ali, Mehtab, Pappu, Qiyamuddin, Rahees, Ram Avtaar, Ranjeet, Riyasuddin, Safeeq, Sanu, Suresh, Taj, have the biggest hand in the implementation of the ID based rhino monitoring program. And I cannot forget to thank my large friends the pachyderms - Batalik, Gajraj, Madhu, Mohan, Pakhri, Pavankali, Pushpakali, Roopkali, Sundar, who did the maximum amount of walking and kept any charging rhinos and tigers at bay.

And last, but not the least, I would like to thank my family for their constant support and encouragement, without which I would not have got here.

Ruchir Sharma
Dudhwa, Uttar Pradesh

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DUDHWA
NATIONAL PARK

Located in the Lakhimpur-Kheri district of Uttar Pradesh, India, along the Indo-Nepal border.

The park consists of dense forests of Sal (*Shorea robusta*), mixed moist forests, riparian communities, and tall wet grasslands with patches of short grasses.

Grasslands cover 20% of the total area, and interspersed in these grasslands are a number of swamps.

Between 28° 18'N and 28°42'N latitudes and 80°28'E and 80°57'E longitudes.

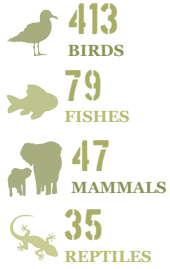
The park covers an area of **680.335 km²**

490.2979 km² forms the core zone and 190.0371 km² serves as the buffer zone (Mathur and Midha 2008)

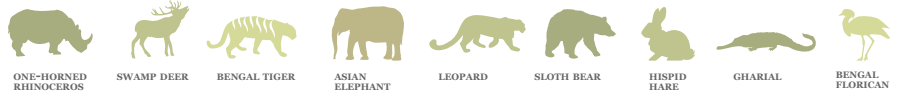
NUMBER OF SPECIES FOUND[1]

Rhino reintroduction area of Dudhwa National Park

NUMBER OF SPECIES FOUND[1]



ENDANGERED FAUNA FOUND[2]



The Greater One-Horned Rhinoceros (*Rhinoceros unicornis* Linnaeus, 1758) is one of the most endangered species of Indian mega fauna, and one of the five remaining species of rhinoceros of an approximately thirty genera that once existed (Nowak and Paradiso 1983). Their distribution once ranged in the flood plains of the Indus, Ganges and Brahmaputra rivers, from the Hindu Kush in the west to the present Indo-Burmese border in the east (Dinerstein 2003); but due primarily to the disappearance of most of the alluvial plain grasslands of the northern Indian subcontinent over the last 300 years, there has been a great reduction in the rhino range. Following their extirpation from the Indian terai in the 19th century, with the last rhino in the Indian terai being shot in the Pilibhit Forest Division in 1878 (Hewitt 1938), the rhino populations were confined almost entirely to national parks and sanctuaries in Assam and West Bengal in India, and in Nepal. In the event of an epidemic, with no alternate refuge for the big rhino numbers in Kaziranga and Chitwan, whole populations would have been pushed to the brink of extinction.

In 1979, the Indian Board for Wildlife set up a committee to evaluate the status of the rhino in India and to make recommendations for the establishment of several new populations (Schenkel 1983). Following extensive surveys in Dudhwa for habitat suitability by the Botanical Survey of India (Hajra & Shukla 1982), five rhinos comprising of a sub-adult and two elderly females, a young adult and one older male were captured in Pobitora Wildlife Sanctuary, Assam, and released into a 27 km² rhino reintroduction area (RRA) in the Kakraha block of south Sonaripur range in 1984. In order to prevent human-rhino conflict in the nearby villages and cultivation, and to assist their initial establishment in optimal habitat, the area was contained in an electrified perimeter. Both the elderly females died shortly after arrival, but the remaining three settled well.

The Rhino Reintroduction program in Dudhwa Tiger Reserve can be deemed as one of the most successful initiatives of its kind in India.

To maintain genetic variability in the reintroduced population, it was decided to introduce some more individuals from a different population. In 1985, with the collaboration of the Nepal government, four female rhinos were relocated from Chitwan National Park, all of which were able to adapt to their new home (Sale and Singh 1987). As of now, only

[1] Sinha and Sawarkar 1991

[2] De 2001

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three from the founding stock are still alive, but the population has seen a steady rise in number.

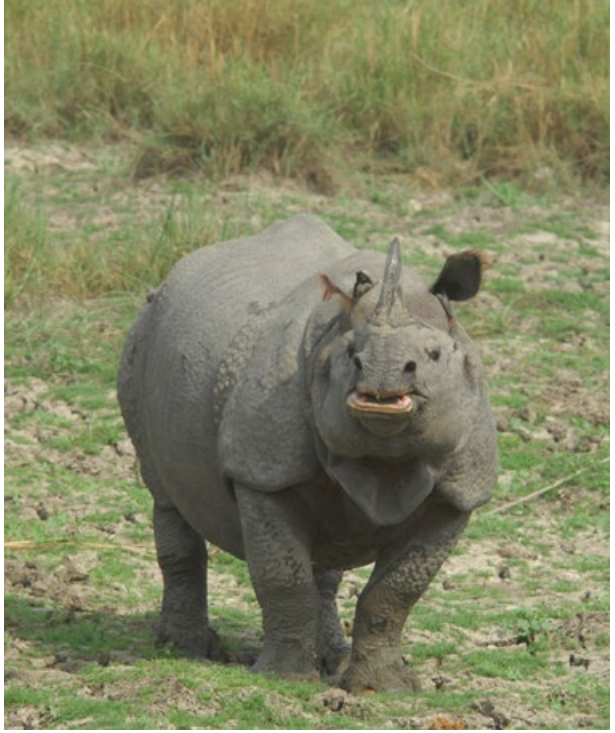
The rhino enclosure in Kakraha, South Sonaripur range of Dudhwa National Park has seen an increase in numbers since the first individuals were translocated into the park. This achievement has been possible due to the dedicated management efforts by the Uttar Pradesh Forest Department, over the past three decades.

Due to the rise in the illegal trade of protected species, there is increasingly a need for a better monitoring program to ensure the safety of wild animals. The ID based rhino monitoring program is a step towards accomplishing that goal. Using identification methods developed by William Andrew Laurie (1978), the Zoological Society of London (ZSL) created a program to monitor whole populations at an individual level, which has since seen successful application in Nepal.

As a first step towards establishing a formal rhino monitoring program, for the past two years WWF-India and the Dudhwa Tiger Reserve staff have jointly identified individual rhinos in the Kakraha RRA using standardized methods that rely purely on photographic data and use individual variations in external morphology to distinguish rhinos. The current survey has established that there are no less than twenty-three adult and four juvenile rhinos in the 21.1 km² enclosure.

This report provides details of these individuals by way of photographs, history and unique features that can be used for their identification.

ID BASED RHINO MONITORING PROGRAM



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India is home to the largest population of the Greater One-Horned Rhinoceros, which is found in great numbers in and around Kaziranga, Assam. While rhino reintroductions have happened in more than one place, the Dudhwa relocation is considered as one of the better models. However, with the increase in population in the last thirty years in the now 21.1 km² enclosure, there is a need to have a more systematized monitoring protocol, to ensure the healthy growth of the rhinos. The Nepalese terai has seen its rhino population bounce back from the brink of extinction, and has adopted an individualized monitoring in Bardia, Chitwan and Suklaphanta to closely follow each individual and its offspring. A similar method has come to be adopted in India, starting with the Dudhwa Tiger Reserve, and in Manas Tiger Reserve.

In Dudhwa, the first step to the commencement of this program was to create an individual identification database. With the help of the National Trust for Nature Conservation (NTNC) of Nepal, several training workshops were conducted for staff in the identifying of rhinos, using the alloted equipment of binoculars, digital cameras and GPS

handsets. The elephant-backed staff of the Kakraha RRA photographed the rhinos found inside the enclosure over a period of two months. This was compiled into the first database of the individual rhinos, identifying each rhino by at least two-three unique features. Due to the fact that the primary form of identification, the horn, changes over a period of time, the IDs are updated on a timely basis. To ease the record keeping and identifying of the rhinos, each rhino was given an ID number and a name.

The rhinos are now monitored on a daily basis with the aid of these IDs. The data accumulated over a period of a month is compiled into a report with the remote sensed data of the sighting information of each individual and the patrol effort of the staff. These reports are provided to the management for the betterment of monitoring and conservation of these mega-herbivores.

Some of the individuals were named at the time of their relocation in 1984 and 1985, and many were named soon after they were born (Sinha & Savarkar 1994). But due to the record not being maintained systematically, there is little proof to identify some of the individuals. As far as was possible, looking through records and the field staff's knowledge of the rhinos, each was given his original name. The ones that could not be connected to any previous records or name have been given a code name. In the recent years, the naming culture has regressed, and so the last few individuals to be indentified do not have a name. They have been given a name based on their family history records maintained by the park management.

This has been the first step towards implementing a scientifically rigorous rhino monitoring program. With continued efforts, the ID based monitoring will enable systematic monitoring of the rhino population over time and yield important information on demographic parameters such as fecundity, birth and survival rates. Moreover, data on individual rhinos will also enable us to understand home ranges, activity patterns, foraging habits and behaviour of Dudhwa's rhino population.

RHINO BIOLOGY

The Greater One-Horned rhinoceros, (*Rhinoceros unicornis*) also known as the Indian rhino is one of the largest land mammals after the African and Asian elephants and the white rhino. As the name suggests (*Rhinoceros* from the Greek, *rhino* meaning "nose" and *ceros* meaning "horn" and *unicornis* from the Latin, *uni* meaning "one" and *cornis* meaning "horn"), the greater one-horned rhino have a single horn which can attain a length of 8 to 24 inches (20 to 61 cm).

Rhinos belong to the order Perissodactyla (from Greek : *perissós* meaning "uneven" and *dáktylos* meaning "finger/toe". Perissodactyls, also called odd-toed ungulates, include horses and tapirs apart from rhinoceros. The rhino has three toes, with large nails which enable it to grip the marshy soil it lives in.

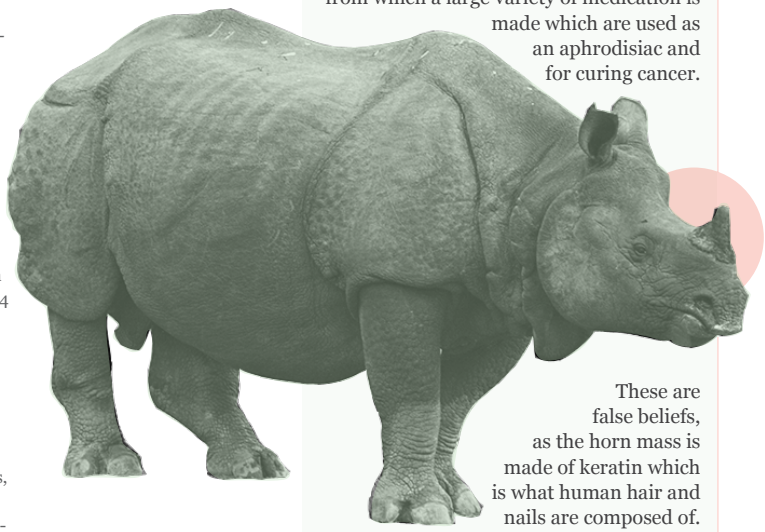
Greater one-horned rhinoceros' footprint

HEIGHT & LENGTH

Height: 6 ft.
Length: 10-13 ft.

WEIGHT

1500-2000 kg.



The color of the greater one-horned rhinoceros' hide is grey-brown, becoming pinkish in the skin-folds; the horn is black. The neck folds in males are visibly more developed than those in females. Body hair is uncommon, but eyelashes, ear-fringes, and tail brush are always present.

THE HORN

The horn does not serve as a weapon, and is used for dominance displays only. It is not made up of bone but of a compact mass of keratin fibres, which instead of being fixed to the skull, rest on a cartilaginous cushion. The horn is subject to wear and tear throughout the life of a rhino and is capable of growing throughout their lifetime.

The Indian rhino is highly endangered due to the increasing demand of rhino horn, from which a large variety of medication is made which are used as an aphrodisiac and for curing cancer.

These are false beliefs, as the horn mass is made of keratin which is what human hair and nails are composed of. However, due to the lack of awareness, the rhino horn trade continues to increase each year.

It is widely believed that the Indian rhinos have very poor eyesight. They rely primarily on their sense of smell and hearing - rhinos are capable of picking up smells that are two to three hundred metres from them and are able to catch sound waves from all directions using their cup-like ears, which they swivel to focus on any nearby noise.

Rhinoceros Pavitri with her 2-3 day old calf

BEHAVIOUR

Indian rhinos are primarily nocturnal, but also active during early mornings and late afternoons. The remainder of the time is mostly spent resting in the shade or wallowing. Rhinos spend a large amount of time wallowing in waterholes, especially during the summer, to regulate their body temperature. This species is the most amphibious of all the species of rhinos. During the monsoons however, rhinos are often prone to feeding at mid-day.

Rhinos do not live in groups, but adult females can be seen with other mothers and calves and also with sub-adult rhinos. Adult male rhinos however are solitary, and loosely territorial. Only the 'strong' males mate with the females, but their territories overlap with those of 'weak' males and even with those of other 'strong' males.

Agonistic interactions take place between adult male rhinos and other rhinos. Usually these end with the flight of one of the rhinos after a display of their lower incisors and charges with the head down. There are instances of fights and even chases in which other adult males and adult females sustain injuries. One such incident in Dudhwa saw an adult female receiving injuries that required medical intervention, while her four month old calf was killed by the adult male.

When startled, rhinos normally run away from the direction of the disturbance while making a snorting or grunting noise. On some instances, particularly with females with young calves, mock charges are not uncommon; however, charges are often carried through. (Laurie 1978)

In Dudhwa, there have been cases of rhinos charging at both domestic elephants and humans, and some cases of mortality of both elephants and humans have been recorded. Even though they appear to be large, short-legged and slow, rhinos are capable of sprinting at fast speeds of 40 km/h!

DIET

Rhinos are mega-herbivores, with a dietary preference of grasses, shrubs and aquatic plants. The Indian rhino consumes about 40 kilograms of vegetation each day.

© SUSHIL KUMAR, MAHAVAT / DUDHWA TIGER RESERVE

Male rhino urinating

© SUSHIL KUMAR, MAHAVAT / DUDHWA TIGER RESERVE

Female rhino urinating

MALE RHINO

FEMALE RHINO

SEXUAL DIMORPHISM

While most male ungulates differ in size and appearance from females, the greater one horned rhinoceros shows few traits in dimorphism. However, rhinos vary greatly in size in relation to their age; a new born calf for example is dwarfed by its mother, but grows at a rapid rate, almost increasing its weight by ten times within a year. Once separated from their mothers, calves are known as sub-adults; sub-adults show development of the horn and neck folds. Sub-adult rhinos are often seen close to their mothers or other female rhinos, possibly to keep a safe distance from solitary males. After about 6-7 years of age, sub-adults are classified as adults. (Dinerstein 2003)

The horn can be of the same length in both males and females, although sometimes the females can have longer horns. But the circumference of the base of the horn is usually greater in males, and the horn is more often grooved, worn down or broken off in males.

Males use their lower incisors to fight other males, hence the lower incisors are longer in males than in the females. Older adult male rhinos have significantly larger neck circumferences than females just behind the head and around the shoulders. This serves in dominance displays as well as protection in fights since in all head-on fights the incisors of a rhino are likely to penetrate the neck.

Although these physical characteristics can be used to determine the sex of rhinos, the easiest and most reliable method to do so in the wild is by observing their external genitalia. Male rhinoceroses' penis is clearly visible from the side or from the back when they take large strides or are sprinting. The female genitalia however is visible only from the back and upon close examination. The other reliable method for sex determination is to observe a rhino urinating. A female's vulva is slightly under the tail, below the anus; whereas a male's penis is between the hind legs. So when female rhinos urinate they lift their tail and spray their urine from a little below their anus, as opposed to the males who spray it from between their legs. (Laurie 1978; Dinerstein 1991, 2003)

REPRODUCTION

Males attain sexual maturity at the age of 7, whereas the females do at 5. The gestation period lasts approximately 15-16 months; and mothers give birth to one calf every 2-3 years. Mating takes place throughout the year.

Birth in rhinos is rapid, following within thirty minutes after the first signs of labour. Female rhinos may either stand or lie during parturition. The calf is able to stand within about thirty minutes, and tries to suckle. Calves suckle frequently till they are about a year old. Up to the age of six months, the mother often leaves the calf alone for as long as 90 minutes while she feeds up to 800 metres away.

Calves are separated from their mothers at least a week before the birth of the next calf; the mother is known to drive her calf away sometimes, violently. Male calves leave their mothers at a mean age of 39 months in comparison to the female calves, who leave at 34 months. (Laurie 1978)

LIFE SPAN

In the wild, rhinos can live up to 30-35 years, and in captivity up to 40-45 years.

Tigers (*panthera tigris*) prey on calves upto the age of six months; there were cases of unsuccessful attempts by tigers on one year old calves. Interestingly, there were two cases of a tiger attacking adult female rhinos, succeeding in one case, while in one case the rhino was rescued before she succumbed to her injuries and was released upon her recovery.

Aside of these cases, the only predator to rhinos are humans. Rhinos have been hunted over the last centuries for sport and for its horn.

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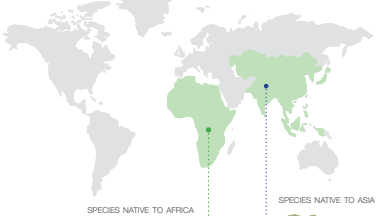
SPECIES OF RHINOS IN THE WORLD



SPECIES NATIVE TO AFRICA

White rhinoceros
Ceratotherium simum
Population[3]: 20,405

Black rhinoceros
Diceros bicornis
Population[3]: 5,055

SPECIES NATIVE TO ASIA

Greater One-Horned rhinoceros
Rhinoceros unicornis

Sumatran rhinoceros
Dicerorhinus sumatrensis
Population: 100

Javan rhinoceros
Rhinoceros sondaicus
Population: 35-44

2500 Approximate rhino population in India

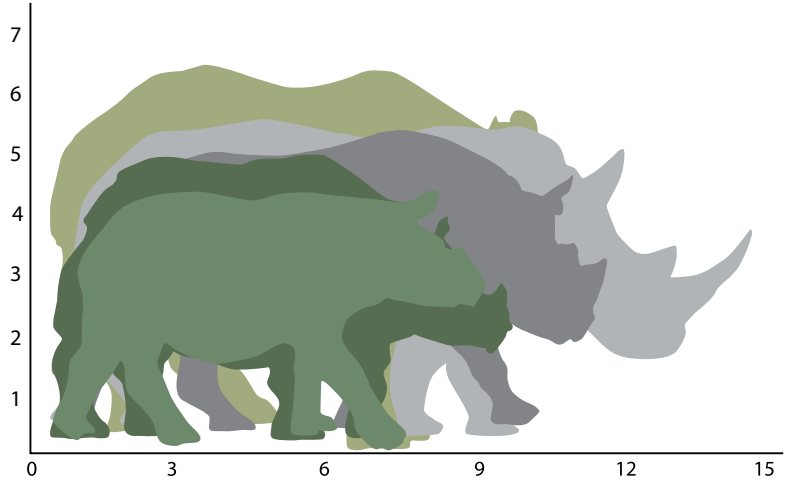
In Nepal, the estimate is at 534 (Subedi et al. 2013)

The Greater One-Horned rhinoceros is found only in India and Nepal. Their home-range once stretched from the Hindu-Kush mountains in Pakistan to Burma, in the far east. However due to their hunting and habitat degradation, in India they are found only in Kaziranga, Pobitora, Orang, Gorumara and Manas in the North-east, in Jaldapara, Bengal, and in Dudhwa, Uttar Pradesh. In Nepal, their populations are limited to Chitwan National Park, Bardia National Park and Suklaphanta Wildlife Reserve.

The Sumatran rhino is found in Sabah, Malaysia and three Indonesian National Parks : Gunung Leuser, Way Kambas, and Bukit Barisan Selatan and are fewer than a 100 left.

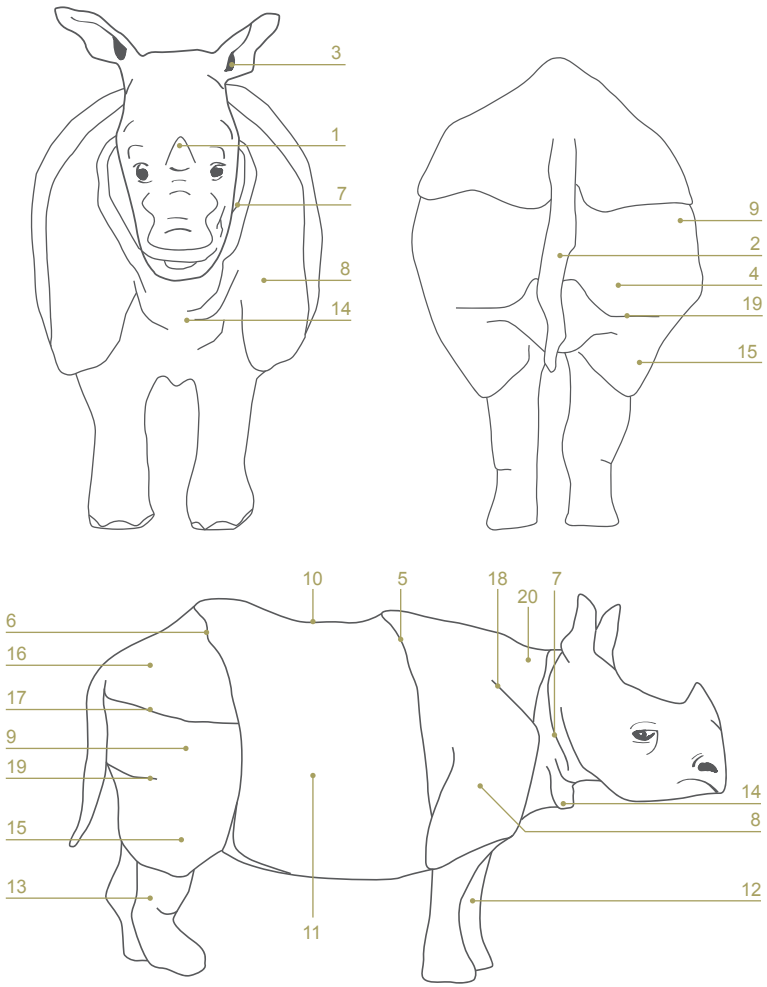
The Javan rhino is found only in Indonesia's Ujung Kulon National Park and number in a meagre 35-44 (IUCN AsRSG 2013).

RELATIVE SIZES OF THE SPECIES OF RHINOS FOUND IN THE WORLD



3 IUCN AfRSG 2013

RHINO BODY PARTS



(1) Horn (2) Tail (3) Ear (4) Anal plate (5) Front cross fold (6) Rear cross fold (7) Neck fold (8) Shoulder plate (9) Upper thigh plate (10) Prong (Spine) (11) Ribs (12) Front Legs (13) Hind Legs (14) Lower neck fold (15) Lower thigh plate (16) Back plate (17) Upper back corner fold (18) Shoulder cross fold (19) Lower back corner fold (20) Upper neck

RHINOS OF DUDHWA NATIONAL PARK

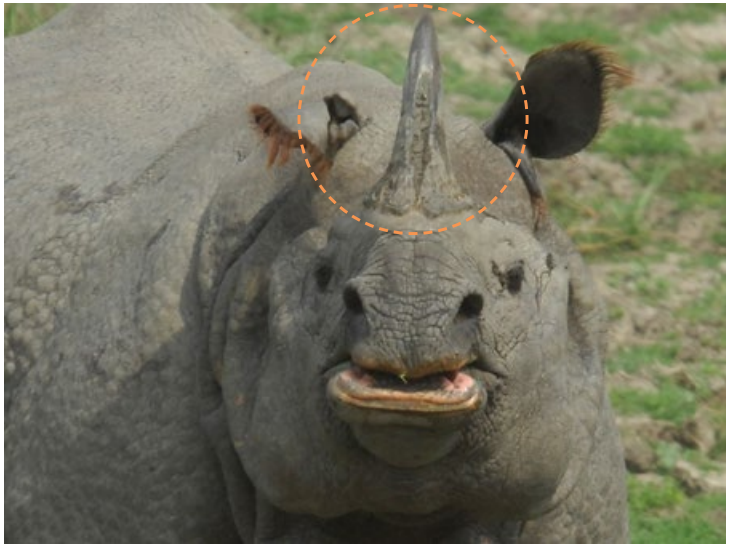
BANKE
ID NO. 01

Sex
Male

Features

Horn - Long, sharp (sword-like), broad uneven base. Crevice in the middle.

Ear - Right - Torn and bent forward.



History

31/03/1984
Brought from Pobitora Wildlife Sanctuary, Assam.
His age at the time of relocation was approximately seven years.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

SWAYAMVARA
ID NO. 03

Sex
Female

Features

Horn - Pointed, Thin at tip, two bands on the base.

Rear Cross Fold - Right-Fold just below upper back corner fold.

History

29/03/1985
Brought from Chitwan National Park, Nepal. Her age at the time of relocation was approximately five years.

Calves timeline :

12/10/1989
Birth of calf. Found dead on 07/01/1990

10/08/1991
Birth of male calf, Bheemsen (ID no. 09)

07/10/1994
Birth of female calf, Rajeshwari (ID no. 12)

06/08/1998
Birth of male calf. Found dead on 28/08/2002

29/07/2004
Birth of calf

Current status
Has one calf, born in 2014

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

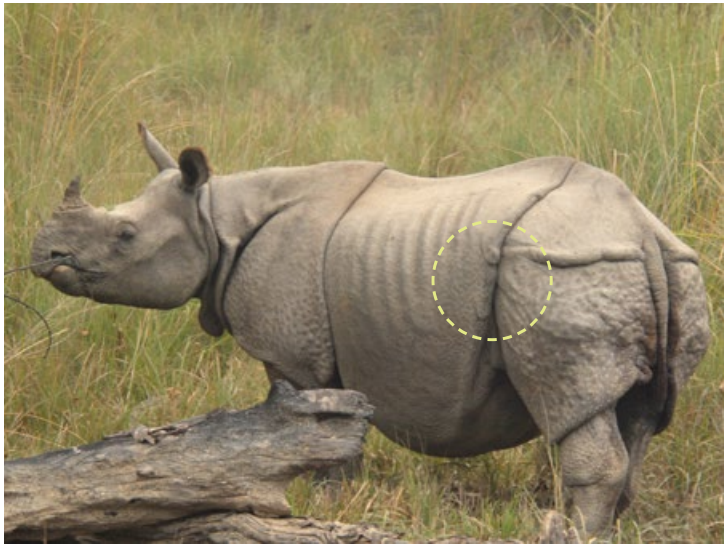
NARAYANI
ID NO. 04

Sex
Female

Features

Horn - Slightly crooked. Pointed (when seen from the front), Chipped tip (when seen from the side)
Face - Melanin deficiency spot between the nostrils

Rear Cross Fold - Left - Fold close to upper back corner fold



History

29/03/1985
Brought from Chitwan National Park, Nepal. Her age at the time of relocation was approximately five years.

Calves timeline:

1987
Calf aborted

01/06/1989
Birth of female calf, Suheli (ID no. 07)

31/07/1992
Birth of male calf, Nakul (ID no. 10)

21/11/1999
Birth of calf. Found dead on 10/01/2001

31/08/2004
Birth of calf outside the RRA fence

~2011
Birth of male calf, Vijay (*ID not prepared*)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

SUHELI
ID NO. 07

Sex
Female

Features

Horn - Broad at base, thin and pointed at tip

Upper back corner fold - Left - Fold above anal plate

History

Born of Narayani (ID no. 04) on 01/06/1989

Calves timeline:

11/01/1994
Birth of calf. Found dead on 17/01/1994

17/09/1997
Birth of female calf

01/11/2002
Birth of female calf, Sada (ID no. 18)

27/06/2005
Birth of a calf

~2009
Birth of calf

Current status
Has one calf, born on 11/03/2013

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

BHEEMSEN
ID NO. 09

Sex
Male

Features

Horn - Long, broad at base, pointed tip, groove in the front

Ear - Left - Upper half of the ear lobe is absent

History

Born of Swayamvara (ID no. 03) on 10/08/1991

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

NAKUL
ID NO. 10

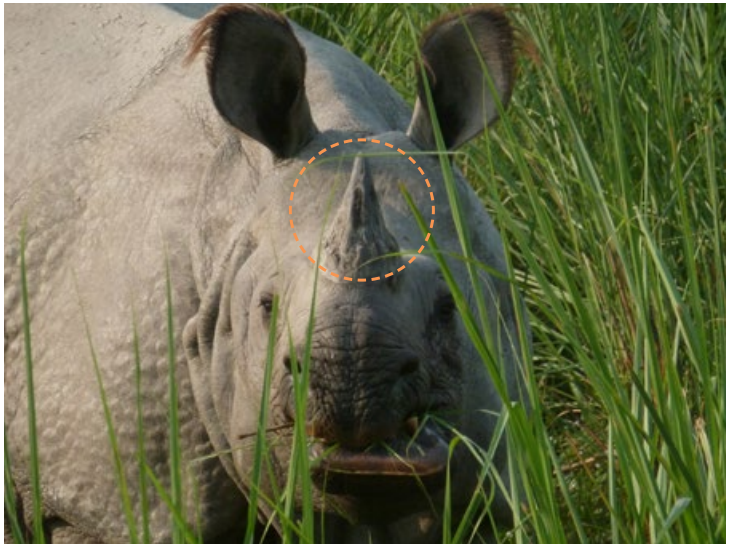
Sex
Male

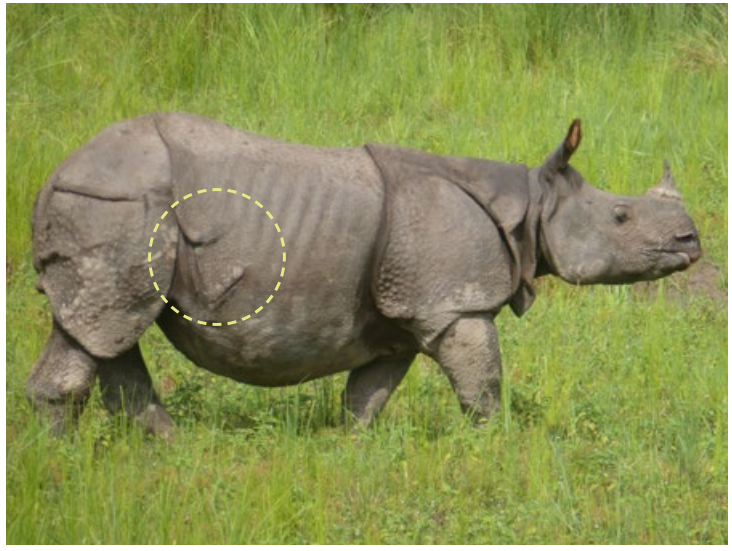
Features

Horn - Long, groove in the middle

Rear Cross Fold- Right - Large fold visible by the ribs

Abdomen - Right - Injury wound under large fold





History

Born of Narayani (ID no. 04) on 31/07/1992

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

RAJSHREE
ID NO. 11

Sex
Female

Features
Horn - Long, narrow from the base to the tip

History
Born of Hemrani on 05/08/1992.

Calves timeline :

12/06/1999
Birth of calf. Killed by a tiger on 25/02/2000

14/09/2007
Birth of male calf, Raghu (ID no. 27)

~2011
Birth of male calf, Arjun. Killed by an adult male rhino on 23/02/2015

Current status
Has one calf, born on 14/05/2014

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

RAJESHWARI
ID NO. 12

Sex
Female

Features
Horn - Very long, smooth texture

History

Born of Swayamvara (ID no. 04) on 07/10/1994

Calves timeline:

07/09/2002
Birth of calf. Injured by a tiger and found dead on 24/12/2002

09/03/2005
Birth of female calf

16/09/2007
Birth of calf

~2011
Birth of a calf (*ID not prepared*)

Current status
Has one calf, born on --/07/2014

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

VIJAYSHREE
ID NO. 15

Sex
Female

Features

Horn - Small, pointed, equilateral triangular shape

Upper back corner fold - Left - Fold close to upper back corner fold

History

Born of Hemrani on 19/10/1997

Calves timeline:

21/05/2006
Birth of a male calf

~ 2008
Birth of calf (ID no. 29)

12/10/2012
Birth of calf. Killed by an adult male rhino on 19/02/2013

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

HEMVATI
ID NO. 16

Sex
Female

Features
Horn - Small, pointed

History
Born of Rajrani on 01/11/2001

Calves timeline:

Current status
Has one calf, born on 21/09/2014

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

SAHDEV
ID NO. 17

Sex
Male

Features
Horn - Long, big crevice in front, stretching from base to tip, curved when seen from the side

History

Born of Hemrani
on 06/08/2002

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

SADA
ID NO. 18

Sex
Female

Features

Horn - Broad at base, narrow at tip

Rear cross fold - Right - Large curved fold next to leg

History

Born of Suheli (ID no. 07) on 01/11/2002.

Calves timeline:

~2009
Birth of female calf, Subhadra (ID no. 30)

19/09/12
Birth of female calf. Found dead on 28/11/2013

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

SHAMA
ID NO. 22

Sex
Female

Features

Horn - Small, rounded with a tip

Upper back corner fold - Left - Whole fold is unevenly shaped

Rear cross fold - Right - Prominent U-shaped fold a little below the Upper back corner fold

History

Born of Suheli
(ID no. 07) on 27/06/2005

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

HEMRAJ
ID NO. 25

Sex
Male

Features
Horn - Medium sized, tip pointed towards back

History

Born of Hemrani on 13/09/2007

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

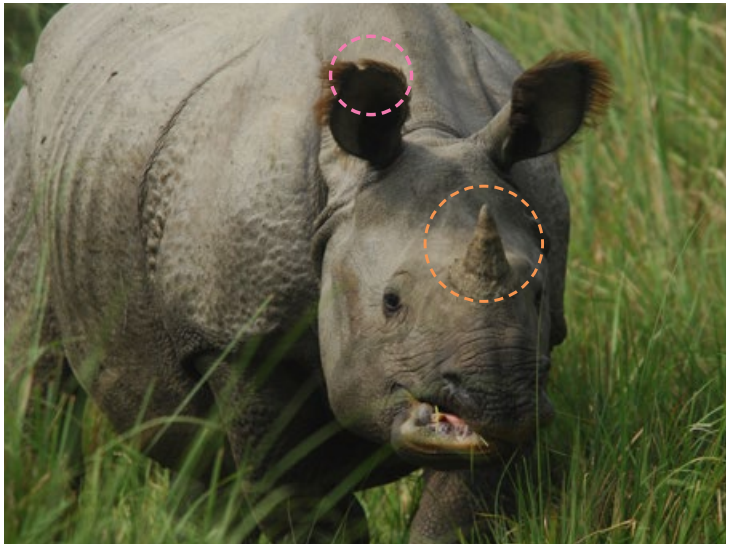
PAVAN
ID NO. 26

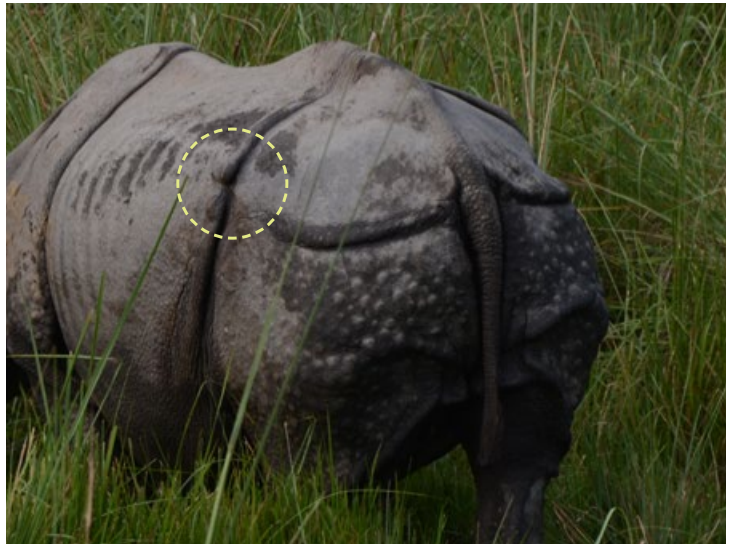
Sex
Male

Features
Horn - Medium Sized

Ear - Right - Nick on the upper portion of the lobe

Rear cross fold - Left - Large fold close to the upper back corner fold





History

Born of Pavitri on 14/09/2007

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

RAGHU
ID NO. 27

Sex
Male

Features

Horn - Broad, uneven base. Small groove in the middle.
Flat tip when viewed from the side.

Rear cross fold- Right - 'X' shaped mark

History

Born of Rajshree (ID no. 11) on 14/09/2007

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

VIJAYSHREE'S CALF
ID NO. 28

Sex
Unknown

Features
Horn - Small

History

Born of Vijayshree (ID no. 15) in ~2008

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

SUBHADRA
ID NO. 30

Sex
Female

Features
Horn - small

History

Born of Sada (ID no. 18) in ~2009.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

UNIDENTIFIED MALE 1

ID NO. U.M.1

Sex
Male

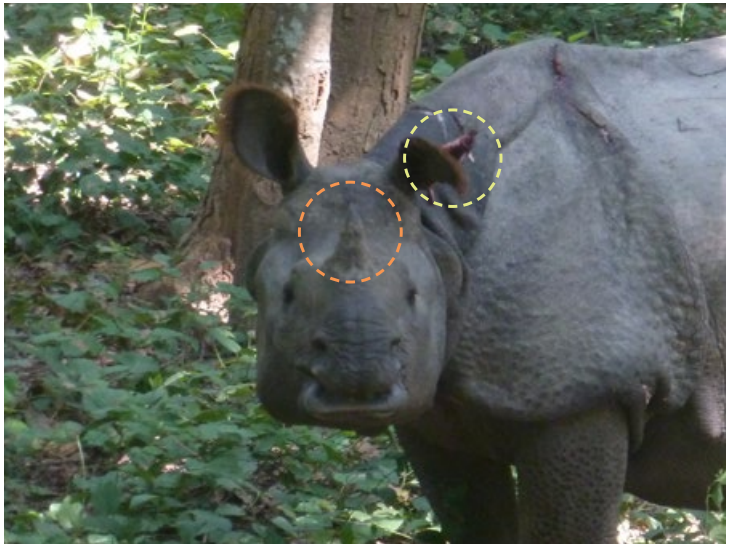
Features

Horn - Long, pointed. Groove towards the base.

Ear - Left - Lobe torn into half.

Rear cross fold - Right - Bruise mark on skin, a little way down from the Upper back corner fold

Upper & lower thigh plates- Left - Large bruise marks running diagonally across



History

N/A

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

UNIDENTIFIED MALE 2

ID NO. U.M.2

Sex
Male

Features
Horn - Long, grooves all along the side and prominent groove in the centre

History
N/A

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

UNIDENTIFIED FEMALE 1

ID NO. U.F.1

Sex

Female

Features

Horn - Long, broad with pointed tip

Rear Cross Fold - Left - Big tear in skin, a little way down from the Upper back corner fold

History

N/A

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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NOTES

Staff on patrol in Kakraha
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Photo credits for rhinos of Dudhwa National Park:

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Mahavats - Chote Lal, Jagroop Prasad, Irshad Ali, Mohd. Umar and Sushil Kumar
Chara-cutters - Aijaj Ali, Pappu, Rahees, Riyasuddin and Suresh

ANNEXURE

DETAILS OF RHINOS RELOCATED TO DUDHWA TIGER RESERVE

S.no.	Name	Sex	Relocation date	Age (at relocation)	Current status	Details
1	Banke	M	31/03/1984	7 yrs	Alive	Was brought from Pobitora Wildlife Sanctuary, Assam
2	Raju	M	31/03/1984	25 yrs	Dead	Was brought from Pobitora Wildlife Sanctuary, Assam. He was severely injured by Banke on 11/12/1988 and died.
3	Saheli	F	31/03/1984	30 yrs	Dead	Was brought from Pobitora Wildlife Sanctuary, Assam. She died on 12/04/1984 due to a stressful abortion.
4	Asha	F	31/03/1984	17 yrs	Dead	Was brought from Pobitora Wildlife Sanctuary, Assam. She died on 31/07/1984 due to an injury sustained during capture.
5	Pavitri	F	31/03/1984	4 yrs	Dead	Was brought from Pobitora Wildlife Sanctuary, Assam. She died on 27/01/2013 due to a cardiac arrest brought on by a tiger attack.
6	Swayamvara	F	29/03/1985	5 yrs	Alive	Was brought from Chitwan National Park, Nepal
7	Narayani	F	29/03/1985	5 yrs	Alive	Was brought from Chitwan National Park, Nepal
8	Hemrani	F	04/01/1985	4 yrs	Dead	Was brought from Chitwan National Park, Nepal. She died on 18/10/2014 due to old age.
9	Rapti	F	04/01/1985	6 yrs	Dead	Was brought from Chitwan National Park, Nepal. She died on 25/09/1991
10	Lohit	M	28/04/1992	8 yrs	Returned	Was brought from Kanpur Zoo and was returned after Banke attacked him. He is presently in Lucknow Zoo.

FAMILY TREES
OF DUDHWA'S RHINOS

Key: Dead rhino **Live rhino**

PAVITRI'S FAMILY

Calf (U) born on 04/08/1991, was injured by a tiger and found dead on 11/01/2000

Calf (U) born on 21/09/1995, was found dead on 21/01/1996

Male calf *Kartikeya* born on 02/10/1997, was found dead on 16/02/2014

Male calf *Pavan* born on 14/09/2007

Female calf born on 06/11/2012, was found dead on 09/01/2013

SWAYAMVARA'S FAMILY

Calf (U) born on 12/10/1989, was found dead on 07/01/1990

Male calf *Bheemsen* born on 10/08/1991

Male calf born on 06/08/1998, was found dead on 28/08/2002

Calf (U) born on 29/07/2004

Calf (U) born in 2014

Female calf *Rajeshwari* born on 07/10/1994

RAJESHWARI'S FAMILY

Calf (U) born on 07/09/2002, was injured by a tiger and found dead on 24/12/2002

Calf (U) born on 16/09/2007

Calf (U) born in ~2011

Calf (U) born on --/07/2014

Female calf born on 09/03/2005

NARAYANI'S FAMILY

Calf (U) was aborted in 1987

Male calf *Nakul* born on 31/07/1992

Calf (U) born on 21/11/1999, was found dead on 10/01/2001

Calf (U) born on 31/08/2004 outside the RRA fence

Male calf *Vijay* born in ~2011

Female calf *Suheli* born on 01/06/1989

SUHELI'S FAMILY

Female calf born on 17/09/1997

Female calf *Shama* born on 27/06/2005

Calf (U) born in ~2009

Calf (U) born on 11/03/2013

Calf (U) born on 11/01/1994, was found dead on 17/01/1994

Female calf *Sada* born on 01/11/2002

SADA'S FAMILY

Female calf *Subhadra* born in ~2009

Female calf born on 19/09/2012, was found dead on 28/11/2013 due to unknown causes

HEMRANI'S FAMILY

Female calf *Rajrani* born on 02/02/1989, was found dead on 02/12/2011

Female calf ***Rajshree*** **born on 05/08/1992**

Female calf ***Vijayshree*** **born on 19/10/1997**

Male calf born on 23/11/2013, was found dead on 09/01/2014

Male calf *Hemraj* born on 13/09/2007

Male calf *Sahdev* born on 06/08/2002

VIJAYSHREE'S FAMILY

Male calf born on 21/05/2006

Calf (U) born in ~ 2008

Calf (U) born on 12/10/2012, was killed by a male rhino on 19/02/2013

RAJSHREE'S FAMILY

Calf (U) born on 12/06/1999, was killed by a tiger on 25/02/2000

Male calf *Raghu* born on 14/09/2007

Male calf *Arjun* born in 2011, was killed by a male rhino on 23/02/2015

Calf (U) born on 14/05/2014

RAJRANI'S FAMILY

Calf (U) was aborted in 1995

Calf (U) born on 02/01/1999, was found dead on 28/10/1999

Female calf *Hemvati* born on 01/11/2001

Male calf born on 07/10/2006

HEMVATI'S FAMILY

Calf (U) born on 21/09/2014

THE KAKRAHA ENCLOSURE

Fence length - 18.2 km.
Enclosure area - 21.1 Sq. km.

MANUAL
FOR GARMIN ETREX 10

(ALSO APPLIES TO ETREX 20 & ETREX 30)

DEVICE OVERVIEW

1. **Zoom Keys -**
   Zoom in and out in map
2. **Back key -**
   To go back
3. **Joystick -**
   Navigate in any direction, and select an option
4. **Menu key -**
   for options
5. **Power/Light key -**
   To switch on device and increase screen brightness when on
6. **Mini USB port** (under weather cap)
7. **Battery Cover**
8. **Battery cover locking ring**

INSTALLING BATTERIES

The device operates on two AA size batteries. First, turn the battery cover locking ring counter-clockwise and pull up to remove the cover. Insert the batteries observing the polarity - each battery has a '+' and a '-' sign, and the batteries must be placed as indicated in the GPS. Place the battery cover, lower end first, and turn the D-ring clockwise.

TURNING ON AND ACQUIRING SATELLITE SIGNALS

Hold the power key ⏻. After the device is on, it begins acquiring signals. It requires an open sky ideally to acquire signals quickly. The device must not be in motion when acquiring signals, so stay in one place till a reading appears, in the upper left corner. To the right of the reading is a number, in metres. This is the accuracy. In order to obtain the optimum accuracy, this number should be as small as possible: 3 m. is the highest accuracy the device can provide and is the ideal, but no reading should be taken until the accuracy is below 10 metres. To see the date/Time or battery life of the GPS, press the light button once. To increase or decrease screen brightness, press the light button multiple times.

SAVING A WAYPOINT

Press the joystick button inwards, and keep it held until the waypoint name and location shows. To edit any details, select an item to edit by scrolling to it using the joystick, manoeuvring upwards, downwards and sideways.

To edit the name, select the waypoint name and press the joystick inwards. A keyboard will emerge and using the joystick, enter the name of choice and then select *Done*. The name will appear along with the location. To save the location, scroll down to *Done* and press the joystick. Once the location is saved, the device will return to its original screen.

NAVIGATING TO A LOCATION

Press the menu key twice to enter the main menu. Select *Where To?*, select *Waypoint* and choose which point you wish to navigate to. Click on *Go* and the map page will open, with a line navigating to the point. Alternatively, a desired location can be accessed through the waypoint manager. Select *Waypoint Manager*, and then using the joystick, scroll to the location name.

SAVING A PARTICULAR TRACK

Press the menu button twice to enter the main menu. Select *Track Manager* and then select *Current Track* (this is the current logged track). Four options will appear on the screen - Select the last one, *Clear Current Track* to delete the tracked data, and click on Yes. To save the previously tracked data, click on the first option *Save Track*, and then edit the name, and scroll to the *Done* button at the bottom of the screen and select it. After saving/exporting the file, the GPS will offer to delete the current track to optimize space, click on *Yes*. The screen will return to that of the *Track Manager* and the saved track will appear under the applied name.

CALCULATING AN AREA

Press the menu key twice to enter the main menu. Select *Area Calculation*, and then select *Start*. Walk the perimeter of the area to be measured, and upon completion select *Calculate*. The calculated area will be displayed. To view the area in different units, select *Change Units* and select the unit the area has to be calculated in. To save the tracked area, select *Save Track*, enter a name and select *Done*.

ADVANCED SETTINGS- IN SETUP

SYSTEM

1. **GPS**
   always set to *Normal*
2. **WAAS/EGNOS**
   always set to *Off*
3. **Language**
   English
4. **Battery type**
   Alkaline, unless using rechargeable, in which case select *Lithium*
5. **USB Mode**
   always set to *Mass Storage*

DISPLAY

1. **Backlight Timeout**
   always set to *15 Seconds*
2. **Adjust Contrast**
   Keep the toggle in the centre

MAP

1. **Orientation**
   select *North Up* for north always at the top of the page, *Track Up* to show current direction of travel at the top of the page
2. **Data Fields**
   o
3. **Advanced Map Setup**
   Auto Zoom - *On*, User Waypoint Zoom Level - *Auto*, User Waypoint Text Size - *Small*
4. Marine Colors - *Off*

TRACKS

1. **Track log**
   always set to *Record, Show on Map*
2. **Record Method**
   set to *Auto*
3. **Recording Interval**
   set to *Normal*

RESET

1. **Reset Trip Data**
   to reset all trip data (i.e. Max Speed, Odometer, etc.), click *Yes*
2. **Delete All Waypoints**
   to delete all waypoints on GPS, click *Yes*
3. **Clear Current Track**
   to clear the current track log, click *Yes*
4. **Reset All Settings**
   to reset GPS to factory state, click *Yes*

PAGE SEQUENCE

Select *Add Page* to add a new page. To move or delete a page, select the page and select either *Move* or *Remove*. Keep this order - *Satellite, Map, Compass, Trip Computer, Main Menu*.

UNITS

1. **Distance and Speed**
   always select *Metric*
2. **Elevation (Vertical Speed)**
   always select *Meters (m/sec)*

TIME

1. **Time Format**
   select *12-Hour* to show time in AM/PM, *24-Hour* to show in hours
2. **Time Zone**
   always select *Automatic*

POSITION FORMAT

(Do not change the position format or the map datum unless specified to. These settings are not to be played with.)

1. **Position Format**
   set to *hddd.ddddd°* for degree decimal or *hddd°mm'ss.s"* for degrees minutes seconds
2. **Map Datum**
   never change from *WGS 84*
3. **Map Spheroid**
   never change from *WGS 84*

HEADING

1. **Display**
   always set to *Directional Letters*
2. **North Reference**
   always set to *True*
3. **Go To Line**
   always set to *Bearing*

CUSTOMIZING THE MAIN MENU (NOT IN SETUP)

Press the menu key twice to enter the main menu. In the menu, press the menu button once and select *Change Item Order*. Select *Add Page* to add a new page. To move or delete a page, select the page and select either *Move* or *Remove*. Keep this order - *Waypoint Manager, Track Manager, Where To?, Area Calculation, Setup*.

DAILY SPECIES MONITORING FORM

Date : _____ Start Time : _____ End time : _____ Patrol team : _____ Armed/Unarmed (Tick one)

G.P.S. location (Dd.mmmmm°)	Location name	Species	Direct Sighting						Indirect Sighting	Notes	Photo. #
			Adult			Young					
			Male	Female	Unknown	Male	Female	Unknown			

LIST OF MAMMALS

FOUND IN THE RHINO REINTRODUCTION AREA

Greater one horned rhinoceros *Gainda*
Rhinoceros unicornis

Tiger *Bagh*
Panthera tigris tigris

Leopard *Tendua*
Panthera pardus

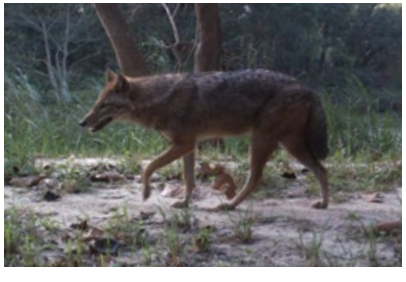
Sloth bear *Bhaaloo*
Melursus ursinus ursinus

Swamp deer *Barasingha*
Rucervus duvaucelii duvaucelii

Spotted deer *Chital*
Axis axis

Hog deer *Pada*
Axis porcinus

Fishing cat *Bagh Dasha*
Prionailurus viverrinus



Golden jackal *Siyaar*
Canis aureus

Smooth Indian Otter *Oodbilau*
Lutra perspicillata

Rhesus Macaque *Bandar*
Macaca mullata

Grey langur *Langur*
Semnopithecus entellus

Indian porcupine *Sayai*
Hystrix indica

Hispid hare *Jhabra Khargosh*
Caprolagus hispidus

Honey badger *Bijju*
Mellivora capensis

Indian gray mongoose *Nevla*
Herpestes edwardsii

Photo credits:
Greater one horned rhinoceros, Swamp deer, Spotted deer, Hog deer: © Ruchir Sharma/WWF-India
Tiger, Leopard, Sloth bear, Fishing cat, Golden jackal, Smooth Indian otter, Rhesus macaque, Grey langur, Indian porcupine, Honey badger, Indian gray mongoose: © WWF-India/Dudhwa Tiger Reserve
Hispid hare: © WWF-India/Manas Tiger Reserve

LIST OF VEGETATION

FOUND IN THE RHINO REINTRODUCTION AREA

GRASSES

TALL

Apluda mutica

Gandar, Khus, Panni seenk
Chrysopogon zizanioides (syn. *Vetiveria zizanioides*)

Dabh
Desmostachya bipinnata

Hemarthria compressa

Meyari, Charni, panhar
Imperata cylindrica (syn. *I. arundinacea*)

Narenga, Tamar, Kanwar
Narenga porphyrocoma (syn. *Saccharum narenga*)

Kans
Saccharum spontaneum

Retwa
Sclerostachya fusca

SHORT

Gurla
Chrysopogen aciculatus

Doob
Cynodon dactylon

Cyperus spp.
(i.e. *C. michelianus, C. kyllingia, C. haspan*)

Munj
Saccharum bengalensis (Syn. *Erianthus Munja*)

MARSH

Kilak nari
Arundo donax

Carex spp.

Hemarthria compressa

Meyari, Charni, Panhar
Imperata cylindrica (syn. *I. arundinacea*)

Paspalidium flavidum

Narkul, Nar, Tatar
Phragmites karka

Retwa
Sclerostycha fusca

Ulla, Sarkhera
Themeda arundinacea

AQUATIC PLANTS

(Anchored hydrophytes with floating leaves)

Nymphacea spp. (*N. Nouchali*, syn. *N.* stellata)

Nelumbo nucifera

(Free floating hydrophytes)

Hygroryza aristata

Trapa natans

(Suspended submerged hydrophytes)

Hydrilla verticillata

Stuckenia pectinata (syn. *Potamogeton pectinatus*)

Vallisneria spiralis

FRINGES & RIPARIAN HABITAT

Semal
Bombax ceiba (syn. *Bombax malabaricum = Salmalia malabarica*)

Dhak
Butea monosperma (syn. *Butea frondosa*)

Shisham, Sissoo
Dalbergia sissoo

Khair
Senegalia catechu (syn. *Acacia catechu*)

Jamun
Syzygium cumini (syn. *Eugenia jambolana*)

SHRUBS

Ageratum conyzoides

Artemisia nilagirica

Chromolaena odorata (syn. *Eupatorium odoratum*)

Bhindu, Puchera, Daya
Colebrookea oppositifolia

Erigeron spp.

Litsaea spp.

Gandhela, Kath Neem, Curry Patta
Murraya koenigii

Polygonum plebeium

Premna spp.

Solanum spp.

Rangoi
Teliacora acuminata

Gutel
Trewia nudiflora

Ber, Jharberi
Ziziphus mauritiana

WOODLAND

Sal, Sakhu
Shorea robusta

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Staff patrolling on a motorable road during the monsoon

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